Chaebols and Catastrophe:

A New View of the Korean Business Groups

and Their Role in the Financial Crisis

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October 2001

Prepared for the Asian Economic Policy conference, Seoul, Korea, October 25-26, 2001. This paper draws upon the forthcoming book, *Emergent Economics, Divergent Paths: Business Groups and Economic Organization in South Korea and Taiwan*, by Robert Feenstra and Gary Hamilton, Cambridge University Press, as well as the dissertation research of Eun Mie Lim.

1. Introduction

The Asian financial crisis of 1997-98 seemed to end as quickly as it began, a grande finale to the 20th century. But as the opening years of the 21st century bring another slowdown, impacting the Asian economies as well as those worldwide, it is appropriate to ask what lessons we might learn from the crisis. What policy actions, if any, should South Korea take in relation to its industrial and financial structure, and could the type of catastrophic shock that occurred in 1997-98 be experienced again?

In the aftermath of the crisis, many economists in the U.S. have criticized the actions taken by the International Monetary Fund (IMF), and in particular, their insistence that countries in crisis undertake contractionary monetary and fiscal policies as a condition of receiving loans. Scholars such as Jeffrey Sachs (1998) and Martin Feldstein (1998), along with Joseph Stiglitz (2000), argued that these conditions turned an initial liquidity crisis into a full-blown banking and financial crisis. A report commissioned by the U.S. Senate, under the Meltzer Commission (2000), agrees with the substance of these views. It recommends that the actions of the IMF be restricted solely to acting as a "lender of last resort" to countries already following pre-established policies, but that no other conditionality be imposed on such loans. Even Stanley Fischer, chief economist at the IMF, speaks of the "revolution" underway inside that institution, albeit a "gradual revolution."[1]

We have no disagreement with these criticisms of the IMF and with a re-thinking of its appropriate role. But at the same time, this seems to distract attention from the question of what happened in South Korea and other countries of Asia, and why. The IMF did not enter Korea until December 1997, and by that time, the financial crisis was fully underway. In order to

[1] Rich Miller, "Does Anybody Love the IMF or World Bank?" *Business Week*, April 24, 2000, p. 47.

understand its origins, we need to go at least some months earlier, before the exchange rate devaluation of November 17, 1997, and even before the exchange rate crises elsewhere in Asia. Let us start at least at the beginning of 1997. On January 23, 1997, the Hanbo Steel group in Korea declared bankruptcy. It was unprecedented that any *chaebol* in Korea would be permitted to go bankrupt, and this was followed in the subsequent months by well-known groups such as Sammi, Jinro, Hanshin, and then Kia in July, which was the 8th largest *chaebol*. Two years later, Daewoo became the first instance of a top five *chaebol* that was permitted to go bankrupt.

Including Daewoo, some 25 *chaebol* went bankrupt during 1997 and 1998, and fully 40%, or 10 out of 25, went bankrupt before the exchange rate crisis of November 17. Why did so many *chaebol* go bankrupt even before the exchange rate crisis, and what role did this play in the financial crisis? It seems to us that these are the central questions that should be addressed, and that need to be answered before Korea pursues any reforms. It is impossible to answer this questions, however, without first having a conceptual framework for thinking about the *chaebol* and their place in the economy. This is provided in sections 2-3 of our paper.

Perhaps the most common framework for thinking about business groups, or the integration of firms more generally, is *transactions cost*. Initiated by Ronald Coase and greatly extended by Oliver Williamson (1975, 1985), this literature was designed to explain why some industries are vertically integrated, and others are not. The *transactions cost* approach typically relies on different *industry* characteristics (such as "asset specificity" of investments) to explain the extent of vertical integration across industries. When we try to apply these ideas to the business groups in Asia, as some authors have (e.g. Chang and Choi, 1988; Levy, 1991) we run into trouble. In the first place, the *same* industry across different countries – such as Korea and Taiwan – are often organized quite differently. So transactions costs are evidently not specific to

industries. Furthermore, if we look at other factors that might influence the level of transactions costs – such as the reliance or non-reliance on formal contracts – we find that these are actually quite similar across Korea and Taiwan. So we are hard pressed to identify the contribution of transactions costs to the differing structure of business groups across these countries.

Government policies are another explanation for business groups, and the growth of the *chaebol* in South Korea is often attributed to the cheap credit that they received during the 1960s and 1970s. But this explanation has another drawback: even when policies are removed, the structure of business groups can remain intact for a considerable time, as happened in Korea. This is consistent with a policy-based explanation only if there is path-dependence at work, so that *past* policies continue to affect *current* structure. Path-dependence, in turn, suggests the possibility of "multiple equilibria" in the structure of business groups, as will be our focus in this paper.

We shall rely on an alternative reason for the formation of groups, suggested by Ghemawat and Khanna (1998) and Khanna (2001), and that is the *market power* explanation: by horizontally integrating, groups achieve the benefits of setting prices across multiple markets (Bernstein and Whinston, 1990); and by vertically integrating, upstream producers can offer preferential prices to those downstream, thereby increasing their joint profits (as originally noted by Spengler, 1950). We shall examine the incentives for integration in a monopolistic competition model with multiple upstream and downstream producers. A *business group* is defined as a set of producers that jointly maximize profits. Note that while profits are maximized for a group, they need not be larger than for unaffiliated firms: in the same way that we allow for the free entry of individual firms, we will also allow for the free entry of business groups, so that profits are bid down to a minimal level in equilibrium.

Allowing for free entry of business groups and unaffiliated firms, we demonstrate the presence of *multiple equilibria* in the economy, having varying degrees of vertical and horizontal integration. Thus, at given parameter values, we often find a stable *high-concentration* equilibria, with a small number of strongly-integrated business groups, and also a stable *low-concentration* equilibria, with a larger number of less-integrated groups. The difference between these is that with a small number of strongly-integrated groups, they charge *higher* prices for external sales of the intermediate inputs, thereby inhibiting the entry of other business groups. In section 4 we shall argue that the strongly-integrated groups arising in the model characterize the *chaebol* found in South Korea, whereas the less-integrated groups describe those found in other countries such as Taiwan.

The finding of *multiple equilibria* offers a new perspective on the business groups in Korea. The *chaebol* should not be viewed as responses to transactions costs, nor as simply the result of industrial policies in Korea. Instead, they should be thought of one of a small number of organizational forms consistent with profit maximization and free entry. That other countries have different group structures reflect historical conditions prevailing in each that have shaped the directions of those economies. The policy choices in Korea can be thought of as establishing initial conditions of the economy, but the fact that the *chaebol* have grown as large as they have reflects that fact that these groups are a stable form of economic organization. Even significant policy changes, such as the end of industrial policies favoring the *chaebol*, should not be expected to "undo" this type of organization.

What about the effects of large shocks to the Korea economy, such as the Asian financial crisis? As discussed in section 4, Korea experienced an abrupt fall in the growth of its exports at the end of 1996, as well as a fall in their prices. We view this as the proximate cause of the

string of bankruptcies in 1997. In mathematical language, this is an example of a "catastrophe," whereby a continuous change in some underlying variable (exports) leads to a *discontinuous* change in a resulting variable (Woodcock and Davis, 1980). Our hypothesis in this paper is that this notion of catastrophe may explain the string of bankruptcies that we saw in Korea during 1997, even before the exchange rate devaluation and financial crisis.

To see whether this hypothesis had theoretical and empirical validity, we first need to understand the reasons for the bankruptcies in Korea. This is done in section 5, in three steps. First, we argue that the bankruptcies before November 17 are predicted well by the excessively high debt-equity ratios of the groups. In contrast, the bankruptcies after November 17 cannot be explained by the overall debt-equity ratios, but rather, by excessively high levels of *short-term debt* that these groups had. In other words, the bankruptcies before November 17 show every indication that the capital market was working as it should, whereas the bankruptcies after November 17 show the characteristics of a financial panic, in which banks are not willing to roll-over short-term loans regardless of the performance of their debtors.

Second, we return to the model of business groups, which displays multiple equilibria. The question we ask is whether a continuous change in some underlying variable, such as export sales, can lead to a discontinuous change in the number of groups. We find that this is indeed the case. As demand falls in our model, it is quite possible for a situation of multiple equilibria to suddenly change to one of a unique equilibria, meaning that there is a discontinuous change in the organization of the business groups: this is an example of a mathematical "catastrophe," which we believe provides an apt description for the unprecedented string of bankruptcies among the *chaebol* during the first part of 1997.

Third, we provide an explanation of how the *interaction* between the bankruptcies of *chaebol,* and the precarious structure of the financial system, combined to create the financial crisis during the last quarter of 1997. This explanation relies on the details of financial sector reform in Korea, which expanded the role of the merchant banks in financing the *chaebol.* As has been described by Ra and Yan (2000), this financing took the form of purchasing and distributing commercial paper for the *chaebol,* and also borrowing abroad and re-lending to the *chaebol.* Both these activities expose the merchant banks to considerable risk, due to a mismatch between short-term and foreign-currency liabilities (borrowings), and long-term domestic currency assets (loans to the *chaebol*). This risk exposure, combined with the bankruptcies of the *chaebol,* proved to be more than the financial system could withstand and led to a banking panic that precipitated the exchange rate crisis.

In summary, our application of a mathematical catastrophe offers a new and intriguing explanation for the events in Korea during early 1997. We believe that the *economic organization* of the South Korea, as evidenced by the organization of the *chaebol* and their financing, makes it more susceptible to the type of downturn that the Asian crisis dramatically illustrated. But arguing that the *chaebol* can experience discontinuous changes in organization, or a catastrophe, is not the same as saying they can or should be eliminated. The Korean government is now attempting to dismantle the *chaebol* in the form that they have existed during the post-war years, in what is known as the "Big Deal". This program continues with structural policies undertaken after the crisis at the insistence of the IMF. We will argue that the policies being undertaken as part of the "Big Deal" are ill conceived, however, and need to be rethought to avoid harming the economy. This is taken up in section 6, and conclusions are given in section 7.

2. A Model of Business Groups

We shall consider an economy divided into two sectors: an upstream sector producing intermediate inputs from labor, and a downstream sector using these intermediate inputs (and additional labor) to produce a final good, as shown in Figure 1. The final good could be sold to firms (as a capital good) or to consumers, but for concreteness, we will consider only the latter case. The intermediate inputs are not be traded internationally, but the final good is traded. Suppose that both the sectors are characterized by product differentiation, so that each firm charges a price that is above its marginal cost of production. As usual under monopolistic competition, we will allow for the free entry of firms in both the upstream and downstream sectors, to the point where profits are driven to zero. In the same way that we allow for the free entry of individual firms, we will also allow for the free entry of business groups.

In contrast to conventional treatments of monopolistic competition, we will also allow groups to produce *multiple varieties* of inputs and outputs.[2] In particular, there will be an incentive to produce both upstream and downstream products to take advantage of the efficiencies from marginal cost pricing of the intermediate input. However, when the groups sell inputs internally at marginal cost, the selling firms will not be covering their fixed costs of research and development. Therefore, it will be necessary for other firms in the group to make a financial transfer to cover these losses. Naturally, this sets up a principle-agent problem, whereby the transfers made to subsidiary firm are not necessarily efficient, due to incomplete information. We will model this as a *fixed cost* for each business group, which we refer to generally as "governance costs." This is very much in the spirit of the diseconomies of size

[2] Other work examining the incentives for vertical integration in a monopolistic competition model follows that of Dixit (1983), Mathewson and Winter (1983) and Perry and Groff (1985). The equilibrium concept we use is most similar to the "vertical equilibrium" investigated by Perry (1988, 229-235), and also anticipated by the "industrial complexes" of Helpman and Krugman (1985, pp. 220-222).

discussed by Williamson (1975, chap. 7; 1985, chap. 6), and some kind of diseconomy of firm or group size must be present in any organizational model.[3] Modeling these costs in any detail would lead us into financial details about the relationship between groups and banks, which is well beyond the scope of our market-power based model.[4] So we will simply assume that they take the form of a *fixed cost* α associated with the running of a business group, and in addition, *additional costs* associated with each intermediate and final product produced by the group (over and above the research and development costs that an unaffiliated firm would incur for such products).

We will consider only *symmetric* equilibria, where each business group produces the same number M_b of intermediate inputs and N_b of final goods. Profits of each business group are denoted by Π_b, and the total number of groups is G. In addition, we will allow for unaffiliated (or "competitive") upstream firms, producing M_c inputs and earning profits Π_{xc}, together with a number of unaffiliated downstream firms, producing N_c final goods and earning profits Π_{yc}. In the free entry equilibrium, all these profits must be non-positive. We will suppose that there is a single factor of production called labor, and choose the wage rate as the numeraire.

We will suppose that each business group is able to choose the number and price of inputs and outputs, taking as given the simultaneous decisions of other groups and unaffiliated firms, so as to maximize the group's *joint profits*:

$$\max_{\{\tilde{M}_b, M_b, N_b, q_b, p_b\}} \Pi_b = [N_b y_b (q_b - \phi_b) - N_b k_{yb}] + [\tilde{x}_b \tilde{M}_b (p_b - 1) - M_b k_{xb}] - \alpha, \qquad (1)$$

[3] Grossman and Hart (1986) argue that transaction cost theory is deficient when it does not have a well-specified mechanism that would limit the size of firms. They develop a two-firm, two-period model where the interests of the firms differ, and the opportunity set under integration can *contract;* therefore, integration is not always efficient.

[4] Theoretical models of financially interlinked groups include Kim (1999) and Ghatak and Kali (2001).

where: y_b is the output of each final good, sold at price q_b and produced with marginal cost ϕ_b and fixed costs k_{yb}; $\tilde{M}_b$ is the number and $\tilde{x}_b$ is the quantity sold of each intermediate input, at the price p_b and produced with marginal costs of unity and fixed costs of k_{xb}; M_b is the number of intermediate inputs developed, which must be at least as large as those sold, $\tilde{M}_b \leq M_b$; and α is the level of fixed "governance costs" associated with the running of a business group. To the extent that these governance costs depend on the size of the group, measured by N_b and M_b, then this would be a reason for the fixed costs k_{yb} and k_{xb} to differ between business groups and unaffiliated firms, as we shall discuss below.

Note that in addition to the external sales of $\tilde{M}_b$ inputs, at the price p_b, the group will also sell *all* M_b of its inputs internally. Profits are maximized by selling these at marginal costs, which is unity, and we will denote the internal quantity sold by x_b. It is quite possible that the profits earned by the upstream firms, which is the second bracketed term on the right of (1), is negative because these inputs are sold internally at marginal cost. Thus, we would expect some transfer from the downstream to the upstream firms to cover these losses. Our key simplifying assumption on the "governance costs" is that *they don't depend on the amount of the transfer,* though they can depend on the numbers of upstream and downstream firms. It is this simplifying assumption that allows us to ignore the transfer in the specification of (1). Indeed, given this assumption, we can provide for weaker group incentives, such as Nash bargaining between the upstream and downstream firms over profits (Pepall and Norman, 2001). Given our specification of governance costs, Nash bargaining over profits would still imply the maximization of profits overall, with the bargaining strength of individual firms then affecting

their share of profits. As we have noted, moving beyond this simplifying assumption to a case where the governance costs explicitly depend on the transfer, as in a principle-agent problem, is beyond the scope of the present paper.

The marginal cost of producing each output variety is assumed to be given by the CES function:

$$\phi_b = w^{\beta}\left[M_b + (G-1)\tilde{M}_b p_b^{1-\sigma} + M_c p_c^{1-\sigma} \right]^{\left(\frac{1-\beta}{1-\sigma}\right)}, \qquad (2)$$

where: w is the wage rate, and labor is a proportion β of marginal costs; M_b inputs are purchased internally at the price of unity; $\tilde{M}_b$ are inputs purchased from (G-1) other business groups at the price of p_b; and M_c inputs are purchased from unaffiliated upstream firms at the price of p_c. We will set w=1 by choice of numeraire, and suppress it in all that follows. The elasticity of substitution σ is assumed to exceed unity, so that it is meaningful to think of changes in the number of inputs available from each source.

Turning to the unaffiliated firms, the upstream firms maximize profits:

$$\max_{p_c} \ \Pi_{xc} = x_c(p_c - 1) - k_{xc}, \qquad (3)$$

where x_c is the output of each intermediate input, sold at price p_c and produced with marginal cost of unity and fixed costs k_{xc}. The elasticity of demand facing these firms is σ, so that the markup of the optimal price over marginal costs equals:

$$p_c - 1 = \left(\frac{1}{\sigma - 1}\right). \qquad (4)$$

Substituting this into (3), we see that profits equal $\Pi_{xc} = [x_c/(\sigma-1)] - k_{xc}$ and setting these equal to zero we obtain the level of output in the free-entry equilibrium:

$$x_c = (\sigma - 1)k_{xc}. \tag{5}$$

While this expression for output under monopolistic competition is not that familiar, it follows directly from the markups in (4), and will be useful in computing equilibria.

The unaffiliated downstream firms maximize profits given by:

$$\max_{q_c} \ \Pi_{yc} = y_c(q_c - \phi_c) - k_{yc}, \tag{6}$$

where y_c is the output of each final good, sold at price q_c, and produced with marginal cost ϕ_c and fixed costs k_{yc}. The marginal cost of producing each output variety is:

$$\phi_c = \left[G\tilde{M}_b p_b^{1-\sigma} + M_c p_c^{1-\sigma}\right]^{\left(\frac{1-\beta}{1-\sigma}\right)}, \tag{7}$$

where $\tilde{M}_b$ are inputs purchased from G other business groups at the price of p_b, and M_c inputs are purchased from unaffiliated upstream firms at the price of p_c. Recalling that we have normalized w=1, it is apparent that the marginal costs for a business group in (2) are *less than* those for an unaffiliated firm in (7), because the business groups are able to purchase their own inputs at the cost of unity.

On the demand side, we will assume a constant elasticity of substitution between output

varieties, denoted by η. Then for each unaffiliated downstream firm, the markup of the optimal price over marginal costs equals:

$$q_c - \phi_c = \left(\frac{1}{\eta - 1}\right)\phi_c . \tag{8}$$

Substituting (8) into (6), profits become $\Pi_{yc} = [y_c/(\eta - 1)] - k_{yc}$ and setting these equal to zero we obtain the level of output:

$$y_c = (\eta - 1)k_{yc} / \phi_c . \tag{9}$$

Again, this expression for output follows immediately from the markups in (8), and will be useful in computing equilibria.

We still need to solve the control problem (1) for the business groups, as will be done in the next section. Before this, it is useful to consider the possible configurations of groups and unaffiliated firms that can arise in a zero-profit equilibrium. This will depend very much on the level of "governance costs" within the groups. If these costs were zero, then a group would be more efficient than a like-number of unaffiliated upstream and downstream firms (due to its internal marginal cost pricing of inputs). Then in a zero-profit equilibrium for groups, the profits of unaffiliated firms would be negative, and they would never enter. Focusing on this equilibrium alone would be uninteresting from an organizational point of view. Conversely, if the governance costs are large than both upstream and downstream unaffiliated firms, together with groups, could very well occur in a zero-profit equilibrium. This is probably realistic, but having all types of firms makes the computation of equilibria intractable. Accordingly, we take a "middle of the road" approach, and will assume that the governance costs are large enough to

allow the possibility that either upstream or downstream unaffiliated firms to enter, but small enough to prevent entry of both types.

With these assumptions, the equilibria that we consider will have one of three possible configurations, as shown in Figure 2: **(1) *V-groups*** - the business groups prevent the entry of unaffiliated producers in both the upstream and downstream sectors ($M_c=N_c=0$), and are therefore strongly vertically-integrated; **(2) *D-groups*** - business groups are the only firms in the downstream sector ($N_c=0$) and are vertically-integrated upstream, while purchasing inputs from some unaffiliated upstream firms $(M_c > 0)$; **(3) *U-groups*** - business groups are the only firms in the upstream sector ($M_c=0$) and are vertically-integrated downstream, but also compete with some unaffiliated downstream firms $(N_c > 0)$. We stress that this terminology does not make any presumption about the *horizontal integration* of the various types of groups: this is something that we will have to determine in equilibrium. In fact, it will turn out that the largest V-groups are also spread horizontally over a wide range of products, much like the largest *chaebol* in Korea.

In order to observe a U-group or D-group equilibrium, we further need to rule out the possibility that all unaffiliated firms would want to *merge* with a business group. This is ruled out by supposing that unaffiliated firms have lower fixed costs associated with product development, which are automatically increased if that firm is part of a group: that is, we will assume that $k_{yb} \geq k_{yc}$ and $k_{xb} \geq k_{xc}$, with these inequalities holding as strict when needed to make merger unprofitable. These extra fixed costs associated with the business group should be interpreted as governance costs that are *additional to* the fixed costs of α. The precise specification of fixed costs to achieve this will depend on the equilibrium. Despite the somewhat *ad hoc* nature of this assumption, we emphasize that it is made as a compromise between

tractability (preventing all firms from entering) and interest (having the possibility that some unaffiliated firms will enter, and not merge). This still leaves the possibility of mergers across groups. In order to rule out this activity we need to appeal to some extra costs associated with governing a group of increasing size, that lie outside the notation of our model. With this list of assumptions, we can turn to the solution of the model.[5]

3. Computing Equilibria of the Model

3.1 When Will Groups Sell Inputs to Each Other?

We first address the question of when the groups will sell inputs to each other. For convenience, we will focus initially on just the V-groups, supposing that any unaffiliated firms find it unprofitable to enter. A key choice variable of the business groups is the *price that groups charge for the intermediate inputs sold to other groups*. This reflects the competition that groups perceive that they face with each other. If a group A believes that selling an input to group B confers a substantial advantage to that group, in the sense that group B can produce the downstream good at lower cost and therefore compete more aggressively downstream, then group A could decide *not* to sell this input even at a very high price. We are interested in knowing when this type of outcome will occur.

To begin, we review some well-known results. An *unaffiliated* firm will find most it most profitable to set the price for a good it is selling in *inverse relation* to its elasticity of demand: this is the familiar Lerner pricing rule. In our model, the elasticity of demand and elasticity of substitution are both measured by σ, which we label as S in our Figures. A product with high elasticity (many substitutes) should therefore be priced close to marginal cost; a

[5] The equilibria of the model described in the previous section are formally solved in Feenstra, Huang and Hamilton (2001).

product with low elasticity (few substitutes) can be priced much higher than marginal cost, earning substantial profits. When the elasticity approaches unity, then the firms do not lose any sales revenue at all from increasing its price, so it will set its price arbitrarily high. Since infinite prices do not make any sense, this leads to the well-known result that the elasticity of demand for any firm with some ability to set its price (i.e. some market power) must be *greater than unity*.

Now consider how this Lerner pricing rule changes when a *group* is selling the intermediate input to another group. We expect that the competition in the downstream market will lead the group to set a price *higher* than would an unaffiliated firm. That is, the group not only wants to maximize its profits from selling the intermediate input (as would an unaffiliated firm), it *also* wants to ensure that it does not give a cost-advantage to the purchasing group from having that input available, since these groups compete in the downstream market. How intense is this competition? That would depend on how many groups are in the economy. If there are only a small number, say two, then each group will be supplying one-half of the entire downstream market (since we are assuming there are no unaffiliated firms). Each group is therefore a large player in this market, and would be concerned about protecting its profits downstream. For this reason, we expect to find that the *smaller* the number of business groups competing "head to head" downstream, then the *higher* prices of the intermediate inputs become.

We can now answer the question of when a group would want to sell to other groups at all. Sales will *not occur* if the optimal price for the intermediate input is arbitrarily high, approaching infinity. In conventional models, infinite prices do not make any sense, but in our model these prices only apply to *external* sales, while the *internal* sales still occur at marginal cost. We find that the external prices are infinite – so that the groups do not sell to each other – whenever the elasticity of substitution is less than or equal to G/(G-1), where G is the number of

business groups. For example, with just two groups, the groups will not sell to each other for any elasticities less than two; with three groups, this occurs for elasticities less than 1.5, and so forth. We will still suppose that the elasticity is greater than unity, so that for elasticities in the range *between* unity and G/(G-1), sales of the inputs will be *only* internal.

