A Market-Power Based Model of Business Groups

by

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Abstract

We propose an model of vertically and horizontally-integrated business groups that allows the number and size of each group to be determined endogenously. We find that more than one configuration of groups that can arise in equilibrium: several different types of business groups can occur, each of which are consistent with profit-maximization and are stable. We suggest 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 Taiwan.

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1. Introduction

Business groups are observed in many countries of Europe, Asia and Latin America. What is surprising about their proliferation is not the contrast with the United States (where such groups violate antitrust law),[1] but the *diverse structure* of such groups in otherwise similar economies. For example, South Korea has some of the largest and most vertically-integrated groups (called *chaebol*) found anywhere in Asia, whereas the groups in Taiwan are much smaller and concentrated in upstream sectors, selling intermediate inputs to unaffiliated firms. The *keiretsu* in Japan are themselves quite diverse, ranging from six large intermarket or "main bank" groups, each of which span a wide range of markets and include a bank and trading company, to other non-bank groups that are vertically-integrated within an industry and may include firms from the "main bank" groups (Ito, 1992, chap. 7).

What accounts for these different group structures across, and even within, economies? The *transactions cost* explanation for vertical integration often relies on different *industry* characteristics: thus, Williamson (1975,1985) emphasizes the "asset specificity" of investments, and subsequent empirical work has attempted to measure this in specific industries. This type of explanation is hard-pressed to explain the very different degrees of vertical integration within the same industries across Asian countries. *Policy-based* explanations overcome this limitation, since policies can be expected to lead to different industrial structure in the same industry, but have another drawback: even when policies are removed, the structure of business groups can remain intact for a considerable time (as happened in South Korea). This is consistent with a

[1] The Glass-Steagall Act of 1933 prohibits U.S. Federal Reserve member banks from owning stock, so banks cannot act as both lenders and shareholders, as occurs in Japan. Furthermore, the Investment Company Act of 1940 prevents one company from taking a managerial role in another, unless it actually owns it. In response to these legal restrictions, it is reasonable to view the multi-divisional structure of American conglomerates as the particular form that "industrial groups" take in America, as argued by Chandler (1982).

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 will rely on the *market power* argument for integration: by horizontally integrating, groups achieve the benefits of multi-market contact (Bernheim and Whinston, 1990); and by vertically integrating, upstream and downstream producers avoid “double marginalization” and increase their joint profits (as originally noted by Spengler, 1950). Similar to Abiru *et al* (1998), we examine the incentives for integration in a model with multiple upstream and downstream producers; but unlike them, we use monopolistic competition rather than oligopoly.[2] A *business group* is defined as a set of upstream and downstream producers that jointly maximize profits.[3] Allowing for free entry of business groups and unaffiliated firms, we demonstrate the presence of *multiple equilibria*, 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 a stable *low-concentration* equilibria, with a larger number of less-integrated groups. The difference between these is that with a small number of groups, they charge higher prices for external sales of the intermediate inputs, thereby inhibiting the entry of other business groups. We suggest 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 Taiwan.

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[2] Other work examining the incentives for vertical integration in oligopoly models includes Durham (2000), Krouse (1995), Greenhut and Ohta (1979) and Pepall and Norman (2001). In contrast, our use of 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).

[3] The implications of weaker groups incentives are discussed in note 14.

In section 2 we briefly discuss the groups South Korea and Taiwan and motivate the assumptions of our model, which is analyzed in sections 3 and 4. In section 5 we compute the equilibria for a range of parameter values, and demonstrate that multiple equilibria with varying degrees of vertical integration indeed occur. Conclusions are given in section 6.

2. Business Groups in South Korea and Taiwan

A large literature describe the business groups in each of South Korea[4] and Taiwan.[5] These two economies have some basic similarities: in their land mass, GDP per capita, levels of education, and religions. Both countries were occupied by the Japanese for extended periods prior to and during World War II, and following the Chinese and Korean civil wars, embarked upon ambitious programs of industrialization. The form of the industrialization programs in the two countries was quite different, however.