These results are illustrated in Figure 3, where we show the number of groups G on the vertical axis, and the elasticity of demand (exceeding unity) on the horizontal axis. The dashed line along which the elasticity S equals G/(G-1) is labeled as such. Whenever the number of groups or elasticity lie *below* this line, there will be no external sales: each group will be entirely self-sufficient, in an extreme form of the "one-setism" that characterizes the *chaebol* in South Korean, whereby they expand into any and all lines of business that serve their member firms. In contrast, when either the number of groups or elasticity lie *above* the line S = G/(G-1), then the groups will be willing to sell their inputs to each other (or unaffiliated firms). This is more characteristic of the vertically-oriented *keiretsu* in Japan, for example, where a supplier to Toyota may also sell its products to other automobile groups.

Our goal now is to "fill in" the regions of Figure 3 with equilibria from the theoretical model. To do so, we pick a value for the elasticity of demand for inputs, E. In our model, we suppose that this same value applies to all possible inputs in the economy (another value of the elasticity applies to all final goods).[6] We then solve for an equilibrium, satisfying profit-maximization and free entry of all business groups (later we also add unaffiliated firms), and full-employment of resources in the economy. This allows us to determine the number of

[6] Initially, we used an elasticity of demand for final goods equal to 5. While we found both V-group and U-group equilibria at this value, it was difficult to find D-group equilibria in which the unaffiliated downstream firms had no incentive to enter. To limit this incentive, it was necessary to use lower values for the final demand elasticity, especially when the elasticity of demand for inputs itself was low. Accordingly, all our equilibria are computed with an elasticity of demand for final goods equal to 5 for $S \geq 2.65$, and equal to $1.9 \cdot S$ for $S \leq 2.60$.

groups, G, in equilibrium, and that will be plotted in Figure 3 above the elasticity we started with. This exercise is then repeated for *every other value of the elasticity:* in each case, we find the number of groups, and their prices charged for inputs and final goods. In this way, we will obtain a plot of various equilibria of the economy, depending on the value of the elasticity. Obviously, the precise position of this plot will depend on details of the model, such as consumer tastes and resource endowments. So our interest will be in the more general features of the equilibria obtained, and in particular, whether for each elasticity there is a *unique* number of groups or *several* group configurations that are consistent with equilibrium.

2.2 Equilibria with Vertically-Integrated Groups

We have found so far that an equilibrium of the economy with only V-groups can take one of two forms: either the groups do not sell to each other, or they choose to do so at some optimal price. Let us focus initially on the case where *no sales* occur between the groups. The question then is: how many groups will choose to enter, so that the profits of each are bid down to zero? This will clearly depend on how large the economy is, as measured by its resource endowments. For a given size, however, we find in the model that the number of business groups is *uniquely determined*. That is, with all groups choosing to expand into as many upstream and downstream products as they find optimal, and free entry of groups of this same size, none of whom are selling to each other, there will only be room for a certain number of groups in the economy.

This result is illustrated in Figure 4, where like Figure 3, we show the number of groups G on the vertical axis, and the elasticity of substitution S for the intermediate inputs on the horizontal axis. The line along which S = G/(G-1) is shown. For each value of the elasticity, we solve for the number of groups consistent with equilibrium, and this value of G is plotted as a

triangle. We see that for elasticities less than about 2.5, the equilibrium number of groups is small enough so that the plotted points lie *below* the line S = G/(G-1), meaning that the groups do not sell any intermediate inputs to each other. Furthermore, in this region the equilibrium number of groups is *uniquely* determined once we specify the elasticity and other parameters of the economy (such as its size): for each elasticity, there is a certain number of V-groups consistent with equilibrium.

Now consider values of the elasticity exceeding 2.5. This moves us into the region *above* the line S = G/(G-1), so that groups begin selling inputs to each other. What then, is the equilibrium number of groups in the economy? It would appear that this depends on the price charged for the intermediate inputs: if this price is high, it would prevent business groups (and unaffiliated firms) from entering; while if this price is low, then more groups would want to enter. But we have already argued that the equilibrium price of the intermediate inputs *depends* on the number of business groups: when there are fewer groups, they each have a larger share of the downstream market, and would want to charge a higher price for the intermediate inputs used by their rivals. So now there is a circularity in the argument: the equilibrium number of groups will depend on the price of the intermediate inputs, but the price charged for these inputs will depend on the number of groups. This kind of circular reasoning is precisely what gives rise to *multiple equilibria* in any economic model, and our stylized economy is no exception. We therefore expect to observe two types of equilibria: those with a small number of business groups and a high price for the intermediate inputs; and those with a large number of groups and a lower price of the intermediate input.

This line of reasoning is confirmed when we actually solve for the equilibria. For elasticities just slightly greater than 2.5, there is a still a unique number of groups G consistent

with equilibrium. However, for elasticities between about 2.8 and 3.2 we find that there are three equilibria, giving the "S-shaped" curve shown in Figure 4. The idea that equilibria come in odd numbers is a characteristic feature of many economic and physical models. Like an egg standing upright either just balances where it is, or falls to the left or right with the slightest bump, the "middle" equilibrium is often unstable, while those on either side are stable. We have checked the stability of the V-group equilibria by slightly increasing the number of groups beyond the equilibrium number, and computing whether profits of the groups rise or fall: if profits fall, then the number of groups will return to it equilibrium number, so the equilibrium is stable; but if the profits rise, then even more groups would be induced to enter, and the equilibrium is unstable.

The *stable* V-group equilibria are illustrated with solid triangles in Figure 4, and the *unstable* are illustrated with open triangles. To further understand how these multiple equilibria arise, in Figure 5 we plot the optimal price for the intermediate input.[7] For values of the elasticity less than 2.5, the business groups do not sell to each other, i.e. the price of the inputs is infinite. For slightly higher values of the elasticity, the price begins to fall, and when the elasticity reaches 2.8 there appear *multiple* equilibria, with high and low prices. The high-priced equilibria supports a small number of business groups, and the low-priced equilibria supports a larger number of groups, with an intermediate case in-between these two. The intermediate case is unstable, while both the high-price and low-priced equilibria are stable.

To summarize our results thus far, computing the equilibria of our stylized model with V-groups confirms our expectation that *multiple equilibria* can arise. The price system itself imposes some structure on the organization of the economy, but equally important, does not fully determine which of these equilibria will arise: in principle, an economy with the same underlying

[7] Note that the marginal cost of intermediate inputs has been set at unity in the model, which equals the internal price within a group.

conditions (such as resource endowments and consumer tastes) could give rise to more than one possible equilibrium organization. We have confirmed these multiple equilibria are stable, meaning that once they are established there is no reason for them to change, even as the economy experiences some degree of change in underlying conditions.

2.3 Upstream and Downstream Business Groups

We now add the possibility of unaffiliated firms locating in the upstream or downstream markets. Because there is free entry of these firms, they will choose to enter whenever the profits available cover the fixed costs of entry; entry will continue until profits are driven down to zero. While we shall allow entry into both the upstream and downstream markets, we do not expect both to occur simultaneously, since the business groups in the model are more inherently more efficient than a like-sized combination of upstream and downstream firms. Recall that we have offset the efficiency advantage of the groups by giving them small "governance" costs, which are an additional fixed cost that each group bears. In our model, we adjust this "governance cost" so that upstream or downstream firms are profitable in at least some equilibria. That is, we intentionally choose the "governance cost" to obtain a *wide range* of possible equilibrium configurations.[8]

To determine whether the unaffiliated firms enter, we first need to check the V-group equilibria illustrated in Figure 4. For many of these equilibria, we find that the profits that could

[8] Actually, we introduce two types of "governance costs" into the model: the first is a fixed cost borne by each group; and the second is a fixed cost for each new input or final good developed (due to research and development, and marketing, for example). The latter fixed cost is borne by both unaffiliated firms and groups, but we assume it is *slightly higher* for the groups. In other words, the *unaffiliated* firms are assumed to be slightly better at creating new products, in either the upstream or downstream market. This assumption is needed to help offset the efficiency advantage that the business group have. In addition, this assumption helps limit the incentive of the business groups to *take over* the unaffiliated firms. We suppose that if such takeover occurs, then the fixed costs of product creation are raised slightly when the unaffiliated firm is merged with the group, so the group will not necessarily want to pursue such a takeover, even if the unaffiliated firm is profitable.

be earned by either unaffiliated upstream or downstream firms are not sufficient to cover their fixed costs, so entry would not occur. This is not the case, however, for the low-priced equilibria with a correspondingly large number of V-groups that occur at the top of the "S-shape" in Figure 4. For values of the elasticity exceeding 2.8, these equilibria allow for profitable entry of *downstream* unaffiliated firms. Accordingly, we allow these firms to enter until profitable opportunities are exhausted, and re-compute the number of business groups in the equilibrium. Since these groups compete with the downstream firms, they are dominant only in the upstream market, and are therefore referred to as U-groups.

In Figure 6, we show the equilibrium number of U-groups as squares, for elasticities exceeding 2.8. We have confirmed that these equilibria are stable, in the sense that a small increase in the number of business groups will lead to lower profits for all of them, and therefore, some groups will exit to restore the zero-profit equilibrium. The U-groups charge low prices for the intermediate inputs, which is optimal because each individual group has only a small share of the downstream market, and because it is not that concerned over the cost-advantage it gives to rivals by selling them inputs. This configuration of the economy can be thought of as analogous to Taiwan, where business groups dominate in the upstream markets, such as chemicals, but supply these inputs at competitive prices to a great number of downstream firms.

Next, we check for the equilibrium configuration in which there are unaffiliated upstream firms, so the business groups dominate in the downstream market, and are called D-groups. For example, D-groups can be conceived of as primarily assembly firms in downstream markets, which produce some of their own intermediate inputs. Automobile manufacturers in Japan such as Toyota seem to fit this description, and GM and Ford in the U.S. are moving in that direction, both of whom have split off their parts production into separate companies (Delphi for GM and

Visteon for Ford). Other example include Dell Computers or any number of footwear and garment brand name manufacturers (e.g., Nike or The Gap), that purchase inputs from various affiliate and non-affiliated suppliers, and then assemble and market the final products. D-groups are plotted as circles at the top of Figure 6, for elasticities between 1.8 and 2.8. These equilibria are all stable, though there are also *other unstable* D-group equilibria that we have not plotted. The prices charged by the D-groups for sale of the intermediate inputs are low, despite the fact that most of these equilibria occur in the range of elasticities where the V-groups would not sell the inputs externally. The D-groups charge a low price for inputs partly because there are many of them in downstream market, so that each group has only a small fraction of the market, but also because they face competition from other unaffiliated upstream producers. Thus, in the same way that we have *multiple* stable equilibria for elasticities exceeding 2.8, with the U-groups pricing low and the V-groups pricing high, we also have multiple stable equilibria for elasticities in the range from 1.8 to 2.6, with the D-groups pricing low and the V-groups pricing high (often at infinity).

At the top of Figure 6, we show a final group of equilibria labeled with a question mark. These are initially solved as D-group equilibria, allowing for the entry of upstream, unaffiliated firms. However, when we check for the profitability of downstream unaffiliated firms, it turns out that they would also want to enter. Therefore, in this range we evidently have an equilibrium configuration with business groups, upstream and downstream firms. The same situation applies at the other end of the D-group equilibria, for elasticities below 1.8. We have not fully explored this case in our model, but logic certainly suggests that it is a plausible outcome; the difficulty of solving for this equilibrium prevents us from analyzing it further.

2.4 High Concentration and Low Concentration Equilibria

Given the complexity of the equilibria in Figure 6, it is useful to pause and summarize the general features of this diagram. Recall that our method of solving for the equilibria has been to pick each value of the elasticity, and then determine the equilibrium number of groups and their prices; this is repeated for all other elasticities. For most of the elasticities, we have found *two* stable equilibria. For example, for elasticities between 1.8 and 2.6, we have either the D-groups or the tightly integrated V-groups, who do not sell inputs to each other. For elasticities between about 2.8 and 3.2, we have either U-groups or V-groups. Beyond elasticities of 3.2, there is a unique type of equilibrium, with U-groups.[9] These unique equilibria extend beyond the elasticity of 3.5 that are shown in Figure 6, up to an elasticity of about 6.6, after which we no longer find profitable business groups for the "governance costs" we have assumed.

We will be arguing that some of the equilibria we have found bear a resemblance to the group structure in Korea, and other equilibria resemble that found in Taiwan. To make this precise, we will have to have some criterion for selecting between equilibria. Since we think of different elasticities as applying to different types of goods, it would not make any sense to say, for example, that Korea has low elasticities while Taiwan has high elasticities. On the contrary, we will suppose that *any* value of the elasticity can apply in either country, and we shall focus on all values between 1.8 and 6.6 (at intervals of 0.05).[10] Then, for each elasticity, we will choose

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[9] Beyond elasticities of 3.2, there is a unique U-group equilibrium shown in Figure 6. Recall from our previous discussion, however, that there is another type of equilibrium in which all three types of firms enter (unaffiliated upstream, unaffiliated downstream, and business groups); this was indicated by the question mark at the top of Figure 6. So there might be multiple equilibria even for elasticities exceeding 3.2: an equilibrium of the U-group type and another with all three types of firms. Since we did not solve for this equilibrium, we cannot include in our analysis.

[10] Below elasticities of 1.8, we show only a single equilibrium in Figure 6, with the tightly integrated V-groups. However, we have also found that for elasticities in this range there is likely to be an *alternative* equilibrium, involving the simultaneous entry of business groups, upstream and downstream firms. Because we have not been able to solve for this equilibrium in detail, we do not consider elasticities below 1.8.

the stable equilibrium with the *large* number of business groups, and say that it belongs to the *low concentration* set, while we will choose the stable equilibrium with the *small* number of business groups and say that it below to the *high concentration* set. In this way, we will be identifying two generic types of equilibria, distinguished by the degree of concentration of the business groups, over the whole range of elasticities being considered.

Figure 6 can be used to illustrate the two equilibria sets. The *high concentration* equilibria include the stable V-group at the bottom of the figure, for all elasticities up to 3.2, followed by the stable U-group equilibria for elasticities above 3.2 up to 6.6. In brief, the high concentration equilibria include the V-groups, which we will show are very big, and the U-groups, which are considerably smaller in their sales. By making the comparison of this equilibria set with South Korea, we are therefore allowing for a variety of different groups in that country: we will argue that the top five *chaebol* have characteristics similar to the V-groups, while some of the other *chaebol* are more similar to the U-groups.

The *low concentration* equilibria form a path at the top of Figure 6, and include the D-group for elasticities up to 2.8, followed by the U-group equilibria for elasticities above 2.8, up to 6.6. When there is a *unique* equilibrium, as for the U-groups with elasticities above 3.2, then it belongs to *both* the high-concentration and low-concentration set. Note that the low concentration equilibria do not include any V-groups, and in the same way, what really distinguishes the groups in Korea and Taiwan is the *absence* of extremely large groups in Taiwan: the largest Taiwanese groups are mainly located upstream, like the U-groups in the low concentration equilibria. There are also groups in Taiwan selling mainly to the downstream domestic market, and these are like the D-groups in the low concentration equilibria.

3. Comparison of Korea and Taiwan with the Model

We shall compare our theoretical model to actual datasets for the business groups in Korea and Taiwan. The primary source for the 1989 Korean data is the volume *1990 Chaebol Analysis Report (Chaebol Boon Suk Bo Go Seo in Korean)* published by Korea Investors Service, Inc. This volume provides information on the 50 largest business groups (measured in terms of assets) in South Korea, but for six of these groups the data on internal transactions within the groups are missing. Thus, the 1989 database for Korea includes only 44 groups, with 499 firms. Data on financial and insurance companies belonging to the groups are excluded from the database, since their sales cannot be accurately measured. In the Appendix, Table A1 we show summary information for each of these 44 groups.

The primary sources for the 1994 Taiwan data are twofold: *Business Groups in Taiwan, 1996/1997,* published by the China Credit Information Service (CCIS); and company annual reports to the Taiwan stock exchange, for 1994, collected by the CCIS, and supplemented by interviews of selected firms. *Business Groups in Taiwan, 1996/1997*, provides information on 115 business groups in Taiwan. For the largest 80 of these groups, data on sales to and purchases from other firms in the groups was collected from their annual reports. As with the Korean database, the sales of firms in some service sectors are incomplete. This means that one of the largest Taiwanese groups, the Linden group (which owns Cathay Insurance) in not included in the database, and also the Evergreen group (a shipping company) is not included. Using the information available, the 1994 database for Taiwan includes 80 groups, with 797 firms, as listed in the Appendix, Table A2.

The firm-level sales in each country are aggregated to twenty-one manufacturing sectors and several non-manufacturing sectors, as shown in Table 1. For South Korea, about one-half of

the sectors have business group sales that account for more than 25% of total sales, and in several cases the business group sales account for more than 50% of total sales, including petroleum and coal, electronic products, motor vehicles and shipbuilding. The groups have a strong presence in both upstream and downstream sectors. Overall, the 44 business groups in 1989 account for 40% of manufacturing output, together with 13% in mining, 32% in utilities, and 24% in transportation, communication and storage.

In Taiwan, by contrast, the business groups dominate in only a selected number of upstream sectors. For example, in textiles the business groups account for nearly one-half of total manufacturing sales. These groups sell downstream to the garment and apparel sector, where business groups are almost nonexistent. This pattern also occurs with strong group presence in pulp and paper products, chemical materials, non-metallic minerals, and metal products. In comparison, business groups have a weak presence in downstream sectors such as wood products, chemical products, rubber and plastic products, as well as beverages and tobacco. Overall, the groups account for only 16% of total manufacturing output in 1994, along with small shares outside of manufacturing.

Our goal for the rest of this section is to contrast the business groups in South Korea and Taiwan in terms of some variables that can be measured in practice, and then to compare these empirical results with the theoretical high-concentration and low-concentration equilibria. We will be arguing that the *chaebol* in Korea seem to conform to features of the high concentration equilibria, and particularly that the largest *chaebol* in Korea are similar to the V-groups in our model. In contrast, the business groups in Taiwan bear a resemblance to the low concentration equilibria, and especially to the U-groups in our model. We will make the connection between the simulated equilibria from the model, and the actual business group data, using both diagrams

and simple summary statistics. The variables that we focus on to compare the actual data and simulated equilibria are fourfold: group sales, vertical integration, horizontal diversification, and product variety in the economy overall.[11]

3.1 Group Sales

In Table 2, data from the 44 Korean business groups in 1989 is shown in the top half, while simulated data from the "high concentration" equilibria is shown in the lower half. We see that the top five groups for Korea – Samsung, Hyundai, LG, Daewoo and SK – have 1989 sales averaging $18.6 billion, while the remaining 39 groups have sales averaging $1.5 billion. Thus, the top five groups are vastly larger than the others. In our model, we have chosen the size of the labor force so that the average simulated sales of the V-groups are 18.4 million, similar to those of the top five Korean groups. Holding the labor force at this same value, we then find that the remaining U-groups in the high-concentration equilibria have average sales of 1.1 billion, or roughly the same as that actually found for the remaining groups in Korea. This is a remarkable similarity of the mean sales for the largest and remaining groups, in the Korean data and simulated high concentration equilibria.[12] It illustrates the vast difference in size between the top five *chaebol* in Korea, and the remaining business groups: a difference that is reproduced across the groups in our high concentration equilibria.

For Taiwan , data from the 80 business groups in 1994 is shown in the top half of Table 3, while simulated data from the "low concentration" equilibria is shown in the lower half. The largest five Taiwanese groups – Formosa Plastics, Shin Kong, Wei Chuan Ho Tai, Far Eastern,

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[11] The material that follows draws on Feenstra, Hamilton and Huang (2001), to which the reader is referred for a more complete discussion.

[12] It might be noticed that the mean sales for all Korean groups, $3.4 billion, is quite different from that from the model, 6.2 billion. This occurs because we have simulated *many* V-group equilibria, which tends to "pull up" the average simulated sales, but only include five *actual* groups in the top five comparison

and Yulon – have average 1994 sales of $5.2 billion. This is much smaller than the top five groups for Korea, but at the same time, is some eight times larger than the average sales for the other 75 groups in Taiwan. In our model, the low concentration equilibria include both U-groups and D-groups. We divide the former into those that are larger (for elasticities between 2.8 and 3.2) and smaller (for elasticities exceeding 3.2). The large U-groups have average sales of 2.1 billion, or twice the average sales of 1.1 billion for the smaller U-groups. The same difference is obtained between the D-groups, with average sales of 2.2 billion, and the smaller U-groups, with sales of 1.1 billion. So the Taiwanese data and the low concentration equilibria both display a contrast between the largest groups and those remaining, though this contrast is more marked in the actual data than the simulated equilibria.

We feel that the largest groups in Taiwan – such as Formosa Plastics – are best described as U-groups, but the low concentration equilibria in our model also include large D-groups. This configuration may be appropriate for some of the Taiwanese groups that have large retail sales, such as some automotive groups and retail groups, or the Acer group. So while the comparison of Taiwan with the low concentration equilibria is not as exact as we obtained for Korea, we feel that it is still highly suggestive.

3.2 Vertical Integration

The vertical integration of each group is measured by the sales between firms in a group, relative to total sales by that group: the *internal sales ratio*, which is calculated both with and without sales to retail firms.[13] The largest five groups for Korea have average internal sales ratio

[13] Retail firms include trading companies, that are engaged in transferring goods between firms within a group. We excluded the within-group purchases (but not the within-group sales) of all trading companies and other retail firms, so as to avoid double-counting these transactions and artificially inflating the internal sales ratio. A fuller description of the trading companies is provided in Feenstra (1997).

is 27% (or 14.3% with retail firms excluded). Comparing Tables 2 and 3, the average internal sales ratio for the top five in Korea is twice as much as that for Taiwan, and three times as much when retail firms are excluded, and these differences are statistically significant. Outside of the top five, Korea has an average internalization ratio of 9.2% for the remaining 39 groups (or 5.7% without retail firms), which compares with the average internalization for all groups in Taiwan of 7.0% (or 4.7% without retail firms).[14] These differences are not statistically significant. Thus, it is the top five groups for Korea that are the outliers in these comparisons.

Our theoretical model does not incorporate any of the informational considerations that would give rise to trading companies, but it does contain a rudimentary distinction between manufacturing and retailing activities. The upstream sector in the model produces and sells intermediate inputs, while the downstream sector assembles and sells the final products. We can conceptually split the downstream sector into its two parts – assembly and retail sales – and treat these as distinct activities. If we suppose that the sales are done by firms other than those engaged in assembly activity but belonging to the same group, then the purchases of the retail firms can be either included within the internal sales ratio, or excluded. These two calculations differ only in an accounting sense in the model, and will correspond to how the internal sales ratios are computed for the actual group data.

In our simulated high concentration equilibria, reported in Table 2, the V-groups have internalization of 46.9% (or 21.7 % when retail purchases are excluded), as compared to 26.1% for the remaining U-groups (or 2.3% without retail purchases). Thus, the model predicts internal

[14] In comparison, Gerlach (1992, 143-149) reports that for the six intermarket groups in Japan, the rate of internal transactions has been variously calculated to be around 10%. For the vertical *keiretsu* however, internalization is higher. An unpublished report by the Japanese Fair Trade Commission asks groups what they buy from companies in which they have more than 10% equity, even when those companies are not part of the same intermarket group. This leads to internal transactions of 38%, or even higher when overseas affiliates are included.

sales in the large V-groups that is between two and ten times bigger than for the remaining groups. This theoretical range includes the *actual* difference of three times between the internalization of the top five and remaining groups for Korea. So while the internalization figures in the model and the Korean data do not match exactly, they are quite similar.

In Table 3, we repeat this comparison for Taiwan and the low concentration equilibria. The internal sales ratios range from 14.3% for the top five Taiwanese groups (or 4.5% when retail firms are excluded), to 6.5% (or 4.7% without retailing) for the other 75 groups. Thus, the largest groups have internalization between one and two times greater than that of the remaining groups. In the low concentration equilibria, we can compare the internalization of the largest U-groups, which is 35.9% (or 3.9% without retailing), to that of the smaller U-groups, which is 26.1% (or 2.3% without retailing). Thus, the internalization of the larger groups is about 1.5 times higher than for the remaining U-groups, which is roughly similar to that found in the Taiwanese data. Focusing on the internalization while omitting retail sales, the simulated low concentration equilibria have *lower average values* than the simulated high concentration equilibria, as we also find when comparing Taiwan to Korea.

3.3 Horizontal Diversification

The comparison of the actual data with simulated equilibria can also be made for horizontal diversification, as measured by the Herfindahl indexes.[15] These indexes are alternatively computed over all products sold by the business groups (the broadest definition), and over just internal sales of intermediate inputs (the narrowest definition). Under the broad

[15] The Herfindahl index is defined as $1 - \sum_i s_i^2$, where s_i is the share of total group sales in each sector. In the business groups data, we use twenty-two manufacturing sectors, two primary products, three non-manufacturing products, and four service sectors. In the theoretical model, we simply use the shares s_i devoted to each different upstream or downstream product and then compute the Herfindahl index with the same formula.

definition, the Herfindahl index at the group level is: 0.72 for the top five groups in Korea, 0.50 for the remaining 39 groups, 0.56 for the largest five groups in Taiwan, and 0.33 for the remaining 75 groups. So not only are the top groups in Korea highly vertically-integrated, they are also horizontally diversified over a very wide range of manufacturing and service sectors.

In Table 2, the top five groups for Korea have product diversity that is 1.5 to two times greater than that of the remaining groups, depending on which measure of the Herfindahl index is used. Similarly, in the simulated high-concentration equilibria, we find that the V-group equilibria have product diversity exceeding that of the U-groups, though this difference is exaggerated in the simulated equilibria: the V-groups have product diversity between three and twelve times greater than the remaining U-groups. Notice that the *overall* mean level of product diversity is quite comparable in the Korean economy and the high concentration equilibria.

This similarity of the overall means also holds for Taiwan and the low concentration equilibria, in Table 3. The large U-groups have product variety exceeding that of the small U-groups, as also observed between the largest and remaining groups for Taiwan, though again, the differences are exaggerated in the simulated data. So while the actual and simulated levels of product diversity do not match exactly, we still feel that the essential features of horizontal diversification in the two countries are well represented by the simulated equilibria.

3.4 Product Variety in the Economy

We have found that the V-groups in the high-concentration equilibria have the greatest product diversity, exceeding that of U-groups and D-groups regardless of how the index is measured. This reflects in part their very large size, and also the economies of scope that come with size: since any new input will be sold to a large number of downstream firms within the V-group, there is a strong incentive to develop more input varieties. From this result we *should not*

conclude, however, that the high-concentration equilibria will have greater product variety for the economy overall. On the contrary, our model predicts that a high concentration equilibrium with V-groups will have *less variety of final products* in the economy *overall* than a low-concentration equilibria evaluated at the same elasticity (and for like values of the other parameters, such as the size of the labor force). This reduced variety of the final goods translates into lower consumer welfare (holding fixed the number of product varieties available through imports). Thus, the inherent efficiency of the business groups (because they sell inputs internally at marginal cost) does not necessarily translate into efficiency for the economy overall.

To understand why the economy-wide variety of final products is reduced by V-groups, note that the large input variety in *each* group, combined with marginal-cost pricing of inputs internally, results in low downstream costs. This gives the V-groups an incentive to produce a higher *quantity* of any final product than would other types of groups or unaffiliated firms, with corresponding higher sales. But now we need to appeal to the resource constraint for the economy. With the V-groups selling more of *each* final good variety than would other types of groups, it is impossible for the economy to *also produce* more final varieties; on the contrary, with the same labor force available, a low-concentration equilibrium with either U-groups or D-groups must have *higher variety of the final goods* than a high-concentration equilibrium with V-groups. Put simply, the focus of the V-groups on high sales for each final product rules out the possibility that the economy also produces a wide range of final consumer goods. A good example is provided by the focus of many of the South Korean groups on a narrow range of products, such as microwave ovens or cars (the Hyundai), striving to be a "world leader" in each product; in contrast, Taiwan supplies a vast array of differentiated products to retailers in the U.S. and elsewhere, customizing each product to the buyers' specification. We find that the

focus on a narrow range of varieties is a characteristic feature of the high concentration V-group equilibria, whereas a broad range of final products in the economy comes from either U-groups or D-groups.

This hypothesis is confirmed empirically when we compare the product variety of exports from Korea and Taiwan to the United States, in Feenstra, Yang and Hamilton (1999). Across a broad range of intermediate and final goods sectors, Taiwan exports a greater variety of goods to the United States than does South Korea. While the reader is referred to that paper for the detailed results, we can illustrate the differences in product variety by using two important examples: transportation equipment, and semiconductors.

Transportation Equipment

Consider the transportation equipment industry, which is labeled 37 in the Standard Industrial Classification (SIC). It contains roughly twenty 4-digit industries, ranging from bicycles to guided missiles. Those industries with the highest value of exports from Korea and Taiwan to the U.S. are shown in Table 4: motor vehicles and passenger car bodies (SIC 3711); motor vehicle parts and accessories (SIC 3714); and motorcycles, bicycles, and parts (SIC 3751). For each of the years 1992-1994, we show the *value of exports* from Korea and Taiwan to the United States (in millions of dollars); the *number of detailed Harmonized System (HS) categories* within which each country is exporting; the *unit-value* of sales from each country; and also a *price index* constructed over the products that are sold by both countries.[16]

[16] We use the Törnqvist formula for the price index. To measure this, we take the natural log of the price ratios for individual products, which we write as $\ln(p_{it}/p_{ik})$, where i denotes the individual products, exported from t = Taiwan or k = Korea. Then we average these using the export shares from Taiwan and Korea, which we denote s_{it} and s_{ik}. The price index, measured as a natural log, is then obtained as: $\sum_i \frac{1}{2}(s_{it}+s_{ik}) \ln(p_{it}/p_{ik})$.

During this period Korea sold between $750 and $1,262 million of motor vehicles and car bodies to the U.S., in up to twenty HS categories; most of these sales were in finished autos. In contrast, Taiwan sold only between $4.3 and $5.0 million in up to four product categories. It is quite clear within "motor vehicles and car bodies," Korea has much greater product variety than Taiwan in its sales to the U.S., which is *contrary* to what is found in most other industries. Furthermore, the unit-value of Taiwanese exports is only about 15% of that for Korean exports, even though the Taiwan/Korean price index (constructed over common products) is about 63%. Evidently, Taiwan must be selling some very low-valued product as compared to Korea.

As we look more closely at the detailed HS categories, the explanation for these results becomes clear. Nearly all of Korean sales in this industry are accounted for by finished autos, or more precisely, HS categories that are further subdivisions of "passenger motor vehicles with a spark ignition engine capacity of over 1000CC" – in other words, the family car, all of which were produced by four of the top ten *chaebol*. By contrast, Taiwan's exports are nearly all in just one single category – a "passenger motor vehicle with a spark ignition engine capacity of *under* 1000CC." Just what is this product? It turns out to be *all terrain vehicles (ATV)*, which are used recreationally and in some construction sights, and which both countries sell to the U.S. So while the huge productive capacity of the Korean *chaebol* are harnessed around worldwide exports by massive groups like Hyundai, Daewoo and Kia, the Taiwanese are mainly exporting *dune buggies!*

Looking at the other industries in Table 4, the results for "motor vehicle parts and accessories" (SIC 3714) are in marked contrast to those for finished vehicles. In this case Korea and Taiwan both sell in a large number of product categories, and many of these (over 50) are common to the two countries. Taiwan sells about twice as much as Korea in total, though its

prices are less than one-half of those from Korea. Turning to motorcycles, bicycles and parts (SIC 3714), the results are quite different again. Now it is Taiwan that sells a great deal to the U.S., some $500 million, in a large number of product categories. Notice that in every product category where Korea sells, Taiwan also does, and considerably more. We easily conclude that Taiwan has greater product variety within this industry.

In these three industries within transportation equipment, we have therefore found a rich array of outcomes. In finished motor vehicles, which require highly capital-intensive and large-scale production, Korea has much greater sales values and product variety than Taiwan. This is also an industry in which the largest *chaebol* dominate. In automobile parts, the two countries cannot be ranked in their product variety of automobile parts, though Taiwan sells about twice as much. Motorcycles, bicycles and their parts can be produced at a much smaller scale than autos, and in this industry Taiwan has both higher value and product variety than Korea. Taiwanese production in this industry is dispersed over many small firms, woven into a tight and highly efficient network: it is among the largest producers of bicycles in the world, but has no large bicycle factory! The contrast between automobiles and bicycles perfectly captures the difference in the economic organization of the two countries, and in their trade patterns.

Semiconductors

Next, we look in detail at another industry – semiconductors and related devises (SIC 3674) – where the differences in production and exports between Korea and Taiwan are especially important. As in automobiles, this is another case where Korea has successfully transformed its industry into a "producer driven" commodity chain, whereby some of the largest *chaebol* have achieved global scale in products such as dynamic random access memories. These products compete with those from Japan, Singapore, and the U.S., for the mass market

available through sales of personal computers. Taiwan, by contrast, has specialized in "designer chips," and its upstream foundries such as Taiwan Semiconductor Manufacturing Company work cooperatively with small chip design firms to create special purpose chips that go into export products. These are purchased by firms worldwide as part of "buyer-driven" commodity chains, and need not be at the high-end of the market: they are used in simple toys, for example, and put the "bark" into electronic dogs. [17]

How well do these differences in the trade patterns of the countries show up their export statistics to the United States? In Table 5, we show the exports within all of semiconductors (SIC 3674), and then separately report exports of dynamic random access memories (DRAMS), and all other products. By 1994, Korea was exporting about twice as much to the U.S. as Taiwan: $3.8 billion as compared to $1.7 billion. Most of this difference is accounted for by exports of DRAMs, where Korea sold ten times as much as Taiwan: $2.1 billion as compared to only $231 million. Considering that production is concentrated in only a handful of the largest *chaebol* – especially Hyundai, Samsung, and LG– this is a remarkable level of sales to the United States, and illustrates the vast scale of resources that each group had committed to this product.

There are five or six distinct types of DRAMs distinguished in the Harmonized System (HS) trade categories, but it turns out that Taiwan and Korea are both selling in all these categories. Similarly, there are roughly fifty types of other semiconductor products in the HS categories, and both countries are selling in nearly all of these. Thus, it is not possible to compare product variety since nearly all products are common to the two countries. Still, it is meaningful to compare the unit-values and price indexes.

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[17] Emily Thornton, "Bowing to Designers: Taiwan chip makers compete for contracts," *Far Eastern Economic Review,* April 3, 1997, p. 54.

Within DRAMs, the average prices are rising over 1992-94, with the unit-values from Korea increasing from about $5.50 to nearly $15, and the unit-values from Taiwan also rising from $3 to nearly $7. As these figures suggest, the unit-value from Taiwan are always roughly half as much as that from Korea. This primarily reflects the fact that Taiwanese exports are skewed towards lower-valued chips, whereas Korea focuses on higher-end products in their exports to the U.S.. The same is true when we do this calculation over all semiconductors products (at the top of Table 5). However, when we just at those products *other than DRAMs* within SIC 3674 (at the bottom of the table), then the results are quite different. While the unit-values from Taiwan are somewhat below those from Korea, the same is true for the price index (constructed across identical products), so there is no evidence that Taiwan focuses on higher or lower-valued products than does Korea.

Korea's focus on the most advanced DRAMS, like their focus on finished automobiles, can be interpreted in several ways. On the one hand, it is an indication of technological prowess in a capital intensive industry, and this is certainly what the largest *chaebol* have strived to achieve. On the other hand, it carries a significant risk: shortly after the time period shown in Table 5 world markets became saturated with DRAMS, which led to a precipitous fall in their prices during 1996-97. Because of Korea's specialization in this product segment, their decline in price can be expected to have a much greater impact on that economy that for Taiwan, whose firms can more easily shift into alternative products. As we argue in the following sections, Korea's specialization in "commodity like" exports, with their potential for large price declines, can be viewed as a proximate cause of the bankruptcies of the *chaebol* in 1997. These bankruptcies had a destabilizing effect on the banks, and ultimately led to the financial crisis there.

4. The Crisis in Korea

So far, our theoretical model and the use of business group data in a given year has given a rather static view of the economy. This is unrealistic, of course, and conditions can change rapidly, as witnessed by the financial crisis that hit Asia during 1997-98. While the chronology of events leading up to the Asian crisis is quite well known, it is useful to review it briefly.

During the years preceding the crisis, a number of countries experienced a large inflow of short-term foreign loans. This arose in part due to low interest rates in creditor countries, especially Japan, but also due to financial liberalization in some of the East Asian countries. Both Thailand and Korea, for example, allowed unregulated financial companies to borrow short-term offshore, and then re-lend these funds domestically (World Bank, 2000, pp. 21-24). Short-term external debt in Korea peaked in at $75 billion in 1996, which was 15% of GDP, and twice the level of foreign exchange reserves.

The buildup of external debt in Korea resulted in part from its current account deficit of $23 billion in 1996, which approached 5% of GDP. This deficit can in turn be attributed to a pronounced fall in export demand and prices. The annual growth rate of Korean exports, which had grown to exceed 30% by the end of 1995, plunged to negative values during 1996. This can be seen from Figure 7, where we graph the change in dollar export values and prices for Korea, over the months September 1994 – September 1997 as compared to one year earlier.[18] The growth rate of exports exceeding 30% during 1995 was not sustainable, especially as neighboring countries (China and Japan) had devalued their currencies and created competition in export markets. As shown in Table 6, exports fell over a wide range of industrial goods, including iron and steel, chemicals, and electronic products, especially semiconductors.

[18] Figure 7 is constructed from data from the International Financial Statistics.

At the same time, Korean export prices in dollars fell by 6% over 1995-96 and another 8% over 1996-97, which was more than in any other East Asian country (World Bank, 2000, p. 43). The fall in export prices is often attributed to the steep fall in the price of semiconductors and other electronic equipment: the price of 16 megabyte DRAM chips fell precipitously from $54 at the end of 1995 to $13 by the middle of 1996, and $3 by the end of 1997 (World Bank, 2000, p. 49). Korea relied on semiconductors for some $16 billion in sales in 1997 and 1998, or 12% of its total exports, so the fall in prices for this commodity had a considerable impact on the economy. Steep price declines also occurred in other electronic products as well as chemicals and steel (Yang, 2000), which are produced in abundance by the Korean *chaebol*.

The comparison of the Korean export prices to those from Taiwan can be seen most clearly by examining their sales to the United States. In Figure 8, we graph the change in monthly price indexes for all exports from these countries to the U.S., for the months September 1994 – September 1997 as compared to one year earlier.[19] In Figure 9, we graph the change in monthly price indexes for just semiconductor exports to the U.S., over the same months. It can be seen that the Korean export prices declined precipitously in 1996, and by December, the overall export prices (Figure 8) had declined more than 15% as compared to a year ago. The Taiwanese export price index declined by only about *one-half* as much. This marked difference is due entirely to the different composition of goods sent from Korea and Taiwan to the U.S., and especially the heavy reliance of Korea on DRAM chips: semiconductors export prices from Korea declined by nearly 45% at the end of 1996, while those from Taiwan declined by less than

[19] Figure 8 is constructed from data from the Bureau of Labor Statistics (BLS), as described in Alterman, Diewert and Feenstra (1999). Specifically, the price index used is the Törnqvist formula using prices collected by the BLS and current annual export values from Korea and Taiwan in their sales to the U.S. (see Alterman, Diewert and Feenstra, 1999, chapter 8). Because the Törnqvist formula uses current rather than lagged export values, it gives a more accurate measure of export prices.

20% (Figure 9). Thus, the focus of the largest *chaebol* on becoming "world leaders" in this product led to a dramatic fall in export prices, which reverberated throughout the entire economy.

Despite the fact that exports began to grow again in 1997, so that the current account was in balance by November 1997, the overhang of the external debt remained. Many observers believe that created a crisis of confidence in the ability of private firms to repay the debt, particularly if the Korean won were to devalue. At that time, the won was on an adjustable peg, with the daily change in the exchange rate limited to a 2.5% band around the previous day's average (Kim, 1999, 72). The anticipation that the won might be allowed to float and depreciate led to an enormous flight out of the currency and into dollars, draining the foreign exchange reserves of the central bank. The central bank devoted some $25 billion to the defense of the won during November, until its foreign exchange reserves reached a low of $6 billion,[20] which was perhaps one-tenth of the short-term foreign debt. This was far too low to support the existing peg, so the won was allowed to float in November 17, 1997, and depreciated by 50% by the end of the year.

As a result of these traumatic events, a massive rescheduling of the external debt was arranged in December 1997 with the IMF. Foreign banks also arranged a second rescheduling in spring 1998, and the World Bank participated that year with agreements that had more specific policy conditions. The IMF/World Bank package was viewed as exceptional in terms of the conditions it imposed on Korea. In addition to monetary and fiscal tightening, it called for two other main features: (i) opening the economy to foreign investment, through purchase of stocks,

[20] These figures are obtained from Kim (1998, p. 35). Shim, (2000, Table 1) reports "usable" foreign exchange reserves of $7.3 billion in November 1997.

corporate bonds, and foreign direct investment; (ii) reforming corporate governance, through improved accounting practices, reducing the level of mutual debt repayment guarantees among the *chaebol*, improved bankruptcy procedures, and reform of the financial sector.[21] The first of these features is generally regarded as a "payoff" to American interests, who wanted access to the Korean market for financial and direct investment. The second feature is regarded in part as coming from Korean government interests, who saw the negotiations with the IMF as an opportunity to begin long-overdue reform of the *chaebol* and the financial sector.

The speed with which Korea and other East Asian economies bounced back in 1999 was surprising. This rapid recovery contributed to the idea that the crisis was caused by financial panic rather than any fundamental weakness in the economies, though the financial sectors obviously need to be better regulated. Generalizations such as this, however, gloss over important details about who went bankrupt, and when, and why. A close examination of the pattern of bankruptcies across groups in Korea, as we turn to next, will suggest some conclusions that cannot be obtained from consideration of the aggregate data.

5. Catastrophe in the *Chaebol*

With the downturn in exports and domestic sales, the *chaebol* suffered greatly. The first blow came to construction sector. In 1996, 189 construction companies went bankrupt (i.e., one in every other day),[22] many of which were large construction firms (*Maeil Kyongje* 96/12/24). As the construction sector declined, the steel industry also suffered as domestic steel consumption from the construction sector dwindled. The decrease in exports goods like automobiles,

[21] The IMF agreements signed with Korea on December 5 and 24, 1997, are described in Yoo, (1999, 152) citing Matthews (1998). The February 27, 1998, memorandum of understanding with the IMF, as well as the February and October 1998 agreements with the World Bank can be found in Yun (2000, Appendix I).

[22] The increase in the number of bankrupt construction firms is astonishing. In 1990, 3 firms went bankrupt while 50 firms in 1994, 145 firms in 1995, and 189 firms in 1996 went bankrupt.

machinery, electronics, and ships also contributed to the fall in steel consumption. With the slump of the steel industry, the *chaebol* specializing in steel (Hanbo, Sammi, and Kia[23]) began to fall one by one in 1997.

Korea was the 6th largest steel producer and consumer, and 7th largest steel trader in the world in 1995. While POSCO was (and is) still the largest steel producer in Korea, other steel *chaebol* had expanded the capacity aggressively between 1993-1995 as the domestic demand for steel increased. The aggressive facility expansions resulted in near maturity of the Korean steel industry in 1995. But, the investments continued with the projection of the booming domestic and world economy. The long-term, on-going, capacity investments in steel industry, however, met with the economic downturn in late 1996, leading to further bankruptcies.

The next chaebol that went bankrupt in 1997 were domestically-oriented midsize chaebol (Haitai, New Core, Dae-Nong, Jinro, Hanshin, etc.). These chaebol had also expanded considerably during the economic boom in 1994-1995, with capital borrowed primarily from domestic creditors. The industrial sectors in which these chaebol engaged were mainly domestic consumer products like food, apparel, retail, and housing building. In addition to the domestic economic slump, the wage increases also negatively affected the financial performance of these firms. By and large, the big burden of financial service that resulted from the massive expansions on debts and the downturn of domestic economy pushed those *chaebol* off the bankruptcy cliff.

In Table 7 we list all cases of bankruptcy among the top 60 *chaebol* during 1996-98, taken from Lee (1999).[24] Only one construction group (Wooseong) was in this situation in 1996, while many bankruptcies occurred in 1997-98 and later. Late in 1999, Daewoo became

[23] Kia produces cars, of course, but the first bankrupt firm of the group was its steel producing firm.

the first instance of a top five *chaebol* that was permitted to go bankrupt. Since that time, individual firms within other top five *chaebol* have gone bankrupt (such as Samsung Motors in 1999, bought by Renault the next year, and a bailout of Hyundai Engineering and Construction in 2001), but without bringing down the entire business group.

Adding the Daewoo to the list of bankrupt groups in Table 7, it is remarkable that fully 40% of these (10 out of 25) went bankrupt *before* the exchange rate crisis of November 17, 1997. Should we interpret this as a sign of structural weakness in the Korean economy, as suggested by Corsetti, Pesenti and Roubini (1998a,b, 1999), which therefore precipitated the crisis? Not necessarily. The fact that certain groups had overinvested, especially in steel and construction, had happened before in the Korean economy and was hardly news. The surprising feature of these stories is that the groups were *allowed* to go bankrupt, rather than being automatically bailed out by the banks. This reflected a new political situation in the country. President Kim Young Sam had been elected in 1992 as the first civilian president, on the promise to "clean up" the highest-level corruption. He made good on this promise by taking a "hands off" approach towards the *chaebol* bankruptcies. Shortly after the Hanbo failure it became apparent that the several close aides to Kim, as well as his own son, had used their influence to arrange for loans to Hanbo that had financed its prior expansion.[25] While this effectively turned the public against Kim, the fact remains that he was the first President who had allowed a large *chaebol* to fail,[26] and was at least attempting to de-link the capital market from political influence.

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[24] Note that these bankruptcies do not include the "workouts" experienced by a number of groups after the exchange rate devaluation of November 17, 1997.

[25] See Shim Jae Hoon, "Hero to Zero," *Far Eastern Economic Review*, March 13, 1997, pp. 16-17.

[26] The only earlier bankruptcy of a top 30 *chaebol* was Kukje, which was completely broken up in 1985 (Nam and Kim, 1994, p. 463). It was alleged, how that this breakup was politically motivated, and occurred because the chairman of the Kukje group did not make sufficient contributions to two government organizations (see Mark Clifford, "Filing for Divorce," *Far Eastern Economic Review*, April 21, 1988, pp. 58-59).

Sammi was the next group to go bankrupt, on March 19, 1997, also due to excessive investment in steel capacity. The next day, the Minster of Finance and Economy Kang Kyong Shik vowed that "the government is no longer able or willing to rescue poorly managed, bankrupt companies with taxpayer's money."[27] This continued the "hands off" policy that had been established with Hanbo. These good intentions were sorely tested, however, by the continuing chain of bankruptcies. On April 21, 1997, the Jinro group defaulted on a large amount of loans to secondary financial institutions, and was technically bankrupt.[28] It was saved by an agreement three days earlier between 35 commercial and state banks, now encouraged by the government, to extend emergency help to financially troubled firms who could recover; the creditors of Jinro subsequently extended it sufficient loans to continue operation. Unable to ignore the difficulties that these bankruptcies created for their creditors, on April 23 the Ministry of Finance and Economy announced a complementary plan to create a 1.5 trillion won ($1.8 billion) fund to take over some of the nonperforming loans in the commercial banks.

Following this, on July 15, 1997, Kia declared bankruptcy, and was placed under the protection of the same government-encouraged alliance of alliance of banks.[29] Despite this passive involvement of the government, Finance Minister Kang Kyong Shik repeatedly said that Kia's problems should be worked out between it and its creditors. Sales in the domestic Korean domestic car market had fallen by 36% in the first quarter of 1997 as compared to 1996, contributing to Kia's bankruptcy, but it was overcapacity in the steel industry that led to the largest losses by Kia Steel. Kia was in fact an attractive asset for the other two, larger

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[27] Quotation from Shim Jae Hoon and Charles S. Lee, "Two Down," *Far Eastern Economic Review,* April 3, 1997, p. 45.

[28] The following material is drawn from Charles S. Lee, "Stopgap Solution," *Far Eastern Economic Review,* May 8, 1997, p. 50.

[29] The following material is also drawn from: Charles S. Lee and John McBeth, "Road Kill," *Far Eastern Economic Review,* July 31, 1997, pp. 57-58; Charles S. Lee, "Goliath vs. Goliath," *Far Eastern Economic Review,* August 21, 1997, p. 82; Charles S. Lee, "Out of Patience," *Far Eastern Economic Review,* November 6, 1997, p. 65.

automobile groups, Hyundai and Daewoo, and in addition, the Samsung group had previously attempted to take it over to expand its own presence in autos. All three groups expressed an interest in acquiring Kia's two automobile units – Kia Motors and Asia Motors. Rumors of such acquisitions made the negotiations between creditor banks and Kia protracted and contentious, and these were further aggravated by a strike of workers there. Finally, on October 22, some three months after its bankruptcy, the government was forced to intervene and announced it would take over Kia Motors. While some observers viewed this as a bailout, the market reaction was positive: the Korean stock index rose by a record 6.08% that day, though quickly reversed due to the financial crisis in Asia, and Kia Motors was sold to Hyundai later in the year.

We have described these cases in some detail because, in our view, they challenge the idea that the crisis in Korea was due to "crony capitalism" between the government and business groups. It is hard to see what the government could have done differently in its dealings with the bankrupt groups during the first three quarters of 1997 so as to improve the situation. Rather than regarding these events as a *failure* of the capital market, we could instead view them as an initially *successful* attempt to separate corporate and political control, by allowing bankrupt groups to work with creditors with the government coming in as a last resort. Even in the United State, comparable situations could be expected to lead to similar results, as in the bailout of Chrysler Corporation in 1980; or the savings and loans institutions in the U.S. in the late 1980s; or of Long Term Capital Management in 1998; or of the public utility companies in California in 2001. The cost of these bailouts to U.S. taxpayers is on the same scale as the public funds provided to corporation and banks in Korea during the first three quarters of 1997, and there is no basis to view the Korean policies as fundamentally different from what would have occurred in the West.

5.1 The Role of Debt

To support our argument that the capital market was working reasonably well during the first three quarters of 1997, we shall look empirically at the relation between the debt-equity ratios of the groups and their bankruptcies. It is well known that Korean firms in general, and the *chaebol* in particular, have exceptionally high levels of indebtedness. The debt-equity ratio for the manufacturing sectors of Korea in 1997 was 396%, while for Taiwan it was only 95%, with Japan (193%) and the U.S. (154%) lying in-between these two extremes.[30] Debt-equity ratios in the range of 400 are nothing new in Korea, and the top 30 *chaebol* have been at that level for the entire decade of the 1990s, while rising from 387 at the end of 1996 to 519 at the end of 1997, after the crisis had hit.[31] Moreover, the debt-equity ratios of the largest groups that would go bankrupt – Hanbo, Sammi, Jinro and Kia – were considerably higher than the top 30 *chaebol* on average.

The high debt of these groups can be explained in part by the pattern of "affiliate payment guarantees" (APG), whereby major firms (*churyok kiop*) in a business group guarantee the bank loans made by their subsidiaries (*chahoesa*) in the group.[32] Because only large-sized firms enjoy accessibility to bank loans, the major firms in a business group play the role of financial provider for all other affiliates through APG (Yoo 1995, pp. 180-186). By providing the banks with APG for the loans their subsidiaries make, major firms serve as the financial conduits from banks to their subsidiaries. Major firms are held accountable for bank loans of their subsidiaries made this way, so that affiliate firms' liability constitute *de facto* major firms'

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[30] *Current Economic Situation*, Executive Yuan, Council for Economic Planning and Development, Taipei, Taiwan, July 1998; Japan value refers to 1996, and all others to 1997.

[31] These debt-equity ratios exclude the financial firms within the groups, and are obtained from the Korean Fair Trade Commission, quoted in *Business Time (Singapore)*, Online, April 16, 1998.

[32] Major firms stand out among affiliates in terms of assets and sales, represent main lines of business, and are financially most capable in a business group. For example, Samsung group owns its major firms in life insurance,

debt. While APG allows *chaebols* to enjoy easy access to bank loans and flexibility in financial allocation among their affiliates, it tends to increase financial vulnerability of business groups because of the liability linkage among firms.

Hanbo, Sammi, Jinro, and Kia all had higher levels of affiliate payment guarantees relative to equity than other top 30 groups in 1997. Although most of the *major* firms in these groups performed quite well and made positive net profits, bankruptcy could not be avoided due to the losses and large amounts of debts that their subsidiaries incurred (Chang and Wang, 1998, p. 130). This illustrates how the web of financial arrangement within the *chaebol* make it difficult to separate the profitable from unprofitable firms, and deal only with the latter: "affiliates are closely interlinked by cross payment guarantees, making freer withdrawals almost impossible."[33] Correcting this by insisting on consolidated financial reports by the *chaebol*, and a reduction in affiliate payment guarantees, are two of the reforms being pursued, as we shall discuss later. It is noteworthy, however, that the level of affiliate payment guarantees within the *chaebol* were already decreasing prior to the crisis (Yoo, 1999, p. 197).

In Table 8 we report the debt-equity ratios for the business groups that were among the top 30 in 1996 or 1997. Groups that went bankrupt before November 17, 1997 are shown in bold, and groups that went bankrupt after that date are shown in bold and italics (Kukdong is in the latter group, but is omitted from Table 8 due to missing data). In total, there are 15 groups among the top 30 that went bankrupt before or after the exchange rate crisis: only one of these (Daewoo) is among the top 5; another 14 (including Kukdong) are in the second-tier of *chaebol* ranked between 6th and 30th; while a further 10 groups (shown in Table 7) are in the third-tier

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electronics, semiconductor, and heavy industry, and Hyundai group has its counterparts in automobile, construction, and heavy industry.

[33] Quotation from a spokesman from the Ministry of Finance and Economy, in the *Korean Herald,* July 19, 1997, "Kia Crisis to Change Government Chaebol Policies".

ranked between 31st and 60th in terms of assets. Thus, *one-fifth* of the largest five *chaebol* has gone bankrupt, while over *one-half* of the second-tier of groups and *one-third* of the third-tier have experienced the same. Based one these preliminary comparisons, it is apparent that the second-tier of *chaebol* experienced the greatest difficulty during the financial crisis. This is consistent with the observations of Kwon and Nam (1999) that it was exactly this group that had the highest level of nonperforming loans throughout the 1990s.

The finding that the second-tier of *chaebol* had the greatest difficulty is also consistent with our theoretical model of sections 2-3. We found there that the "high concentration" equilibria that describe Korea include both large, vertically-integrated groups (V-groups), and smaller groups focused on upstream production (U-groups), both of which are stable. In between these is a range of mid-size vertically integrated groups that are *unstable*, meaning that with any shock to the system these groups would disappear, either downsizing into the smaller groups or being absorbed into the larger groups. Both of these events happened in Korea, as Kia was absorbed upwards into the larger Hyundai, and many others groups were downsized. The Asian crisis was certainly a shock to the economic system, and at a stylized level, our model gives a fair description of the bankruptcies that are predicted to occur in the second-tier of *chaebol*.

To examine the link between debt-equity ratios and bankruptcy more systematically, we performed logit regressions of bankruptcy – distinguishing those which occurred before and after November 17, 1997 – on the debt-equity ratios. The sample for these regressions is the top 30 groups shown in Table 8, along with a few other smaller *chaebol* for which we had complete information, with results shown in Table 9. In the first regression, we include those groups that went bankrupt *prior* to the exchange rate crisis, as well as those groups that did not fail. We find that the debt-equity ratio in 1996 is a highly significant variable ($p=0.03$) in explaining the

pattern of bankruptcies. The probability of bankruptcy based on regression 1 is shown in the final column of Table 8. Of the 27 groups that did not go bankrupt during this period, all but one – Doosan – are correctly predicted to survive, and of the eight groups that did go bankrupt, all but two – Kia and Haitai – are correctly predicted to fail. The cases not well explained by the regression are themselves of interest: Doosan did not fail despite its high debt, but this only because of a very aggressive restructuring effort undertaken by its head Park Yong Maan;[34] and while Haitai had relatively low debt in 1996, it was much higher in 1997 (see Table 8), so that using this value it would indeed be predicted to fail using regression 1. Kia's bankruptcy is another case that is not accurately predicted by the regression equation, and while it clearly had excess capacity in autos and steel, we will make some further observations on why it went bankrupt below.

We see that a relatively simple consideration of debt-equity ratios goes a long way towards explaining the pattern of bankruptcies during the first three quarter of 1997. This indicates to us that the capital market was functioning as it should: penalizing those groups that had debt in excess of their ability to repay. This is not to say that the capital market could not have functioned better. Most of the groups that went bankrupt had some profitable and some unprofitable firms, and it may have been preferable to penalize the latter firms only rather than the entire group. The interlinked financial structure of the *chaebol* makes it difficult to achieve this, however. Our conclusion at this stage is that prior to the exchange rate crisis, the capital market was acting in a rational manner by allowing the most heavily indebted groups to go bankrupt, which was unprecedented for Korea, and quite the opposite of what we would expect from "crony capitalism"!

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[34] See Charles S. Lee and Dan Biers, "Remaking Korea Inc.," *Far Eastern Economic Review,* April 30, 1998, pp. 10-13.

What about after the exchange rate crisis? In the second set of regressions in Table 9, we include those top 30 groups that went bankrupt after November 17, 1997, together with those that never failed. In regression 2(a), we again use the debt-equity ratio in 1996 as the explanatory variable, and find that it performs very poorly: the estimated equation does not predict bankruptcy for *any* of the groups, despite the fact that eight groups in the sample went bankrupt during this period. The same in true in regression 2(b), where we instead use the debt-equity ratio in 1997 as the explanatory variable, and find the equation has no predictive power at all. Given that the total amount of debt does not explain bankruptcies after November 17, we considered instead the *term structure* of debt.

Our data source (*New Industry Management Academy, 1999*) listed the amount of short-term and long-term loans by each group, and we used the ratio of these as another explanatory variable. When this variable is added for all available groups, it is insignificant in the regression. This is because there are two groups that did not go bankrupt despite having unusually high values of short-term debt: Doosan has short-term debt that is *five times* its long-term, while Lotte has short-term debt that is nearly *ten times* higher, as reported in Table 8. If we exclude these two groups, as in regression 2(c), then the ratio of short-term to long-term debt is highly significant ($p=0.06$). While the estimated equation still has difficulty in predicted bankruptcies with probability > 0.5, if we consider instead the weaker criterion of probability > 0.4, then we successfully predict four out of the seven bankruptcies: Ssangyong, Dong Ah, Halla and Keopyung. Most of these groups have short-term loans that are more than three times the level of long-term loans.

While thee regression including the ratio of short-term to long-term debt is clearly sensitive to its specification, the fact that this variable becomes a predictor of bankruptcy makes

sense in the context of the financial crisis, but *should not* be considered an indication of a well-functioning capital market. On the contrary, among these four groups, only Halla has a level of debt relative to equity in 1997 that would justify bankruptcy according to using first regression we have estimated. Thus, the bankruptcies occurring *after* the exchange rate crisis are not predicted on the basis of "fundamentals" (i.e. the debt-equity ratio), and are therefore attributed to some other cause. Our argument here is similar to that made by Woo, Carleton and Rosario (2000) who used logit regressions to investigate the *countries* that experienced currency crises in 1997 and earlier. They find that the 1997 experience *does not* fit the equation estimated from earlier crises, suggesting that the events of 1997 were a financial panic. Our own estimates from the *chaebol* bankruptcies likewise suggest that there was a panic in the financial markets after November 17, such that groups were penalized based on their short-term rather than total debt.

These observations raise two critical questions: (1) why factors led to the high debt-ratios and bankruptcies of the *chaebol* during the first half of 1997; (2) how precisely did these bankruptcies contribute to the exchange rate devaluation and subsequent panic in the financial markets? These questions will be addressed in the next two sections.

5.2 The Role of Export Demand

Let us return to the large fall in Korean export demand and prices during 1996-97, as illustrated especially by semiconductors. It is surprising that the four *chaebol* most heavily invested in the electronics industry – Hyundai, Samsung, LG and Daewoo – did not appear to suffer too much at the time from this sharp decline in prices. The subsequent bankruptcy of Daewoo it attributed more to excess capacity in automobiles, and fraudulent financial practices by its management, rather than losses in its electronics firms; so too, the bankruptcy of Samsung Motors in 1999 was not due to losses in electronics. A glance at Table 7 confirms that while

some of the bankrupt *chaebol* were in export sectors like autos and steel, many other were in construction, retailing, distribution and various other sectors focused on the *domestic* market. The question then arises as to whether the fall in export demand and prices really contributed to the bankruptcies that occurred?

A clue towards answering this question comes from a company review of Samsung conducted at the end of 1996 – after the fall in semiconductor prices, but before the Asia crisis:[35]

> When semiconductor earning began sagging, Samsung managers say they redoubled their efforts towards making and marketing such consumer items as TVs, refrigerators and cellular phones. Sale of non-semiconductor products jumped 31% to $15 billion, more than enough to make up for the 17% decline in semiconductor sales to $8 billion. "We have succeeded in changing our product portfolio," says Noh Geun Sik, executive vice-president in charge of Samsung Electronics' global operations. "In the past, we were too dependent on one product. But when things are going well in semiconductors, we made bold investment in other areas. Now, that's helping us to cover the slump in semiconductors."

In fact, Samsung had 1996 sales exceeding those in 1995, despite the fall in semiconductor prices. The explanation given by its managers is the diversification of this group across product categories. We find it plausible that the largest groups can achieve this diversification, effectively insulating them from large falls in export prices. But the same would not be true for smaller groups, whether they are focused in the export or domestic market. Thus, the *chaebol* that obtain a majority of revenues from autos, steel, construction, or retailing, would be hit particularly hard by the general slowdown caused by a fall in exports, and this is exactly what happened to second-tier groups such as Hanbo, Sammi, Kia, Haitai, and others.

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[35] Quotation from Charles S. Lee, "The Chips are Down," *Far Eastern Economic Review*, December 26, 1996 and January 2, 1997, p. 90.

It may appear paradoxical that a fall in exports could impact smaller groups oriented towards the domestic market even more than the large, export-oriented groups. But this observation is consistent with our theoretical model of sections 2-3. There we found that the "high concentration" equilibria characterized by Korea would have *less variety of export products* than a like-sized economy that was in a "low-concentration" equilibria, such as Taiwan. This theoretical result was confirmed empirically, and implies that the Korean economy overall would be harder hit by the fall in exports. But it is still the case that the *largest* business groups in Korea would have greater diversity across product varieties than smaller groups found in either country. Thus, the "high concentration" economy like Korea will be focused on a narrower range of product varieties, and therefore be more adversely affected by price declines than Taiwan, even though the *largest groups* are better insulated from price shocks than are smaller groups. These observations help us understand why the top five *chaebol* were not unduly affected by the fall in semiconductor prices, even though the smaller groups in Korea were. It also helps to explain why the Korean economy overall was much more impacted by the crisis than was Taiwan.

Our model of sections 2-3 can in fact be used to demonstrate these ideas. Let us consider a fall in overall demand, as was experienced for Korean exports. Total demand in our general equilibrium model is measured by income, and with wages normalized at unity, income equals the size of the labor force L (which is the only factor of production). Thus, to explore the consequences of a fall in demand, we simply lower L from its initial value of L=1000 in our model. To simplify the exercise, let us focus only on the V-group configuration, as was graphed in Figure 4 for a wide range of the elasticity of substitution, S. We are most interested in those

elasticities that lead to *multiple equilibria*, which occur between S=2.8 and S=3.2 in Figure 4. For concreteness, let us choose a particular value of the elasticity, say S=3.

At the elasticity of 3, there are two stable V-group equilibria: a low-concentration equilibria that allows for a large number of business groups, and a high concentration equilibria that only allows for a smaller number of groups. While we have argued that the Korean *chaebol* typically display the characteristics of a *high concentration* equilibria, we now want to discuss the dynamics of how this organizational structure can come about. To this end, suppose that through past entry some Korean industry finds itself with a larger number of business groups, in the *low concentration* equilibria. In Figure 10, this would occur at point A with the initial income of L=1000. What happens now as the total demand, measured by L, decreases?

As demand fall in Figure 10, the equilibrium number of groups will also fall, to the left of point A. Under the conditions of free entry and exit in our model, a smaller market will imply a smaller number of business groups. This process is "continuous", so that a *small* change in demand would lead to a correspondingly *small* change in the structure of the business groups. However, when we reach the point B at about L=700, the nature of the organizational change suddenly changes. For any further fall in demand, the equilibrium will drop *discontinuously* from B to C, and the number of groups is reduced suddenly to restore a zero-profit equilibrium at C. This requires the bankruptcy of many of the groups at B, leading to a drastic change in the organizational structure of the industry.

The process of moving from B to C is called a "catastrophe" in mathematical language (Woodcock and Davis, 1978), and it is well know that this type of discontinuity is a generic feature of many nonlinear systems, including those in economics (Rosser, 1991). It has even been suggested that such catastrophe might apply to monopoly equilibrium (Bonanno, 1987). In

our model, such catastrophic changes in organization are a characteristic feature of the V-group equilibria. This is shown by Figure 11, which expands Figure 10 by graphing the V-group equilibria over a wide range of elasticities S, and values of demand. Whenever demand falls (moving backwards in Figure 11), there are a range of industries (i.e. values of the elasticity S) for which the "low concentration" equilibria will no longer exist, and the industry must therefore be reorganized toward *increasing concentration*. In less formal language, the industry will "fall off the cliff" illustrated in Figure 11. But as demand grows again, the reverse change *does not necessarily happen.* Returning to Figure 10, as demand grows, the equilibria would most plausibly move from C to D, thereby remaining on the "high concentration" path. It would take some significant shock to move the equilibria back to the less-concentrated point A. Without such a deliberate push, the process of a fall in demand and subsequent recovery could plausibly move the equilibrium from a less-concentrated position towards greater concentration.

It seems to us that these theoretical results provide an apt description of the process of bankruptcies in the Korean *chaebol* during the first three quarters of 1997. The groups that went bankrupt often some firms absorbed by other business groups (such as with Kia being absorbed by Hyundai), so that the resulting equilibria became more concentrated. This trend towards increasing concentration was *not* automatically reversed by the economic recovery of 1999. Rather, the bankruptcies and reorganizations that occurred during 1997-98 became an "embedded" feature of the economic organization, so that the Korean economy ended the 20th century with groups that were as large or even larger than before. According to Beck (2000, p. 19) and data from the Korean Fair Trade Commission, nearly all of the top ten *chaebol* increased their assets from 1996 to 1999, and top four's share of total assets among the top 30 rose from 48% to 58% over this period.

Since then, there has been some further reorganization of the groups. The leading example is the Hyundai group, where divisions among the sons of founder Chung Ju-yung has led to a breakup of the group: into Hyundai Motor Co. (split from Hyundai in September 2000); Hyundai Construction (split off in August 2001); Hyundai Heavy Industries (due to split off in December 2001); and a possible split of Hyundai Investment and Hyundai Securities. Prior to these, LG Semiconductor was merged with Hyundai Electronics in May 1999 as part of the governments "Big Deal" policies, and then Hyundai Electronics split off from Hyundai in August 2001 and was renamed Hynix Semiconductor. Despite these various splits, the individual Hyundai groups are still very large, with Hyundai Automobiles listed as the fifth ranked *chaebol* in terms of assets in 2001.

Generally, we support the breaking apart of the groups when it occurs through a change in ownership, as with the older generation passing control to the younger. But the proposed "Big Deal" policies of the Korean government work in the opposite direction to this, and can be seen as an attempt to consolidate the groups within each industrial sector. This opens up the groups to the risks of falling demand and prices. Indeed, Hynix Semiconductor is currently in a new financial crisis due to falling demand for semiconductors, which seems to us to be a replay of the events leading to the 1997-98 crisis. Based on this recent experience, it should be questioned whether the "Big Deal" policies of the Korean government are desirable or not. Before turning to this, however, we still need to address the events that occurred later in 1997. Why did the initial bankruptcies of the *chaebol* lead to a subsequent exchange rate and financial panic? Answering this leads us into the details of reform in the financial sector in Korea, which we describe next.

5.3 The role of the financial sector

The linkages between the *chaebol* and financial institutions were greatly affected by Korea's liberalization of its financial sector during the 1990s. This included the liberalization of interest rates (November 1991),[36] overseas issuance of foreign currency denominated bonds (1991),[37] opening the Korean stock market to foreign investors (January 1992),[38] foreign currency borrowing by domestic firms (beginning 1995),[39] and also the conversion of 26 investment and finance companies into "merchant banks" in 1994 and 1996 (under the Act Concerning the Merger and Conversion of Financial Institutions), bringing the total number of merchant banks to 30.[40] These actions were undertaken to improve the functioning of the capital market, and can be seen more generally as part of the globalization policy (*segyehwa)* undertaken by President Kim Young Sam (Kim, 2000b), which included Korea's entry into the Organization of Economic Cooperation and Development (OECD). While these reforms did not cause the crisis, we believe that they were a contributing factor, especially due to their differential impact on the top five versus the second-tier of *chaebols*.

Before indicating how these reforms affected the debt structure of the *chaebol*, we first summarize the structure of the Korean financial markets, and the role of the commercial banks. As is well known, the Korean government supported the business groups during the 1960s and 1970s through low-interest loans, provided by the Korean Development Bank and the commercial banks. Because of the below-market rates, the banks were forced into the position of *rationing* loans, i.e. demand from the *chaebol* exceeded supply at these interest rates. As described by Nam and Kim (1994), this policy was implemented by having each of the top 50

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[36] See Byrne (1993, Table 2, p. 53).
[37] Dooley and Kim (undated).
[38] Dooley and Kim (undated).
[39] "Foreign Exchange Reform Moves Forward," *Korean Business Review,* 171, April 1995, pp. 25-26.

chaebol assigned to specific commercial bank called the "principal transactions bank," which monitored the loans received by the group; the top 30 *chaebol* each had an upper limit on loans. These regulations were loosened in 1991, so that up to three "major corporations" within the top 30 *chaebol* were no longer subject to credit controls. Loans extended by overseas branches of Korean banks were also exempted from controls. In addition, the non-bank financial institutions (especially the merchant banks) were entirely *outside* this system of regulation, so their loans to the *chaebol* were not monitored.

The structure of the financial system between the commercial banks and business groups is illustrated in Figure 12. At the top of that figure we show the *chaebol,* who are borrowing money to invest in long-term projects. At the bottom of the figure are the commercial banks, who are obtaining funds from domestic deposits and also foreign borrowing. As part of liberalization measures, banks were allowed to open and expand operations of overseas branches, and the foreign currency liabilities of domestic and foreign branches both roughly doubled from 1994 to 1996; the increase in external debt of the financial sector over this period exceeded that of the corporate sector.[41] In between these two are the merchant banks, which act as a financial intermediary and a source of funds for the *chaebol*. In contrast to Japan, where many of the *keiretsu* have a bank at the center of the group, commercial banks in Korea are legally prohibited from being a part of the *chaebol.*[42] The merchant banks play this role instead, and in fact, all but

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[40] Ra and Yan (2000, p. 331, note 5).

[41] Dooley and Shin (undated, Tables 1 and 2). They report an increase in bank's foreign currency liabilities of $22.6 to $50.7 billion for domestic branches, and $31.7 to $52.9 for foreign branches, over 1994-96 (Table A2). Over the same period, total external debt of the financial sector increased from $33.3 to $66.7 billion, with more than half of this short-term, while external debt of the corporate sector increased from $20 to $35.6 billion, with more than half of this short-term (Table A1).

[42] Chan Guk Huh and Sun Bae Kim, "Japan's Keiretsu and Korea's Chaebol," *Federal Reserve Bank of San Francisco Weekly Letter*, number 93-25, July 16, 1993. Nam and Kim (1994, Table A13.3, pp. 464-465) show that 6 of the top 30 *chaebol* in 1991 have a small equity interest in their principal transactions bank, not exceeding 5 percent.

three of the top 30 *chaebol* owned one or more such non-bank financial institutions in 1996 (Lee, *et al*, 1999, Table 8).

The merchant banks were not subject to the regulations on the larger commercial banks, and became the scapegoat for the crisis in Korea, leading to the closure of many of them in 1998. Two activities of the merchant banks were particularly risky. First, they actively borrowed short-term on foreign markets and funneled these loans to the *chaebol*. These loans were in foreign currency (dollars or yen), but were not hedged for devaluation risk, since this had not entered anyone's mind at the time. Actually, the commercial banks were also actively borrowing in foreign currency, and in amounts *exceeding* that of the merchant banks: the foreign currency borrowings of the commercial banks peaked at 15.2 trillion won ($19 billion) in 1996, whereas the *combined* foreign plus domestic borrowing of the merchant banks were 11.6 trillion won ($14.5 billion) in the same year.[43] Nevertheless, the foreign currency borrowing of the merchant banks was much higher relative to their size: only 7% of the total liabilities of commercial banks consisted of foreign currency borrowings in 1996, whereas for the merchant banks fully 45% of the liabilities were to foreigners, and only 18% of the assets were held abroad.[44] Thus, the exposure of the merchant banks to exchange rate risk was extremely high.

A second risky activity of the merchant banks, that illustrates their close links to the *chaebol,* was issuing and dealing in "commercial paper." Commercial paper is a short-term (typically 90 day) unsecured promissory note issued by a company, i.e. a promise to pay back the money within three months, with nothing standing behind this promise except the good name of the company. This type of financing is used by only the most credit-worthy firms in industrial

[43] The Bank of Korea, *Monthly Statistical Bulletin,* November 1999, "Accounts of Commercial Banks," p. 31 and "Accounts of Merchant Banking Corporations," p. 45.
[44] Ra and Yan (2000), p. 336.

countries, and only to raise a small amount of total debt: 0.1% in Germany, 1.2% in the U.S., and 0.9% in Japan.[45] In contrast, Korean manufacturing firms raised 17.5% of their funds from the commercial paper market in 1996, an amount that expanded more than seven times between 1991 and 1997.[46] For both the buyer and the seller, commercial paper is inherently risky: there is a risk for the buyer because the issuing company might not be able to repay (default risk), but in that case the seller would immediately lose the ability to refinance the debt (rollover risk). The merchant banks actively distributed the commercial paper of the *chaebol,* as well as issuing their own. And who bought this risky product? None other than the commercial banks! To understand how this unlikely situation arose, we return to the financial reform of the 1990s.

As described by Ra and Yan (2000), in 1991 the interest rates for long-term deposits (trust accounts) at the commercial banks was liberalized, leading to an inflow of long-term funds. At the same time, the interest rates on loans from the commercial banks were *not* raised, so the banks had to seek uses for their deposits that promised higher returns, and commercial paper was the answer. The commercial banks became the biggest buyers of such paper, holding about 60% of total issues, compared to 20% for pension funds and insurance companies.[47] Notice that this created a mismatch in the maturity structure of the banks, with their liabilities (i.e. deposits) increasingly long-term, and their assets (including commercial paper) increasing short-term. Provided that the return on short-term commercial paper remained above the interest rates on long-term deposits, as was the case, this was profitable for the commercial banks.

But for the merchant banks, the situation was reversed. They were selling commercial paper, and also actively borrowing in the foreign market, both of which were short-term liabilities. On the asset side, they were making long-term loans to the *chaebol* to finance

[45] Ra and Yan (2000), p. 339.
[46] Ra and Yan (2000), pp. 331 and 339.

investment projects.[48] This is the worst situation for any financial institution to be in: with long-term assets and short-term liabilities, any increase in the short-term interest rates will quickly lead to insolvency. In terms of Figure 12, the reader might visualize the right-hand side of the figure being pushed up by the increased inflow of foreign funds, and loans from the commercial banks, while the left-hand side of the figure is being pulled down by the outstanding issues of commercial paper; as this visual analogy is meant to suggest, the situation was precarious indeed!

Putting a strain on the whole system were the bankruptcies of *chaebol* during the first three quarters of 1997. As we have already argued, these bankruptcies were fully justified and showed that the capital markets were doing their job. But in *combination with* the precarious financing between the *chaebol* and banks, the system barely able to withstand these shocks. Ra and Yan (2000) describe the unraveling that occurred for one group, Kia:

> …the excessive reliance on highly risky commercial paper led the whole financial system and corporate sector to be extremely vulnerable to adverse external shocks. For example, after hearing the financial rumors about the Kia Group, Korean merchant banks recalled commercial paper worth 4.2 trillion won [$5.25 billion] in a single day in mid-July 1997 from Kia, which had used it as one of its main corporate financing sources. The recollection of loans pushed it into insolvency immediately. This punitive action further squeezed the credit pool of merchant banks that concentrated about 80 percent of their business on commercial paper. (p. 329)
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> With Kia Group defaulting, Korean commercial banks, the largest buyer of commercial paper, refused to purchase and discount the paper dealt and issued by them. (p. 328)

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[47] Ra and Yan (2000), pp. 333-334.

[48] In 1996, about 60% of loans from the merchant banks were made in the form of relatively illiquid assets: lease, foreign securities, and factoring (Ra and Yan, 2000, p. 336).

This shows how the combination of default risk and rollover risk can quickly lead to a panic by creditor banks, and bankruptcy of a group, even if its long-term debt and financial prospects might not warrant this. Furthermore, these risks were greatest for the smaller, or second-tier *chaebol*. The reason is that the top five *chaebol* had *direct access* to foreign loans, due to their size and high credit rating, but this was not the case for the smaller *chaebol*. This is demonstrated by Lee *et al* (1999), who use firm-level financial data for a large sample of Korean firms over 1981-197 to investigate how the debt-structure has changed over time. They show that the top 30 *chaebol* firms have consistently had higher debt-equity ratios than non-*chaebol* firms. Within the top 30, however, there are important distinctions between the top five and the second-tier, ranked 6-30th. The top five firms have had relative stable debt-equity ratios since 1991, but within total debt, there has been an *increasing* proportion of long-term and or foreign debt. In contrast, for the second-tier *chaebol* firms, the proportion of long-term debt has *fallen* since 1989, and the proportion of foreign debt has also *fallen* since 1992, since they have not had access to this market.

The story from these empirical results is that the top five *chaebol* gained increasing access to international markets for debt, so that the second-tier *chaebol* (ranked 6-30th) were then diverted to the domestic market for commercial paper. This increased the risks for these smaller *chaebol* because, in the event of financial difficulty, they could abruptly find themselves without access to continuing credit. Furthermore, it increased the vulnerability of the merchant banks affiliated with the *chaebol*, because in the event of bankruptcy, the banks could find themselves with bad loans in excess of their own net worth: the loans on which Kia defaulted are purported

to account for 184% of the aggregate capitalization of the eight merchant banks in Seoul, and 75% of sixteen regional banks.[49]

According to Ra and Yan (2000), the event that toppled the whole system was Moody's downgrading of its credit rating for the Korea Development Bank on July 30, 1997, so that Korean banks and corporations found it increasingly difficult to borrow abroad:

> As a result, commercial banks, merchant banks, and corporations returned to the domestic financial and foreign exchange markets to raise funds. The commercial banks recalled foreign currency loans from the merchant banks. This forced the merchant banks to bid by "all-out" efforts for any available foreign currency … It accelerated the depreciation of the won and the won-dollar exchange fell to an unprecedented low… The turmoil among merchant banks was one of the key reasons behind the sharp fall of the won against the dollar. (pp. 327-328).

Notice that this account of events challenges the idea that the floating of the won was brought about by the actions of international speculators; instead, it may well have been domestic agents scrambling for foreign currency that drained the reserves of the central bank, and precipitated the exchange rate crisis.[50] Regardless, we would classify the recall of loans by the commercial banks and subsequent actions as elements of a banking crisis and financial panic, and in our view, this was the proximate cause of the bankruptcies that occurred *after* November 17, 1997. Rather than looking at long-term profitability and debt structure of groups, the financial markets focused solely on short-term accounts, leading to bankruptcy for those second-

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[49] Ra and Yan, (2000), pp. 327-328.

[50] Support for this idea comes from U.S. Treasury Secretary Robert Rubin, who observed in a 1998 speech about the Asian crisis: "When these crises began, foreign investors started to withdraw capital, local companies sought to hedge hard currency exposures, exporters stopped bringing their export earning home, and citizens moved their saving abroad. I think it has now become accepted that most of the pressure on these currencies comes from local sources and not foreign investors." (Address on the Asian Financial Situation to George Washington University, Washington, D.C., January 21, 1998; cited by Kim, 1998, p. 34).

tier groups that found themselves with excessive short-term debts. Unlike the bankruptcies that occurred before November, these were not based on "fundamentals." The costs of this financial panic and subsequent bankruptcies were very large for the workers involved, not to mention the creditors and taxpayers who have ultimately paid for the bailouts.

6. Reforms in Korea

6.1 Internal Trades within the Chaebol

At the heart of the criticisms of the *chaebol* after the crisis is the way that their financial and production structures lead to tight linkages between affiliate firms, and the reforms since the crisis seek to "undo" these. In general, internal trade within *chaebol* groups can be divided into two categories: financial and non-financial. Financial transactions include: (i) borrowing from banks through affiliate payment guarantees; (ii) trade of equities and commercial papers; and (iii) direct internal loans. Non-financial internal trades includes the trade of commodities, and provision of facilities and staffs. Whether financial or non-financial, internal trades are intended to transfer resources from affiliate firms of greater financial ability to weaker ones, so that the weaker can secure sufficient operational capital.

We have already discussed above the first type of international financial transactions, affiliate payment guarantees (APG), which were widely blamed for the corporate sector's high leverage and bankruptcies. Reducing these loans has been a focus of major government policies, and was also a criterion of the IMF loans. The Korean government prohibited APG for new borrowings starting April 1998, and urged *chaebols* to reduce existing APG liabilities (Sohn and Yang, 1998, p. 143). According to press releases by the Ministry of Finance and Economy, existing APG liabilities of the top thirty *chaebols* should be reduced to a level not exceeding 100 percent of equity by March 1998 and eliminated entirely by the end of 1999! An penalty was

scheduled to be imposed from April 1998 with respect to the outstanding amount of APG liabilities exceeding 100 percent of equity, and from January 2000 with respect to the any outstanding amount at all (Sohn and Yang, 1998, p. 144).

The second pattern of financial transactions among affiliates is through the issue of equities and commercial paper. According to *Proceedings of Commission Decisions* (PCD) issued by Fair Trade Commission (FTC), all of the top five *chaebols* tried to trade equities and commercial paper internally in order to transfer financial resources among their member firms. The primary purpose was to support less performing affiliates by buying their equity and commercial paper at preferential rates. To give just one example, during the period April 1997-September 1998, Samsung Life Insurance, which is one of the most profitable affiliates in the group, bought 272 billion won ($225 million) worth of commercial papers issued by Hansol Paper and Hansol Electronics, at preferential rates.[51] These two companies were severely hit by the financial crisis and on the verge of bankruptcy. Net financial transfers from Samsung Life Insurance to the two failing firms were 5.1 billion won ($4.3 million) (Korea Fair Trade Commission, PCD No. 99-28). Similar examples have been identified by the Korean Fair Trade Commission for Daewoo, Hyundai, SK, and the LG groups.

Since the crisis, the Fair Trade Commission in Korea has actively levied fines against all of the top five *chaebol,* and also groups within the second tier, for subsidization of unprofitable affiliates through these methods.[52] When these activities interfere with the ability of creditors to accurately assess the financial health of *chaebol* firms, then such fines are appropriate and should

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[51] Hansol Paper and Hansol Electronics are actually in the Hansol group, which was founded in November 1991 when Chonju Paper, than an affiliate of the Samsung group, separated from that group. In 1992, the company changed its name to Hansol paper. Despite that fact that Hansol is a separate group from Samsung, there remain family ties between the two groups.

[52] See "FTC brings charges," *Korea Herald*, July 30, 1998, and "Fines for the mid-size,' *Korea Herald*, February 26, 1999.

be levied. The government has also insisted on consolidated financial reports, which for the first time reveal the true (and higher) levels of debt with the business groups (Beck, 2000, Table A2). Consolidated financial reports are the norm in industrial countries such as the U.S. when firms have overlapping ownership, and are overdue in Korea. But beyond achieving transparency in the extent of these internal financial transactions, and reducing them to more prudent levels, it is surely unrealistic to expect that these transactions could be eliminated entirely. As argued by Rajan and Zingales (1998), there are distinctive differences in banking and business relationships between the West and those in many emerging markets, including Korea and Taiwan. Systems of "relationship lending" versus arm's-length contracts work best in economies where there is low "contractibility," and also capital is scarce relative to the opportunities for profitable investment. This seems like a reasonable description of East Asia in the past, if not the future. It would be premature to abandon one system and expect another –the "Western form of free market capitalism," to use Greenspan's (1998) phrase – to simply spring up in its place.

Furthermore, we would argue that the specific structure of the *chaebol* demands a role for the internal transfer of funds. While financial transfers should be expected between divisions of a corporation, and likewise between firms within a business group, the need for such transfers is attenuated by the strong *vertical integration* observed in the Korean *chaebol*. As described in our model of sections 2-3, this integration occurs precisely so that upstream firms can sell products to downstream firms in the same group at the lowest possible cost, i.e. marginal cost, without attempting to recover fixed costs of product development. Sales at such low prices would not occur through market transactions, and the strength of a business group is that it enables these transactions to occur. This means that a financial transfer *back* to the upstream firms is essential within the group. So the internal purchases of equity and commercial paper, as

well as intra-group loans, should be viewed as more that just a smoke-screen to hide unprofitable activities: they are an essential means to transfer funds and rationalize the marginal-cost pricing within the group. These financial transfers go hand-in-hand with the vertically integrated production structure of the groups, and we should not expect to resolve the one problem without addressing the other.

6.2 The "Big Deal"

The second broad set of policies towards the *chaebol* is indeed aimed at their overall production structure. Known as the "Big Deal," these seek to *reduce* the "excessive" horizontal diversification of the business groups, and have each group focus on a more limited set of activities. Thus, the government will determine that one group should be responsible for semiconductors; another for aircraft manufacturing; another one or two in petrochemicals, and so forth (see Table 10). These outcomes will be implemented by the merger of specific units across business groups, with one group or a professional manager named at the controlling body. To date, however, only a few deals have gone through: the biggest was the sale of LG Semiconductor to Hyundai Electronics in May 1999 (*Korea Herald*, April 24, 1999), which was renamed Hynix Semiconductor in March 2001, and then split off from the Hyundai group in August, 2001. Setting aside the issue of whether other mergers can actually be achieved, are they desirable?

There is a grain of truth in the idea that the *chaebol* are too diversified. The "one-setism" that characterizes the largest groups means that they all must have their own steel mills, and construction units, and automobile plants, etc. This is indeed a waste of resources. Before the exchange rate crisis in Korea, the bankruptcies that occurred among the *chaebol* were often related to excessive investment in steel, construction, or real estate. So diversification into such

areas is indeed risky, and the groups involved had to bear the consequences of such risk. But diversification also brings *benefits,* so that lower sales in some product areas can be offset with higher sales and profits elsewhere. We have already argued that this diversification worked to the benefit of the largest *chaebol,* including those involved in semiconductor manufacturing: Samsung, Hyundai, and LG continued to be profitable in 1996-97 despite the steep drop in prices and sales. In contrast, Hynix Semiconductor is currently in a new financial crisis due to falling demand for semiconductors. To avoid bankruptcy, the president of Hynix, Park Chong-sup, has been forced to *specialize* the group on semiconductors even further by selling off other units.[53] Some of these divestitures, such as its basketball team and water treatment plant, seem appropriate and well outside its normal range of activities. Nevertheless, by specializing further in semiconductors, the group is open to the risk of cyclical prices in this sector without the ability to move into alternative products. This is the greatest downside to the "Big Deal" proposals: that they will create monopolies in each sector, losing the benefits of competition, and focusing the resulting groups on a narrower range of products. Thus, the benefits of diversification would be lost without bringing any real gains.

Nevertheless, some restructuring of the groups would be desirable. Our recommendation is to pursue policies that lead to less *vertical* integration of the groups, rather than less horizontal diversification. That is, rather than cutting up the groups horizontally, and artificially assigning each sector to some ownership, the *chaebol* should instead be cut up vertically, so that they are encouraged to buy and sell more goods from unrelated firms. While this may not be easy to achieve, we believe it would be in the long-term interests of the economy. The Korea Fair Trade Commission already levies fines on *chaebol* when they are found to favor internal suppliers, and these type of anti-trust actions should be pursued more aggressively. A more forceful

[53] Chris Wright, "As Business Models Go, It Could Have Been Better," *South China Morning Post,* 7/20/01, p. 3.

application of inheritance taxes, so as to prevent the *chaebol* from being passed down intact, is also needed (Beck, 2000, p. 20). There may now be some movement towards breaking up the *chaebol* as the founders pass control onto the next generation, when these sons do not agree. This is illustrated by the breakup of Hyundai group among founder Chung's sons, and has long been a explanation for the less-concentrated Taiwan business groups: because partible inheritance is practiced there, in which the father's estate is divided among sons (and now sometimes daughters), as the second and third generation becomes involved it is impossible to maintain a centrally controlled group (Wong, 1985). To the extent that the primogeniture pattern of inheritance in Korea is modified by demands from younger sons or shareholders, this may contribute to the splitting up of some groups.

Furthermore, we believe that competitive pressures themselves may support the movement towards less vertically-integrated business groups. This can be seen by looking at a recent example from the United States, in the automobile industry. In spring 2000, Ford Motor Company announced that it would "spin off" its massive parts unit, Visteon, in a move intended to benefit its stockholders and also generate more competition upstream competition. With 1999 sales of $19.4 billion and more than 81,000 employees, Visteon certainly rivals in size the largest of the upstream portion of Japanese or Korean groups involved in automobiles. The spin off is intended to encourage Visteon to sell more to units outside of Ford, and indeed, more than 35% of the Visteon's recent new business has been with companies other than Ford (and the largest contract, booked in the first quarter of 2000, was with General Motors).[54]

This separation of Ford into its upstream and downstream operations follow the example of General Motors in 1999, which spun off Delphi Automotive Systems. The move is expected

[54] Mark Yost, "Analysts Up Ford 2000 EPS Views Following Strong 1Q Earns," *Wall Street Journal Interactive Edition*, April 18, 2000.

to benefit Ford in several ways:

> Without the fixed costs of its parts subsidiary, it (Ford) will be less cyclical. Ford will also presumably have more flexibility in the future to source parts from other vendors, which have better pricing, better quality, or better technology.[55]
>
> It's a powerful statement about the strength of Ford Motor Company's new business model. Great products, strong brands, shareholder and customer focused Web-enabled, less asset intensive, less cyclical, and reinvesting capital for profitable growth, not for growth's sake.[56]

What we find interesting about both these quotes is that they take it for granted that shedding the *upstream fixed costs* will make Ford *less cyclical.* This corresponds closely to our argument about the Korean *chaebol:* being strongly vertically-integrated, with the associated internal loans and focus on a narrow range of final products, makes the economy overall more vulnerable to market downturns. In contrast, the less integrated groups in Taiwan are not as sensitive to cyclical movements.

To make more precise this link between the changing structure of Ford, and the business groups in Korea and Taiwan, we think of the "old" Ford as essentially like the V-groups of our theoretical model: pursuing a "one-set" production system from raw materials to finished cars, and reluctant to sells its parts to competitors. In contrast, the "new" Ford is much more like a D-group in our model: actively marketing its products downstream, but using a range of upstream suppliers, including Visteon. This analogy is strengthened when we realize that despite being an independent company, Visteon will be owned by *all the same shareholders as currently own*

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[55] Mark Yost, "Analysts Applaud Ford's Visteon Spinoff, $10B Dividend," *Wall Street Journal Interactive Edition,* April 17, 2000; quotation is from Rod Lache, and auto analyst with Deutsche Banc Alex. Brown.

[56] Mark Yost, "Analysts Applaud Ford's Visteon Spinoff, $10B Dividend," *Wall Street Journal Interactive Edition,* April 17, 2000; quotation is from Gary Lapidus, auto analyst at Goldman Sachs & Co.

Ford, including a controlling interest of some 40% of shares by the Ford family.[57] This is very much like the common ownership of group companies that occurs in Korean or Japanese groups, so the resulting "Ford-Visteon" amalgam is as much like a business group as is permitted under U.S. antitrust law.

The important point is that by spinning off Visteon, Ford is moving away from the old model of vertical-integration, towards a new model of more flexible sourcing of parts and focus on downstream assembly and marketing. Meanwhile, Visteon also benefits by having numerous buyers, and on its production side, has already teamed up with an Internet firm to develop online business-to-business sourcing for its raw materials.[58] At several levels, then, Ford is "disintegrating" *vertically*, and expects to be a more profitable and less cyclical company as a result. This perfectly illustrates our recommendation for the Korean *chaebol:* they should split up vertically rather than horizontally, to result in a situation where many groups are selling in each market, and also purchasing from many upstream suppliers. This is the opposite of the current intentions under the "Big Deal" program, which we fear would lead to the exercise of market power in individual products, and also *across* markets with groups still being unwilling to sell their intermediate inputs to others.

6.3 Reform of the Banks

Immediately after the crisis, many merchant banks were shut down in 1998. As we have already described, they were the "weakest link" in the financial structure (see Figure 12), and lacked both governmental oversight and prudent internal practices. While the intent was presumably to de-link the *chaebol* from these financial institutions, this has not been the result:

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[57] Gregory White, "Ford Plans to Give Stock, Visteon Unit to Shareholders," *Wall Street Journal Interactive Edition*, April 17, 2000.

the top five *chaebol* have actually increased their equity ownership in non-bank financial institutions since the crisis (Beck, 2000, Table 2, p. 26).

The risky activities of the merchant banks were closely tied to the commercial banks, however, which both made loans in foreign currency and purchased a large amount of commercial paper. In the latter activity, the commercial banks acted as a sophisticated *customer* of the merchant banks, which themselves acted on behalf of the *chaebol*. This provides an interesting comparison to an early period of financial development in the United States, during the 1920s, when banks both made loans to corporations and also underwrote the securities issued by those companies and sold to the public. This combined commercial and investment banking activity was thought to lead to conflicts of interest, whereby an unsuspecting public could end up purchasing securities that were issued to protect a bank's loans to that company. While current research (Krozner and Rajan, 1994) casts doubt on the validity of this view, it was sufficiently important at the time to lead to the Glass-Steagall Act of 1933, which completely separated commercial and investment bank activities. This governed the U.S. banking sector until its repeal in 1999.

The contrast with Korea is that the commercial banks were both lending money to the merchant banks (and hence to the *chaebol*), and were the chief purchasers of the commercial paper issued by them. Thus, there was no "unsuspecting public" in this equation, expect insofar as the public was ultimately responsible for bailing out the commercial banks with their non-performing loans. And therein lies the question the issue for reform: why did the commercial banks not adequately assess the risk on the commercial paper that they were purchasing, and the loans they were providing to the *chaebol?* Was it simply that they thought they would be

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[58] Roy R. Reynolds, "Free Markets to Provide Visteon Corp with Bus-to-Bus Svcs," *Wall Street Journal Interactive Edition*, April 17, 2000, Dow Jones Newswires, 201-938-5400.

covered by the government as a lender of last resort, which is the "moral hazard" argument? Or alternatively, were their short-run profits from lending to the merchant banks (via loans and purchasing commercial paper) sufficiently high that they did not consider the underlying risk? Or were they so used to acting as a vehicle for funneling money to the *chaebol,* doing so at the explicit or implicit direction of the government, that they had not developed the internal capacity to assess the return on these loans?

There is probably some truth in each of these hypotheses, but we would like the highlight the final one. We have already rejected the simplest policy-based explanation for the *chaebol,* under which they arose solely due to the low-interest loans given by the government. Rather, we view the *chaebol* as one of a small number of stable organizational forms that are possible in an economy, and the low-interest loans provided by the government may well have contributed to "selecting" this equilibrium over alternative organizational structures. Likewise, the decades of preferential credit to the *chaebol* funneled through the banks can be expected to have long-lasting effects on these institutions. Acting as agents of the government, the banks would not be expected to assess the credit-worthiness of the business groups. Even after the privatization of the banks in the early 1980s, they frequently provided loans to groups at the (legal or illegal) request of government officials. And the remarkable growth of the Korean economy, combined with the insurance provided by affiliate payment guarantees within the *chaebol,* gave the banks little experience in assessing the riskiness of loans. This scenario has clearly come to an end, and various efforts are being undertaken to bring the operations of commercial banks up to international standards (Claessens, et al, 1999; Köllner, 2000; Mann, 2000). What is needed is not so much a separation of the banks from the business groups, as a clear separation of the banks from the political influences that governed loan allocations in the past.

7. Conclusions

The Asian financial crisis of 1997-98 was not the first occasion that a number of Korean business groups had excessive levels of debt: this had also occurred following the interest rate reform of 1965 and the introduction of foreign capital in 1966, after which the government undertook restructuring of insolvent companies in 1969-71; and again in 1986-88, there was a comprehensive restructuring of corporations with excessive debt (Nam and Kim, 1994, pp. 453 and 463). So the fact that some of the same groups found themselves in this position in 1996 should come as no surprise to careful observers of the Korean economy. On the contrary, the surprise was that the government *did not* automatically step in and bailout Hanbo, Jinro, Sammi, Kia and the other groups that went bankrupt in the first quarters of 1997, as it would have done in the past. These bankruptcies came in the midst of a financial sector reform that had permitted greater inflows of foreign capital to the commercial and merchant banks, and more lending of the commercial banks to the *chaebol*, both directly and through the purchase of commercial paper. Both the financial reforms and the initial "hands off" policy of the government towards the bankruptcies were in principle desirable, but their combination proved to be volatile: the non-performing loans in the merchant and commercial banks threatened the viability of these institutions, which caused foreigners to withdraw their loans, which touched off a chain reaction that was both a banking and a exchange rate crisis.

What lessons can we learn from this crisis? Among U.S. scholars, there has been a tendency to blame to IMF for imposing excessive conditions to receive loans, which aggravated the crisis. This may well be true, but diverts attention away from the underlying cause of the crisis. Likewise, the claim that "international speculators" were responsible for the attacks on exchange rates does little to explain the events that *preceded* the currency devaluations. There is

some truth to the argument by Bhagwati (1998) that the inflow of foreign capital to the Asian countries resulted from financial market liberalizations foisted on these countries by the "Wall Street-Treasury complex" (see also Wade and Veneroso, 1998), but this alone cannot explain the financial panic in Korea. Rather, any explanation of the crisis in Korea must begin by explaining the unprecedented bankruptcies that occurred from early 1997, before the exchange rate and banking crisis there.

Our argument in this paper is that the bankruptcies of the *chaebol* in early 1997 were a direct result of their organizational structure. The vertically-integrated structure of the largest *chaebol*, under which they strive to achieve a "one set" production system including the manufacture of their own inputs and marketing of their final products, means that they must sell extremely high quantities of final products to support their upstream affiliates. This leads them to become "world leaders" in exporting selected products, such as steel, automobiles, consumer electronics, and semiconductors. While the largest of the *chaebol* are still diversified across many products, the economy as a whole has less product variety in exports than does a comparably sized economy such as Taiwan. Accordingly, the economy is more susceptible to downturns in world demand, as occurred for apparel, chemicals, steel, electronic products, and especially semiconductors during 1996. The *chaebol* that went bankrupt first were not those that were involved in exporting these products, but rather, the second-tier *chaebol* that relied on domestic demand for construction, steel, retailing, etc. Effectively, the drop in export demand led to a dramatic reorganization of these domestically-oriented groups.

Within the popular press, the bankruptcies were often attributed to "excessive" prior investments by the groups in steel and construction. The model we have presented suggests another explanation, however. We have shown that the organization of business groups is

subject to "multiple equilibria;" that is, there is more than one organizational structure that is consistent with economic conditions of profit maximization and free entry. We have argued that the "high concentration" equilibria provides an description of Korean groups, whereas the "low concentration" equilibria describes Taiwan. But at the same time, there can be range of group structures within each country. An industry in Korea that has a large amount of entry, in anticipation of future sales, may be trying to achieve a "low concentration" equilibria. We have found that a drop in demand can have a "catastrophic effect" on this equilibrium: suddenly shifting the industry back towards a "high concentration" equilibria, with a smaller number of business groups operating. In less formal language, a drop in demand can push the industry "over a cliff" (see Figures 10 and 11), and lead to string of bankruptcies and consolidation within the surviving business groups.

We view the fall in export demand as the proximate cause of the bankruptcies among the *chaebol*, which are consistent with our model. Going beyond the model, we then considered the financial linkages between the *chaebol* and the merchant banks, as described by Ra and Yan (2000). It is now quite well accepted by Korean scholars that the merchant banks were open to considerably risks due to a mismatch in the maturity structure of their assets and liabilities, as well as their exposure to exchange rate risk. The interaction between the bankruptcies of the *chaebol* and this precarious financial structure proved to be too much for the financial system to withstand, and led to the banking crisis and exchange rate devaluation.

In brief, we view the financial crisis in Korea as the failure of a *system* of production and finance, or of economic organization, that has roots that date from well before the specific policy choices of the 1990s. This is what Nicole Woolsey Biggart (1998) calls "deep finance": the search for systemic features that explain the differential impact of the crisis in South Korea as

compared to Taiwan. The fact that the government supported the *chaebol* for decades through low-interest loans, via the commercial banks, does not explain the emergence of the groups, but did indeed lead to a co-dependency between government, banks, and business groups that was extremely difficult to break. Instead of the metaphor of an "Asian flu" sweeping through the region that South Korea happened to catch (because its foreign exchange reserves were too low), we prefer to think instead of a county that was trying to "break a habit" of government-directed credit that had both contributed to, and been reinforced by, the structure of the business groups. The "deep" explanation, then, lies in the economic organization of Korea; not as an example of "crony capitalism," but as a fully rational system of production that is inherently susceptible to shocks which economies organized differently would be able to withstand.

How can the crisis that unfolded in Korea in 1997-98, replaying episodes of corporate insolvency that occurred decades earlier, be avoided in the future? We are in full agreement with the proposals in Sachs and Woo (2000), especially those on financial reform and governance of banks and corporations in developing countries. More specific to the situation in Korea, however, is the inter-relationship between the business groups, banks, and the government. At the present time, the government is taking a rather interventionist role in restructuring the *chaebol* via the "Big Deal" mergers. We believe that these are misguided, and more likely to harm the economy through reducing competition. Instead, reforms should focus on diminishing the *vertical linkages* within the *chaebol,* since the vertical integration enables a much greater exercise of market power than their horizontal diversification. Strengthening the activities of the Fair Trade Commission in monitoring and fining internal trades at low prices that exclude outside firms, as well as encouraging the growth of small and medium-sized enterprises, and a more forceful application of inheritance taxes, are all policies that will facilitate this.

Ultimately, the industrial structure will change only if individuals are willing to leave positions in the *chaebol* and develop their own competing enterprises, as is common in Taiwan. There are signs that this is occurring in the information-technology sector in Korea, where combined sales of the 252 startups in 1999 are equivalent to the 13th largest *chaebol;* many of the largest *chaebol* are experiencing an outflow of skilled personnel to startups (Beck, 2000, p. 23).

In addition, the largest *chaebol* are themselves experiencing internal struggles for control, as illustrated by the breakup of the Hyundai group. It is possible that such divestiture will also occur in other groups. The SK group has already assigned a professional manager to run day-to-day operations after the death of its founder in 1998, and LG intends to separate ownership from management by 2003 (Beck, 2000, p. 21). These are positive developments, in our view, and indicate that the family-governed structure of the *chaebol* need not be absolute. While our argument in this paper has been that this structure has had strong economic forces sustaining it in Korea, other modes of business organization are completely viable, as in Taiwan. In the presence of large shocks, it is possible that an economy can be moved from one type of economic organization to another. If this proves to be an outcome of the Asian financial crisis, then it could turn out to be in the long-term interests of the Korean economy.

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Table 1: Group Sales in South Korea and Taiwan

Sector	Korea, 1983 Group Sales /Sector Sales	Korea, 1989 Group Sales /Sector Sales	Taiwan, 1983 Group Sales /Sector Sales	Taiwan, 1994 Group Sales /Sector Sales
Primary Products:				
Agriculture, Forestry, Fisheries	na	0.3	na	2.9
Mining	10.6	12.8	0.0	0.0
Manufactured Products:				
Food Products	33.7	23.8	26.3	13.9
Beverages and Tobacco	27.6	47.3	3.8	1.4
Textiles	38.4	32.5	50.7	45.3
Garments and Apparel	12.6	0.9	12.0	0.4
Leather Products	15.2	7.6	9.1	\1
Lumber and Wood Products	31.5	13.4	4.0	1.1
Pulp and Paper Products	6.7	15.4	20.1	20.8
Printing and Publishing	\2	9.2	\2	0.0
Chemical Materials	54.3	37.5	42.4	35.3
Chemical Products	24.0	26.9	8.4	2.2
Petroleum and Coal Products	91.9	100	0.0	4.25
Rubber Products	76.8	21.9	13.0	1.2
Plastic Products	\3	38.8	5.4	5.0
Non-Metallic Mineral Products	44.6	28.0	47.6	37.6
Primary Metals	28.0	34.3	7.8	2.8
Metal Products	26.7	25.8	6.0	22.5
Machinery	34.9	33.9	3.6	12.3
Electronic Products	50.9	64.3	22.7	24.4
Motor Vehicles and Shipbuilding	79.0	80.4	23.6	34.9
Precision Instruments	14.0	11.1	0.0	0.0
Misc. Industrial Products	5.2	2.88	10.7	0.12
Total Manufacturing	45.4	40.7	19.0	16.4
Non-Manufactured Products:				
Utilities	na	3.6	na	1.2
Construction	66.0	31.7	5.6	8.4
Transportation, Comm. & Storage	23.1	23.6	1.8	3.0

Notes:

1. Leather products for Taiwan are included with garments and apparel.
2. Printing and publishing is included with pulp and paper products.
3. Plastic products for Korea in 1983 are included with chemical materials.

Table 2: Comparison of Korean Groups with *Simulated* High Concentration *Equilibria*

Included Groups	Statistic	Sales ($ mill.)	Internal Sales Ratio (percent)[1]	Internal Sales Ratio (no retail)[2]	Herfindahl Index (all sales)[3]	Herfindahl Index (internal inputs)[4]
(a) Korean Groups, 1989						
All 44	Average	3,441	11.3	6.7	0.52	0.26
	St.Dev./$\sqrt{N}$	917	1.6	1.0	0.03	0.04
Top 5	Average	18,645	27.0	14.3	0.72	0.54
	St.Dev./$\sqrt{N}$	3,329	2.4	2.1	0.02	0.08
Other 39	Average	1,492	9.2	5.7	0.50	0.23
	St.Dev./$\sqrt{N}$	212	1.4	0.9	0.03	0.04
(b) Stable *High Concentration* Equilibria						
All	Average	6,236	32.3	8.1	0.51	0.34
	Stan. Dev.	8,072	11.1	9.0	0.34	0.41
V-groups[5]	Average	18,412	46.9	21.7	0.96	0.95
	Stan. Dev.	2,704	1.9	1.8	0.01	0.03
U-groups[6]	Average	1,119	26.1	2.3	0.32	0.08
	Stan. Dev.	365	6.7	0.8	0.20	0.12

Notes

1. Computed as the ratio of sales between firms in each group to total sales of the group.
2. "No retail" means that the internal sales ratio is calculated without including the purchases of any trading companies and other wholesale or retail firms from within the group.
3. The Herfindahl index equals $1-\sum_i s_i^2$, where s_i is the share of total sales in each sector i.
4. The Herfindahl index is computed over just internal sales of manufacturing inputs.
5. The V-groups consist of those equilibria with elasticities between 1.8 and 3.2.
6. The U-groups consist of those equilibria with elasticities between 3.2 and 6.6.

Table 3: Comparison of Taiwan Business Groups with Simulated *Low Concentration* Equilibria

Included Groups	Statistic	Sales ($ mill.)	Internal Sales Ratio (percent)[1]	Internal Sales Ratio (no retail)[2]	Herfindahl Index[3] (all sales)	Herfindahl Index[4] (internal inputs)
			(a) Taiwan, 1994			
All 80	Average	954	7.0	4.7	0.35	0.10
	St.Dev./$\sqrt{N}$	154	0.8	0.5	0.03	0.02
Top 5	Average	5,164	14.3	4.5	0.56	0.23
	St.Dev./$\sqrt{N}$	457	6.0	3.0	0.06	0.10
Other 75	Average	673	6.5	4.7	0.33	0.09
	St.Dev./$\sqrt{N}$	96	0.7	0.5	0.03	0.02
			(b) Stable *Low Concentration* Equilibria			
All	Average	1432	29.3	2.54	0.42	0.15
	Stan. Dev.	598	7.8	0.8	0.24	0.15
Large[5] U-group	Average	2,116	35.9	3.9	0.66	0.45
	Stan. Dev.	131	0.3	0.2	0.02	0.04
Small[6] U-group	Average	1,119	26.1	2.3	0.32	0.08
	Stan. Dev.	365	6.7	0.8	0.20	0.12
D-group[7]	Average	2,193	38.7	2.6	0.70	0.29
	Stan. Dev.	240	0.9	0.5	0.01	0.04

Notes

1. Computed as the ratio of sales between firms in each group to total sales of the group.
2. "No retail" means that the internal sales ratio is calculated without including the purchases of any trading companies and other wholesale or retail firms from within the group.
3. The Herfindahl index equals $1-\sum_i s_i^2$, where s_i is the share of total sales in each sector i.
4. The Herfindahl index is computed over just internal sales of manufacturing inputs.
5. The large U-groups consist of those equilibria with elasticities between 2.8 and 3.2.
6. The small U-groups consist of those equilibria with elasticities between 3.2 and 6.6.
7. The D-groups consist of those equilibria with elasticities between 1.8 and 2.8.

Table 4 – Transportation Industry Exports from South Korea and Taiwan to the U.S. (Values, number of HS categories, Unit-Values and indexes)

Year	Variable	Korea	Taiwan	Taiwan/Korea Unit-Value Ratio	Taiwan/Korea Price Index
SIC 3711 – Motor vehicles and passenger car bodies					
1992	Value ($mill)	1,205	4.3	0.13	0.63
	Number HS	9	2		
1993	Value ($mill)	750	5.0	0.18	0.63
	Number HS	15	2		
1994	Value ($mill)	1,262	4.7	0.17	0.65
	Number HS	20	4		
SIC 3714 - Motor vehicle parts and accessories					
1992	Value ($mill)	150	309	0.39	0.36
	Number HS	52	59		
1993	Value ($mill)	154	325	0.44	0.51
	Number HS	54	63		
1994	Value ($mill)	188	373	0.32	0.46
	Number HS	71	78		
SIC 3751 – Motorcycles, bicycles, and parts					
1992	Value ($mill)	11	476	0.53	1.39
	Number HS	11	38		
1993	Value ($mill)	3.2	506	2.50	0.55
	Number HS	11	37		
1994	Value ($mill)	2.0	492	6.0	1.45
	Number HS	7	36		

Table 5 – Semiconductor Exports from South Korea and Taiwan to the U.S. (Values, number of HS categories, Unit-Values and indexes)

Year	Variable	Korea, total	Taiwan, total	Taiwan/Korea Unit-Value Ratio	Taiwan/Korea Price Index
SIC 3674 – Semiconductors and related devices					
1992	Value ($mill)	1,951	882	0.568	0.820
	Number HS	53	54		
1993	Value ($mill)	2,388	1,155	0.500	0.601
	Number HS	53	53		
1994	Value ($mill)	3,784	1,663	0.506	0.897
	Number HS	61	61		
DRAMS only, within SIC 3674					
1992	Value ($mill)	730	65	0.543	0.875
	Number HS	6	6		
1993	Value ($mill)	1,043	136	0.398	0.768
	Number HS	6	6		
1994	Value ($mill)	2,060	231	0.456	1.027
	Number HS	5	5		
All other SIC 3671, except DRAMs					
1992	Value ($mill)	1,122	817	0.797	0.804
	Number HS	47	48		
1993	Value ($mill)	1,345	1,019	0.750	0.551
	Number HS	47	47		
1994	Value ($mill)	1,724	1,433	0.907	0.815
	Number HS	56	56		

Table 6 – Change in Korean Exports, 1995-1996 (%)

	1995 (year)	1996 (year)	1996 (Jan-Mar)	1996 (Apr-Jun)	1996 (Jul-Sep)	1996 (Oct-Dec)
Total Exports	30.3	3.7	-5.6	7.1	15.6	3.6
Light Industry Products	14.1	7.4	2.2	3.5	11.2	-3.6
Textile Yarn	26.1	9.8	4	-2.8	13.5	26.9
Textile Fabrics	13.5	1.4	-6.4	1.7	6.9	3.3
Apparel	-12.5	-14.9	-6.4	-17.8	-17.4	-15.8
Tires	7.9	16.5	24.3	16.6	6.9	18.4
Heavy industry Products	37.7	0.9	24.6	0	-14.2	-1.6
Chemicals	43.5	-0.7	4	-11.4	-1.1	6.3
Metal Goods	29	-14.1	-4.7	-32.2	-12.7	0.1
Machinery & Equip.	33	8.6	20.1	7.7	-2.5	10.5
Electronic Products	39	-2.8	28.3	-0.8	-18.2	-11.7
Elec. home appliance	6.8	-0.3	10.2	10.3	-3.4	-15.7
Semiconductors	66.4	-13.9	43.7	-13.8	-37.9	-26.9
Passenger Cars	70.7	26.0	34.0	29.9	10.1	29.4
Ships & boats	11.9	28.8	87.6	57.8	-28.6	32.9

Notes:
Growth rates are compared with the same period of the previous year.

Source: The Bank of Korea, Statistics Database, Foreign Trade & Foreign Exchange Section, www.bok.or.kr/index_e.html .

Table 7. Bankruptcies in the Korean *Chaebol*, 1996-98

Name of Group	Major Products	Date Bankrupt
Wooseong	Construction	96-01-19
Hanbo	Construction, steel	97-01-23
Sammi	Steel	97-03-19
Jinro	Liquor, foods	97-04-21
Hanshin	Construction	97-05-31
Kia Auto	Automobiles, steel	97-07-18
Dae-Nong	Textiles, retail	97-09-11
Ssang-Bang-Ul	Apparel, construction	97-10-20
Haitai	Confectionary, beverages	97-11-03
Newcore	Retail	97-11-04
Floating of the Korean won on November 17, 1997		
Su-san	Machinery	97-11-18
Tae-Il	Hard disk drive	97-11-18
Sin-Ho	Paper	97-11-28
Halla	Auto parts, construction	97-12-08
Hanwha	Explosives, chemicals	97-12-16
Jin-Do	Fur coats, containers	97-12-16
Ssangyong	Cement, construction	98-01-10
Dong-Ah	Construction	98-01-10
Hanil	Cement, construction	98-01-15
Nasan	Textiles	98-01-15
Kukdong	Construction	98-01-20
Kohap	Textiles, plastics, chemicals	98-01-30
Chung-Gu	Construction	98-04-23
Keopyung	Chemicals, retailing	98-05-20

Source: Revised from Lee (1999).

Notes:
All firms belong to the top 60 largest conglomerates in terms of the asset values as of the end of 1996, assessed by the Bank Supervision Authority of Korea.

Table 8: Data for Top 30 Korean Chaebol, 1996-97

Business group	Sales ($million)	Debt/Equity 1996	Debt/Equity 1997	Short/Long debt, 1996	Short/Long debt, 1997	Prob. Of Bankruptcy
Hyundai	84,633	437	579	1.26	1.52	0.07
Samsung	70,194	270	367	0.96	0.92	0.00
LG	58,284	351	527	1.10	1.17	0.01
Daewoo	***49,636***	***382***	***474***	***1.35***	***1.70***	***0.03***
SK	28,195	350	461	2.01	2.01	0.01
Ssangyong	***22,081***	***297***	***403***	***1.66***	***3.25***	***0.00***
Kia	**15,150**	**514**	**n.a.**	**n.a.**	**n.a.**	**0.19**
Hanwha	***11,405***	***665***	***1,066***	***1.58***	***3.09***	***0.61***
Hanjin	10,810	558	920	0.43	0.26	0.30
Lotte	8,770	190	219	2.12	9.62	0.00
Hyosung	6,778	377	467	1.48	2.35	0.02
Daelim	5,976	418	508	1.42	2.16	0.05
Keumho	5,823	473	968	1.65	2.94	0.11
Kolong	4,989	341	421	1.63	0.03	0.01
Dong Ah	***4,821***	***350***	***353***	***1.80***	***3.26***	***0.01***
Halla	***3,974***	***451***	***976***	***1.99***	***3.49***	***0.08***
Doosan	3,919	743	623	1.80	4.98	0.78
Dongkuk Steel	3,817	219	323	1.10	1.21	0.00
Hanbo	**3,549**	**675**	**1,501**	**n.a.**	**n.a.**	**0.63**
Haitai	**3,227**	**521**	**814**	**1.70**	**3.09**	**0.21**
Dongbu	3,227	250	350	1.74	3.67	0.00
Kohap	***3,130***	***592***	***474***	***1.66***	***2.35***	***0.40***
Hansol	2,979	340	459	1.35	0.87	0.01
Anam	2,427	526	1820	1.73	2.88	0.22
New Core	**2,273**	**1224**	**1,784**	**n.a.**	**n.a.**	**0.99**
Dongyang	2,257	294	389	1.01	1.02	0.00
Sammi	**1,856**	**-3,329**	**n.a.**	**n.a.**	**n.a.**	**1.00**
Hanil	***1,618***	***563***	***n.a.***	***n.a.***	***n.a.***	***0.31***
Jinro	**1,515**	**2,948**	**-813**	**1.45**	**2.44**	**1.00**
Daesang	1,394	471	637	2.20	3.88	0.11
Shinho	1,224	391	798	1.28	1.64	0.03
Keopyung	***1,053***	***269***	***357***	***1.57***	***2.60***	***0.00***

Notes: 1. Groups shown in bold declared bankruptcy prior to November 17, 1997; groups in bold and italics declared bankruptcy after that date.
2. Group sales have been converted to US$ using the 1996 exchange rat of 804 won/$.
3. Debt/equity ratios and short term/long term loan ratios are at end of the calendar year, and exclude financial firms in each group.

Sources: New Industry Management Academy (1999), supplemented with information from the Korean Fair Trade Commission.

Table 9: Regression results for Bankruptcy of *Chaebol,* 1996-98

Regression 1: Those *chaebol* going bankrupt **before** November 17, 1997

$$\text{Probability of Bankruptcy} = -47 + 7.3 \ln\left|\frac{\text{Debt 96}}{\text{Equity 96}}\right|, \qquad N=35,\ R^2=0.60$$

(s.e.= 3.4, p=0.03)

No. of observations **without** bankruptcy = 27, Successfully predicted (probability < .5) = 26
No. of observations **with** bankruptcy = 8, Successfully predicted (probability > .5) = 6

Regressions 2: Those *chaebol* going bankrupt **after** November 17, 1997

(a) $$\text{Pr(Bankrupt)} = -11 + 1.7 \ln\left|\frac{\text{Debt 96}}{\text{Equity 96}}\right|, \qquad N=36,\ R^2=0.05$$

(s.e.=1.3, p=0.19)

No. of observations **without** bankruptcy = 27, Successfully predicted (probability < .5) = 27
No. of observations **with** bankruptcy = 9, Successfully predicted (probability > .5) = 0

(b) $$\text{Pr(Bankrupt)} = -1.8 + 0.12 \ln\left|\frac{\text{Debt 97}}{\text{Equity 97}}\right|, \qquad N=27,\ R^2=0.00$$

(s.e.=0.97, p=0.70)

No. of observations **without** bankruptcy = 20, Successfully predicted (probability < .5) = 20
No. of observations **with** bankruptcy = 7, Successfully predicted (probability > .5) = 0

(c) Excluding Doosan and Lotte groups from the estimation:

$$\text{Pr(Bankrupt)} = -1.2 - 0.67 \ln\left|\frac{\text{Debt 97}}{\text{Equity 97}}\right| + 2.7 \ln\left(\frac{\text{Short term loans 97}}{\text{Long term loans 97}}\right),$$

(s.e.=1.1, p=0.55) (s.e.=1.5, p=0.06)

$N=25,\ R^2=0.22$

No. of observations **without** bankruptcy = 18, Successfully predicted (probability < .4) = 15
No. of observations **with** bankruptcy = 7, Successfully predicted (probability > .4) = 4

Table 10: "Big Deal" Plans as of October 7, 1998

Business line	Plan of the Deal	Controlling Body
Semiconductor	(1) Samsung Electronics Co. ——————→ (2) Hyundai Electronics Ind. (2,3) combine→ (3) LG Semiconductor Co.	Samsung Electronics Co. Hyundai Electronics
Power-Generation Equipment	(1) Hyundai Heavy Industries Co. ——————→ (2) Korea Heavy Industries & Construction Co. (2,3) combine→ (3) Samsung Heavy Industries Co.	Hyundai Heavy Industries Co. Korea Heavy Industries & Construction Co.
Petro-Chemicals	(1) SK, LG, Daelim, Lotte, Hanwha ——→ (2) Hyundai Petro-Chemical Co. (2,3)combine→ (3) Samsung General Chemical Co.	SK, LG, Daelim, Lotte, Hanwha Third party Professional Manager
Aircraft Manufacturing	(1) Korea Air Line Co. ——————→ (2) Samsung Aerospace Industries Co. (3) Daewoo heavy Industries Co. (2,3,4) —→ (4) Hyundai Space & Aircraft Co.	Korea Air Line Co. Third party Professional Manager
Railway Vehicles	(1) Hyundai Precision & Ind. Co. ——————→ (2) Daewoo Heavy Industries Co. (2,3)combine→ (3) Hanjin Heavy Industries Co.	Hyundai Precision & Ind. Co. Third party Professional Manager
Ship-Engines	(1) Hyundai Heavy Industries Co. ——————→ (2) Korea Heavy Industries & Construction Co. (2,3) combine→ (3) Samsung Heavy Industries Co.	Hyundai Heavy Industries Co. Korea Heavy Industries & Construction Co.
Oil Refining	(1) SK, LG, Ssang ——————→ (2) Hyundai Oil Co. (2,3) acquire→ (3) Hanwha Energy Co.	SK, LG, Ssang Hyundai Oil Co.

Source:
Federation of Korean Industries (FKI), *Hankook Ilbo*, October 8, 1998, as cited in Yoo (1999, p. 198).

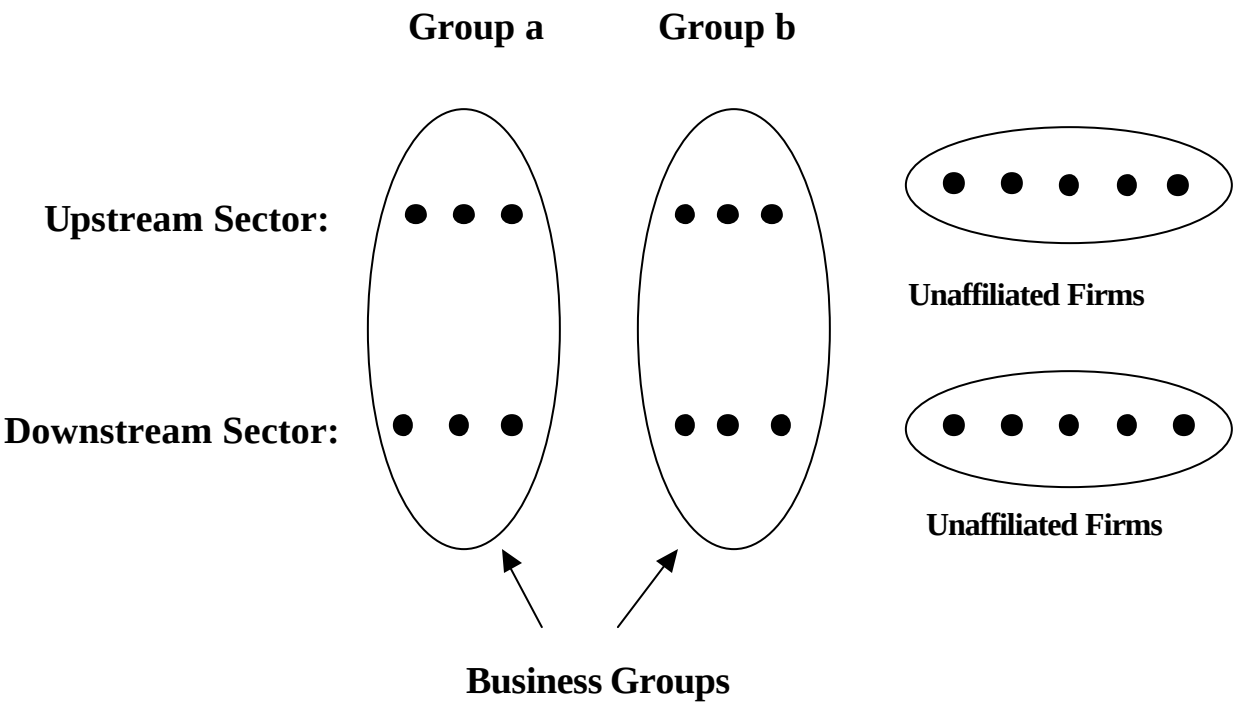


Figure 1: Model of Business Groups

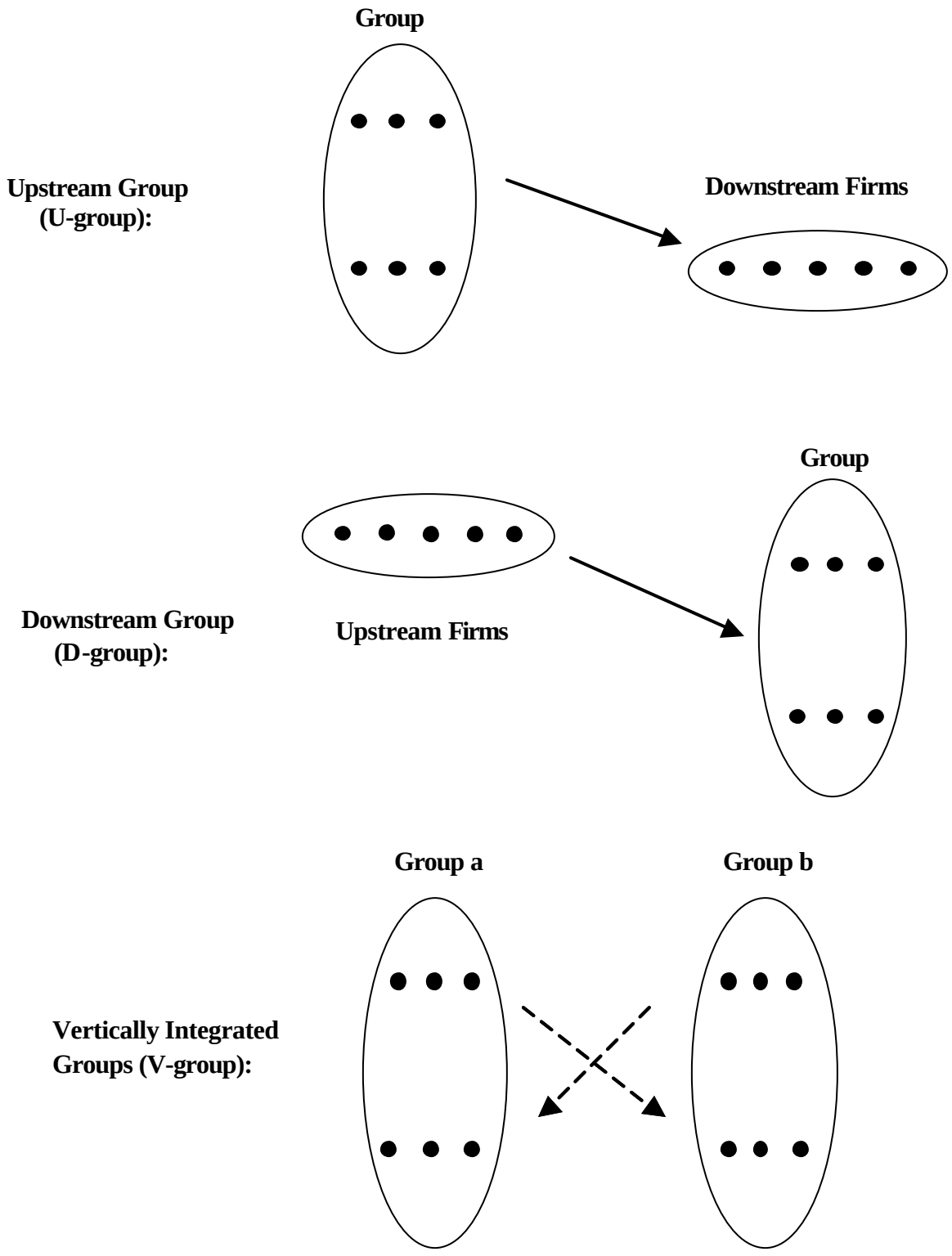


Figure 2: Types of Business Groups

Figure 3: Regions Where Groups Sell Inputs or Not

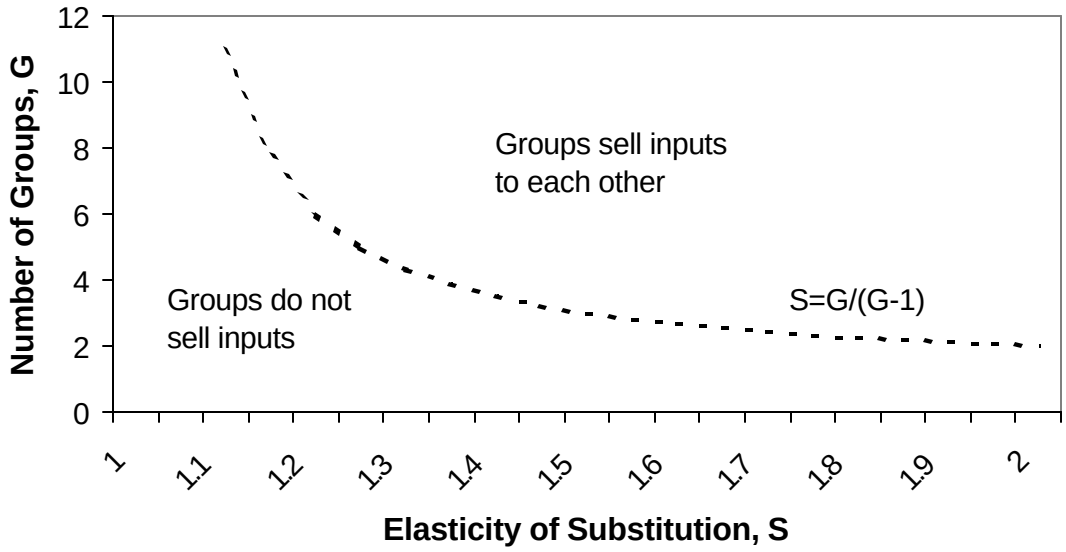


Figure 4: Number of V-Groups

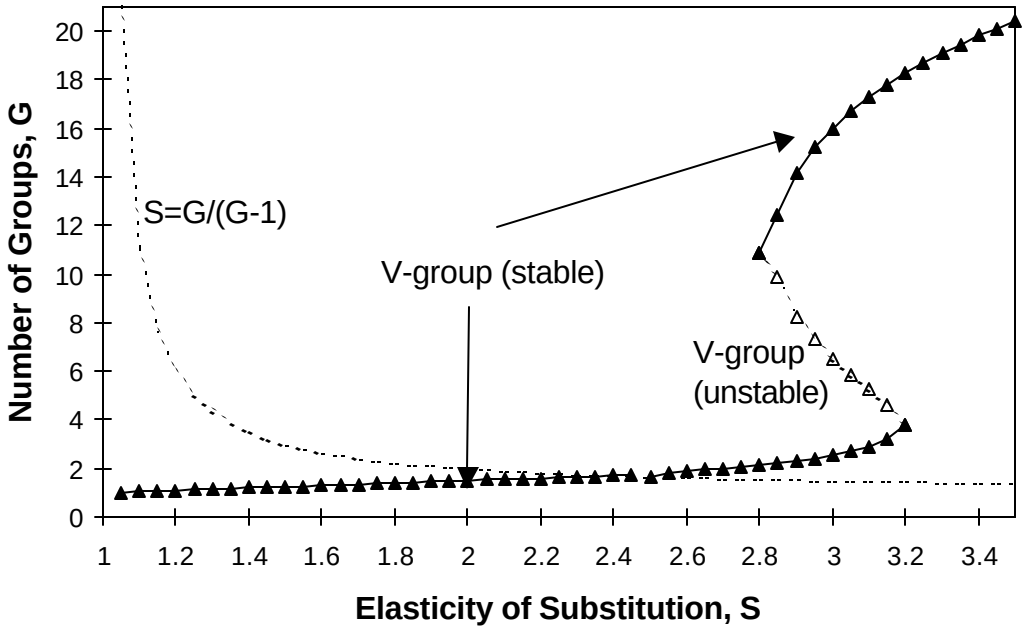


Figure 5: Pricing of Inputs with V-groups

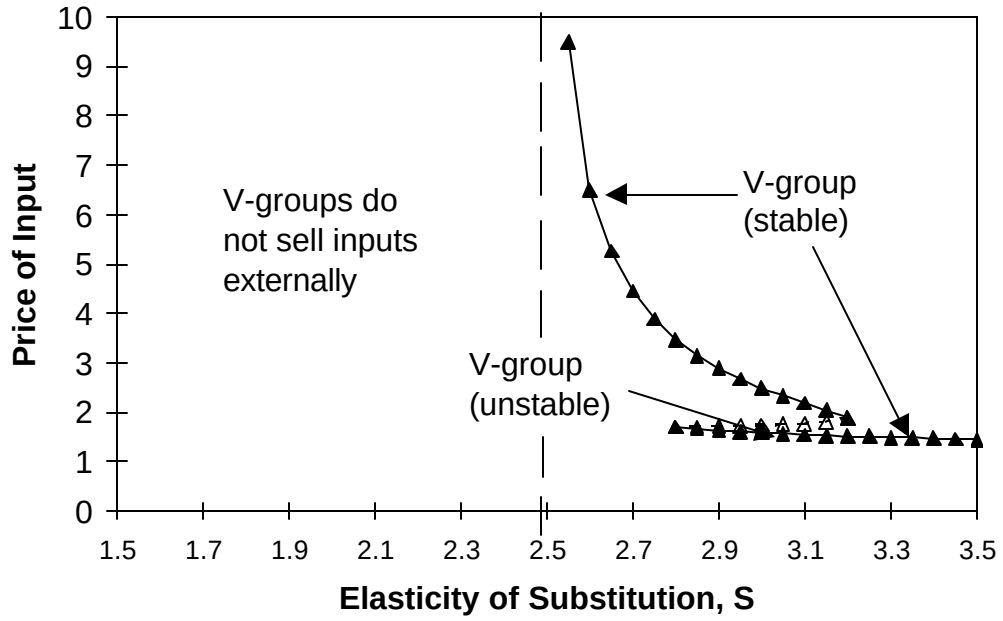
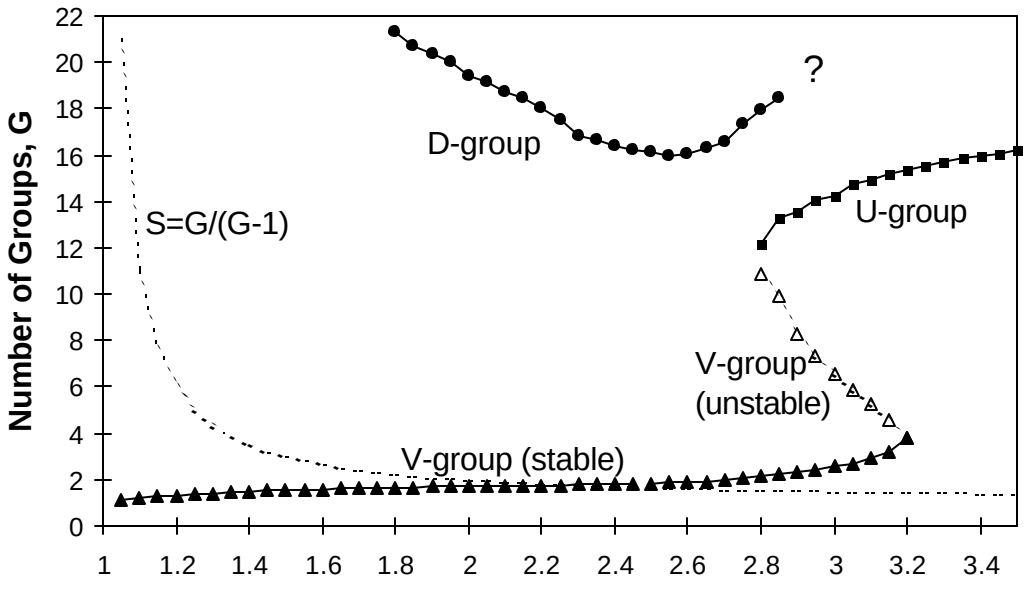


Figure 6: Number of Business Groups



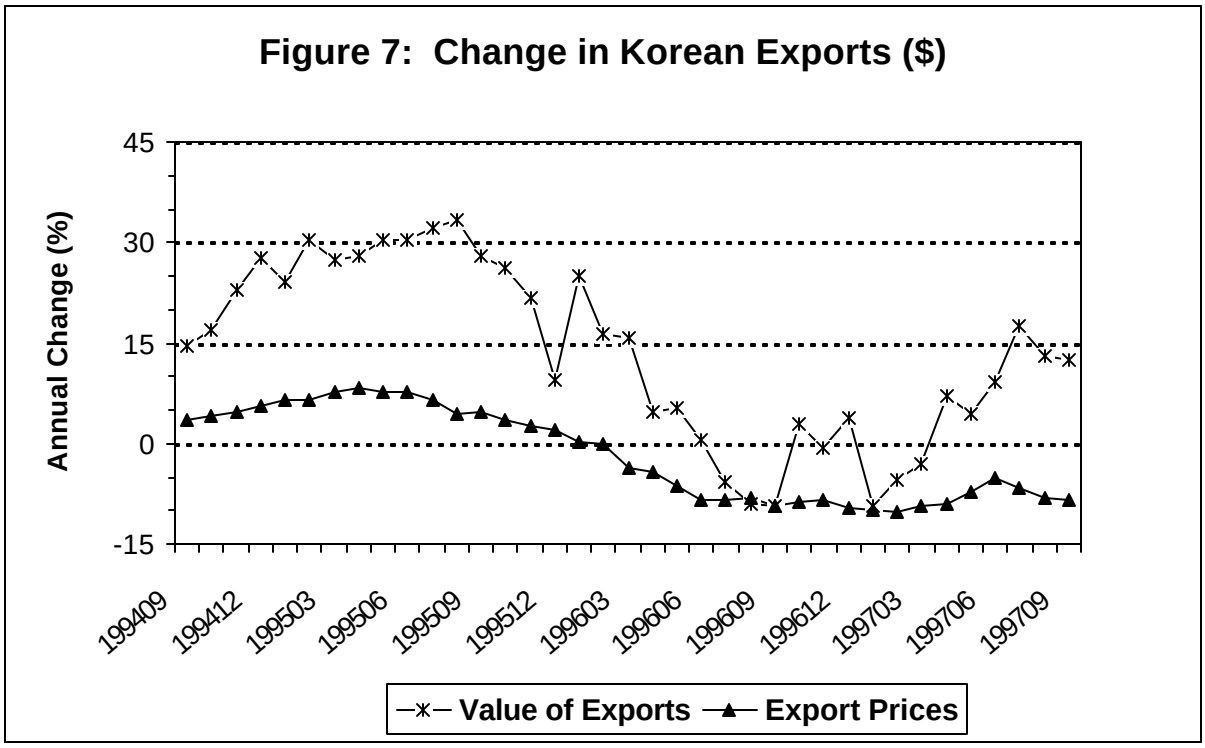


Figure 7: Change in Korean Exports ($)
Annual Change (%)
45
30
15
0
-15
199409
199412
199503
199506
199509
199512
199603
199606
199609
199612
199703
199706
199709
Value of Exports
Export Prices

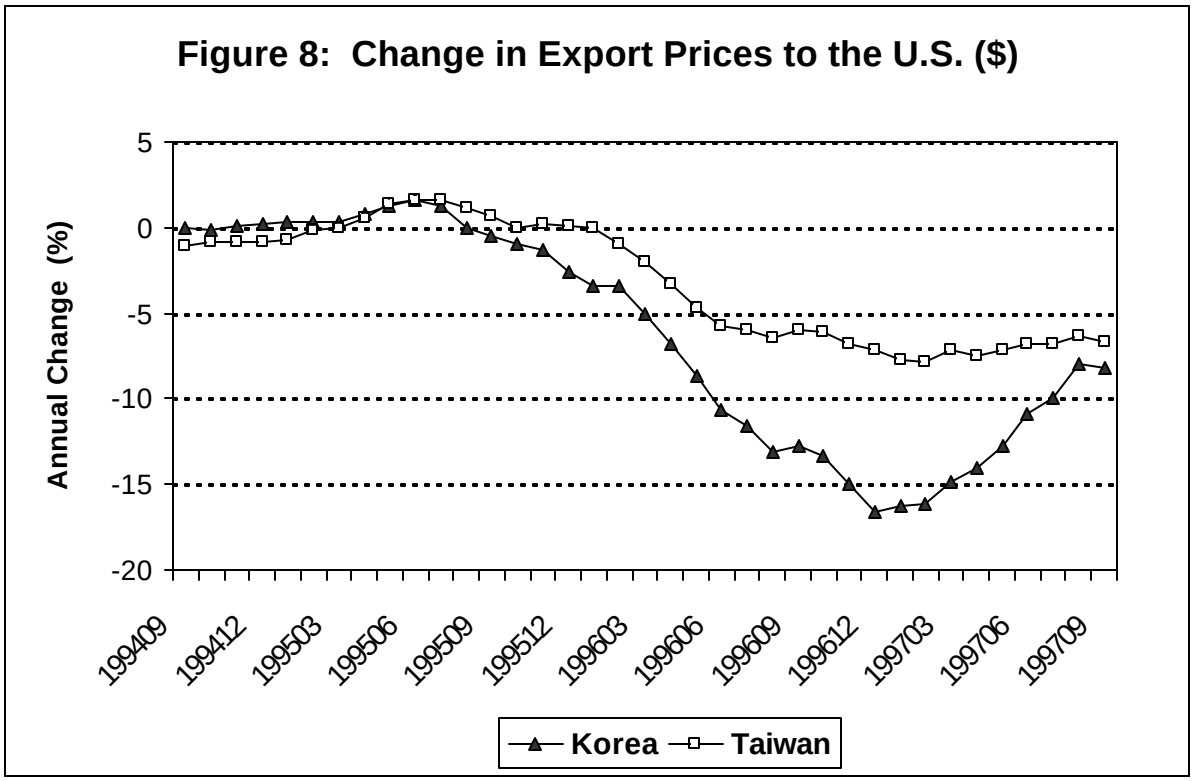


Figure 8: Change in Export Prices to the U.S. ($)
Annual Change (%)
5
0
-5
-10
-15
-20
199409
199412
199503
199506
199509
199512
199603
199606
199609
199612
199703
199706
199709
Korea
Taiwan

Figure 9: Semiconductor Export Prices to the U.S. ($)

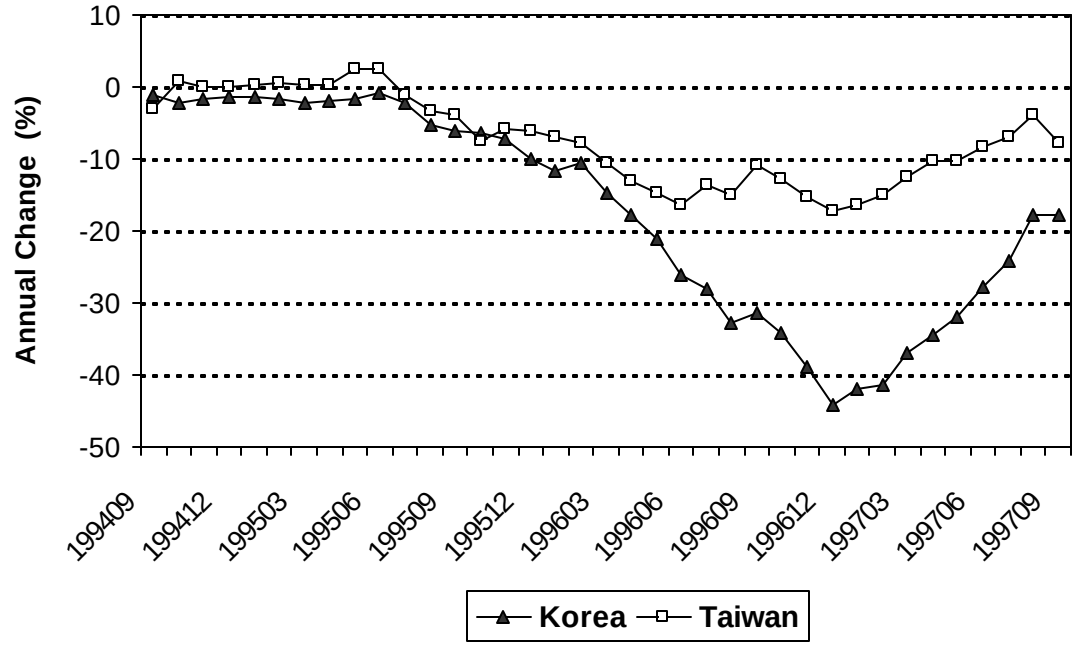
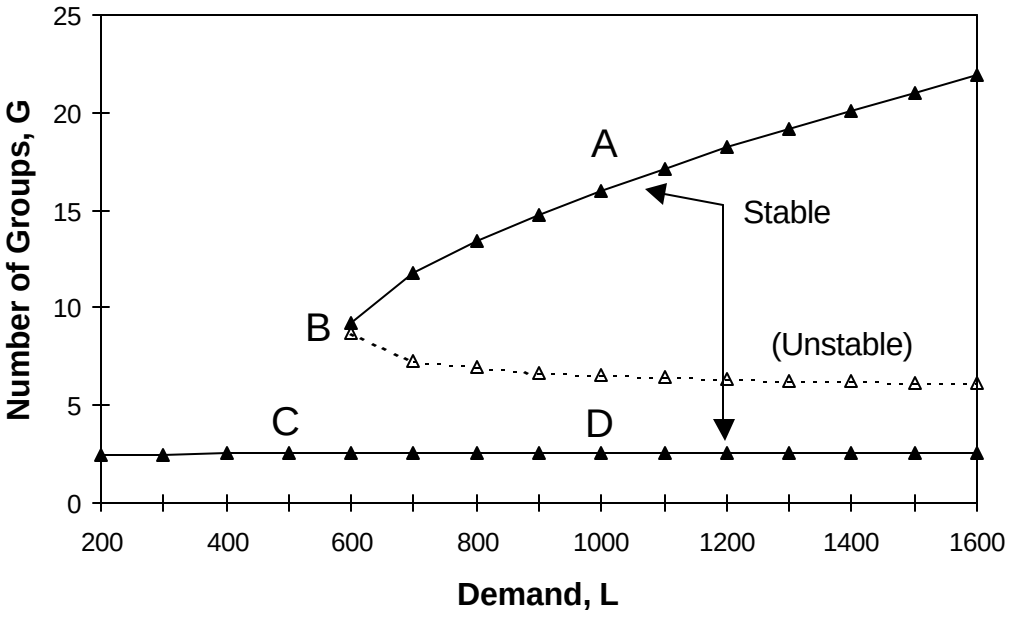


Figure 10: V-Groups (Elasticity=3)



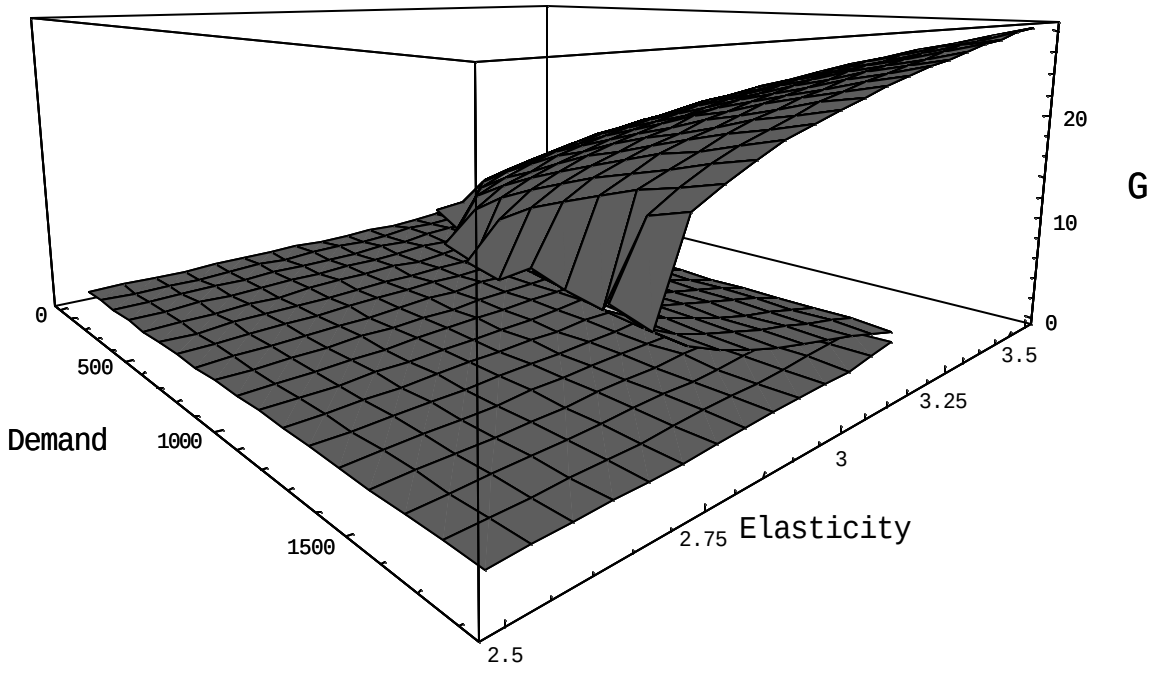


Figure 11: V-group Equilibria

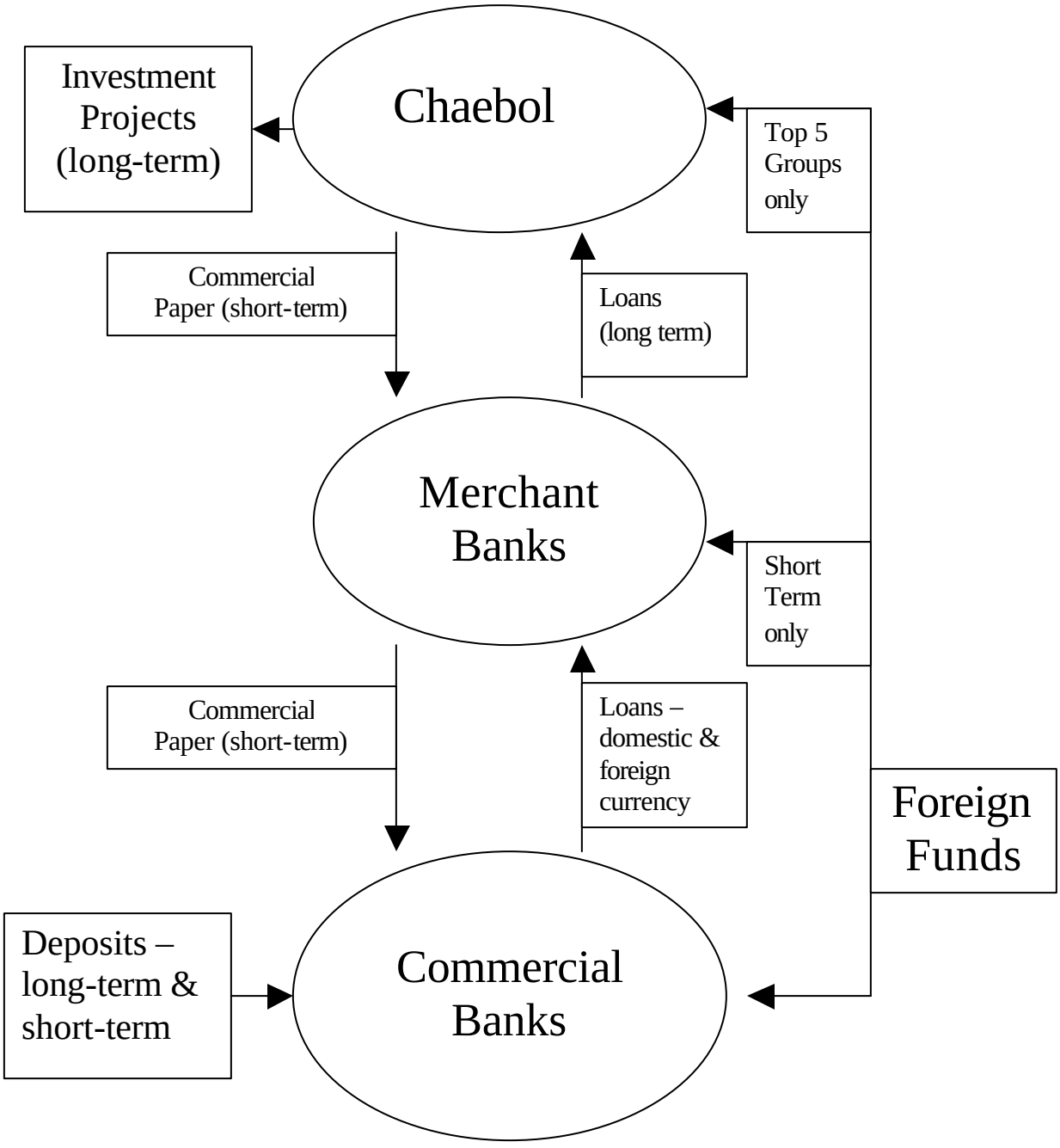


Figure 12: Financial Structure in Korea

Appendix: Data on Business Groups

The primary source for the 1989 Korean data, shown in Table A1 is the volume *1990 Chaebol Analysis Report (Chaebol Boon Suk Bo Go Seo* in Korean) published by Korea Investors Service, Inc. Complete data were available for 44 groups, with 499 firms. The primary sources for the 1994 Taiwan data are twofold: *Business Groups in Taiwan, 1996/1997*, published by the China Credit Information Service (CCIS); and company annual reports to the Taiwan stock exchange, for 1994, collected by the CCIS, and supplemented by interviews of selected firms. *Business Groups in Taiwan, 1996/1997*, provides information on 115 business groups in Taiwan. The 1994 database for Taiwan includes 80 groups, with 797 firms. These data are described in detail in Feenstra (1997) and Feenstra, Hamilton and Huang (2001), from which the summary Table A1 and A2 are drawn. Each table has the following information:

Column 1: Name of group

Column 2: Sales ($ million)

Column 3: Number of firms (* indicates that the group has a trading company)

Column 4: The internal sales ratio for each group, calculated as (internal sales within a group)/(internal sales within a group plus all external sales to other firms or consumers).

Column 5: The internal sales ratio for each group, calculated by ignoring the purchases of trade companies and other retail firms in a group. This internal sales ratio is calculated as (all internal sales within a group, except those made to trading companies or other wholesale/retail firms)/(all internal sales within a group, except those made to trading companies or other wholesale/retail firms, plus all group sales to external firms or consumers).

Columns 6-7: The Herfindahl index, defined as $1-\sum_i s_i^2$, where s_i is the share of total sales in each sector i. To implement this index we divided the entire economy into 31 sectors, with 22 in manufacturing and 7 in services. Each firm in a group is identified as selling in one of these sectors by its major product category, and then the Herfindahl index is computed for each group. We considered four different calculations: using all sales or just internal sales; and using all products or just manufacturing. Column 6 reports the broadest case, where the Herfindahl index is defined over all sales and all products; and column 7 the narrowest case, where the Herfindahl index is defined over just manufacturing inputs sold internally to the group.

The averages shown at the bottom of each table are computed as simple average of the data in each column, while the weighted averages use group sales as weights.

Table A1: Business Groups in Korea, 1989

Group Name	1989 Sales ($ mill.)	Number of Firms (* TC)	Internal Sales Ratio (%)	Internal Sales (no Retail)	Herfindahl Index (all sales)	Internal Sales (internal manufact.)
Samsung	26,175	32*	31.9	18.8	0.70	0.35
Hyundai	25,500	30*	33.0	19.8	0.80	0.78
LG (Lucky Goldstar)	18,807	45*	26.0	12.5	0.74	0.46
Daewoo	13,837	24*	23.5	9.7	0.68	0.66
SK (Sunkyong)	8,910	16*	20.6	10.3	0.69	0.42
Ssangyong	5,777	15*	14.8	11.6	0.75	0.63
Hyosung	4,697	20*	7.4	3.3	0.20	0.04
Kia	4,602	9*	25.6	6.6	0.80	0.64
Lotte	3,900	23*	9.2	7.7	0.25	0.12
Han Jin	3,895	11*	2.7	2.2	0.63	0.43
Korea Explosives	3,172	19*	7.7	4.7	0.80	0.58
Doosan	2,417	17*	13.3	11.5	0.84	0.77
Kolon	2,218	14*	10.6	4.0	0.65	0.00
Dongbu	1,978	7*	26.1	17.3	0.50	0.12
Daelim	1,951	12*	4.4	0.6	0.38	0.27
Dongkuk Steel Mill	1,886	10*	5.4	3.4	0.27	0.01
Dong Ah Construction	1,866	12*	1.1	0.7	0.39	0.00
Sammi	1,696	5*	36.6	27.0	0.51	0.00
Kumho	1,430	8*	3.3	0.4	0.64	0.00
Hanil	1,296	12*	7.1	7.1	0.61	0.39
Miwon	1,295	13*	12.5	6.4	0.65	0.26
Halla	1,262	7	10.2	10.2	0.62	0.51
Kangwon Industries	1,256	12*	33.5	11.4	0.74	0.31
Samyang	1,038	5	1.6	1.6	0.41	0.63
Kohap	1,016	6*	18.2	12.5	0.53	0.37
Poongsan	941	6	3.3	3.3	0.36	0.08
Woosung Construction	834	6	2.0	2.0	0.47	0.00
Kukdong Oil	812	3	19.3	0.0	0.39	0.00
Dongkuk Corporation	689	7*	11.3	1.1	0.55	0.00
Tongil	685	10	4.4	4.4	0.74	0.08
Tong Yang	672	5*	9.3	9.3	0.49	0.33
Byucksan	661	17	0.6	0.6	0.75	0.50
Taejon Leather	627	7	1.6	1.6	0.61	0.11
Daesung Industries	589	8	2.0	2.0	0.55	0.55
Anam Industrial	537	5	8.7	8.7	0.28	0.00
Oriental Chemical	528	9	8.9	8.9	0.40	0.48
Jinro	490	40	2.6	2.6	0.63	0.14
Taihan Electric Wire	490	3	3.0	3.0	0.12	0.00
Kyesung Paper	437	5	17.3	17.3	0.28	0.00
Han Yang	436	4*	6.6	0.7	0.22	0.00
Hanbo	420	3	2.6	2.6	0.35	0.44
You One Construction	281	2*	0.3	0.0	0.41	0.00
Kuk Dong Construction	247	4	0.1	0.1	0.10	0.00
Life Construction	211	4	3.5	3.5	0.48	0.00
Average	**3,441**	**11.3**	**11.3**	**6.7**	**0.52**	**0.26**
Weighted Average		**23.9**	**22.1**	**12.2**	**0.66**	**0.45**

Table A2: Business Groups in Taiwan, 1994

Group Name	1994 Sales ($ mill.)	Number of Firms (* TC)	Internal Sales Ratio (%)	Internal Sales (no Retail)	Herfindahl Index (all sales)	Internal Sales (internal manufact.)
Formosa Plastics	6,654	16	15.8	15.8	0.54	0.58
Shin Kong	5,724	25*	0.4	0.4	0.40	0.22
Wei Chuan Ho Tai	4,889	23*	28.1	0.4	0.55	0.02
Far Eastern	4,291	26	0.7	0.5	0.53	0.05
Yulon	4,264	23*	26.6	5.2	0.77	0.26
President	3,932	31*	6.4	4.5	0.70	0.29
Tatung	3,634	36	8.3	6.3	0.38	0.18
Acer	3,243	9*	3.5	2.4	0.62	0.01
Chinfon	2,986	16*	24.1	1.1	0.19	0.00
Hualon	2,517	9*	16.4	4.7	0.70	0.00
Ho Hsin	2,104	15*	0.2	0.2	0.50	
Tuntex	1,831	16*	8.1	7.9	0.78	0.38
Teco Electric & Machinery	1,474	17*	2.6	2.6	0.60	0.15
Chi Mei	1,268	6*	0.3	0.3	0.25	0.09
Rebar	1,221	9*	1.4	0.9	0.72	0.00
Pacific Cable	1,214	26	3.2	3.2	0.54	0.05
Sampo	1,096	11	12.5	12.5	0.26	0.00
Tainan Spining	1,075	17	2.1	2.1	0.71	0.00
Pacific Construction	1,032	15	2.8	2.7	0.63	0.46
Yuen Foong Yu	1,000	8*	18.5	4.5	0.46	0.13
Ruentex	997	25*	0.7	0.0	0.51	0.00
Taiwan Cement	997	16	3.6	3.6	0.48	0.39
Lien Hwa Mitac	900	12*	2.8	2.7	0.53	0.00
Walsin Lihwa	881	8	0.1	0.1	0.02	0.06
Lite-On	875	10	0.5	0.5	0.71	0.50
Kwang Yang	855	7*	6.3	6.3	0.20	0.18
Cheng Loong	823	7*	16.3	16.2	0.08	0.00
Shih Lin Paper	766	5	0.1	0.1	0.20	0.00
United Microelectronics	673	4	8.5	8.5	0.00	0.00
Chung Shing Textile	668	5	6.6	6.1	0.50	0.00
Yeang Der	618	14	1.0	0.1	0.37	0.02
China General Plastics	598	5	12.6	12.6	0.67	0.00
Chun Yuan Steel	528	5	4.7	4.7	0.36	0.00
Adi	484	9	0.7	0.3	0.22	0.00
Shinlee	456	12*	0.4	0.4	0.52	0.00
Umax Elitegroup	436	8*	7.2	7.2	0.00	0.00
Pou Chen Industrial	434	3	4.5	4.5	0.49	0.50
Aurora	406	7*	17.5	8.6	0.09	0.00
Ase	404	5*	10.5	1.3	0.35	0.00
Great Wall	375	12	21.1	20.7	0.31	0.17

Ho Cheng	375	8*	14.5	14.5	0.26	0.00
Taiwan Glass	350	9*	2.6	0.6	0.00	0.00
Tung Ho Steel	350	4	0.6	0.6	0.25	0.09
Lealea	335	7	9.4	9.4	0.17	0.00
Vedan	327	8*	8.1	7.5	0.04	0.00
Chia Hsin Cement	303	7*	7.0	7.0	0.00	0.00
Hwa Eng Cable	303	3	8.9	8.9	0.51	0.00
Lily Textile	301	7	0.7	0.7	0.04	0.00
Chia Her	293	5	1.6	1.6	0.38	0.00
Sun Moon Star	287	5*	7.1	3.8	0.49	0.00
Ta Ya Cable	276	6	4.0	4.0	0.10	0.21
Shing Nung	256	13*	6.2	5.9	0.42	0.22
Tah Tong Textile	235	13*	4.5	0.7	0.55	0.39
Dahin	231	5*	12.3	9.9	0.51	0.21
Chicony Electronics	217	3	4.3	4.3	0.00	0.00
Kenda Industrial	211	8	0.5	0.5	0.49	0.00
Lee Tah Farm Industrial	204	5	11.6	11.6	0.19	0.50
Fwu Sow Industrial	200	7*	7.1	7.0	0.01	0.00
Asia Chemical	180	13*	4.6	2.7	0.10	0.00
Men Yi	170	4	1.0	1.0	0.00	0.00
China Unique	166	4	2.8	2.8	0.22	0.00
Ve Wong	161	3	10.0	10.0	0.00	0.00
Hong Ho Precision Textile	159	6*	3.4	3.4	0.10	0.00
Chun Yu	158	7*	6.1	5.3	0.45	0.50
Ability	157	11	2.2	2.2	0.26	0.38
Far Eastern Machinery	156	7	0.3	0.3	0.20	0.00
UB	139	8	7.4	7.4	0.48	0.00
Chien Shing Stainless Steel	137	6	8.4	8.4	0.17	0.00
South East Cement	134	5	8.0	8.0	0.12	0.46
Bomy	116	9	29.5	0.0	0.48	0.00
Taiwan Everlight Chemical	104	5*	14.2	3.5	0.30	0.00
Ching Kuang Chemical	104	3	10.6	10.6	0.26	0.00
Nan Pao Resins	104	3	8.4	8.4	0.22	0.00
Victor Machinery	101	12*	1.2	1.2	0.16	0.00
Ren Hou (Chih Lien)	83	10*	0.0	0.0	0.51	0.00
Yung Shin Pharmaceutical	78	8*	2.7	1.8	0.05	0.00
Fu I Industrial	77	5*	5.1	5.1	0.30	0.00
San Wu Textile	53	3	2.7	2.7	0.57	0.05
Fong Kuo	48	4	6.5	6.5	0.34	0.10
Tong Hsing	35	4*	2.8	2.0	0.57	0.00
Average	**954**	**10.0**	**7.0**	**4.7**	**0.35**	**0.10**
Weighted Average		**16.9**	**9.5**	**4.5**	**0.48**	**0.16**