In South Korea, extensive government support in the form of low-interest loans and export subsidies was given to the *chaebol*, which grew in part from firms associated with the Japanese *zaibatsu*.. The *chaebol* rapidly diversified both horizontally and vertically, controlling the full range activities from resource processing to international marketing. Despite the excess capacity that developed, leading to a reversal of policy after the Park regime ended in 1979, Amsden (1989) argues that this was a successful case of government intervention. In Taiwan, by contrast, government support was much more limited, and consisted of encouraging the establishment of upstream industries to supply the essential inputs for independent firms downstream. Wade (1990) also describes this as a case of successful intervention.

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[4] The *chaebol* are described in Amsden (1989), Biggart (1990) Hamilton and Biggart (1988), Hamilton, Zeile, and Kim (1990), Kim (1991,1993,1997), Orru, Biggart, and Hamilton (1991), Steers et al. (1989) and Zeile (1991).
[5] See Chou (1985), Gold (1986), Greenhalgh (1988), Hamilton and Biggart (1988), Hamilton and Kao (1991), and Numazaki (1986,1991), and Wade (1990).

The structure of business groups established in the post-war years has proved to be remarkably stable. Recent evidence is provided by firm-level databases of the largest 44 business groups in South Korea in 1989, and largest 80 groups in Taiwan in 1994, described in Feenstra (1997) and Feenstra, Hamilton and Huang (2001). The firm-level sales are aggregated to twenty-one manufacturing sectors and several non-manufacturing sectors. 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.

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 trading companies.[6] The largest groups for Korea – Samsung, Hyundai, Lucky-Goldstar, Daewoo, and Sunkyong – have 1989 sales ranging from $8.9 to $26 billion. Their average internal sales ratio is 27%, or 17.6% with trading companies excluded. These huge groups are all larger than the top five for Taiwan – Formosa Plastics, Shin Kong, Wei Chuan Ho Tai, Far Eastern, and Yulon – with average 1994 sales of $5.2 billion. 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 trading companies are excluded (and these differences are statistically significant).[7]

Outside of the top five, Korea has an average internalization ratio of 9.2% for the remaining groups (or 7.2% without trading companies), which compares with the average internalization for all groups in Taiwan of 7.0% (or 6.0% without trading companies). These differences are not statistically significant. Thus, it is the top five groups for Korea that are the outliers in these comparisons. In addition to their vertical integration, these groups are also diversified over a broader range of sectors than are smaller groups in Korea or in Taiwan. Thus, the Herfindahl index at the group level is:[8] 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.

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[6] The trading companies are engaged in transferring goods between firms within a group, so including them within the internal sales ratio artificially inflates this measure of vertical integration. A fuller description of the trading companies, and how they affect the internalization ratio, is provided in Feenstra (1997).

[7] 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.

[8] The Herfindahl index is defined as $1 - \sum_i s_i^2$, where s_i is the share of total group sales devoted each of twenty-two manufacturing sectors, two primary products, three non-manufacturing products, and four service sectors.

What accounts for this differing group structure in South Korea and Japan? As noted above, the differing industrial policies adopted in the two countries were undoubtedly important. But since the low-interest loans to the *chaebol* were pursued mainly in the 1970s, this explanation alone does not explain their similar structure throughout the 1980s and up until recently. Besides such a policy-based explanation, Ghemawat and Khanna (1998) provide three other reasons for business groups, which we discuss below. Our model will build upon the *first* of these – market power. Khanna (2000) concludes that this is the least understood possible reason for the existence of groups, so we provide the greatest justification for it.

Since business groups typically are selling a range of different products, they benefit from multi-market collusion, analyzed in a repeated game by Bernheim and Whinston (1990). While our model will be static, the multi-firm nature of groups will contribute to higher prices and profits. Thus, for multi-product groups that are *horizontally* integrated, profits are increased through strategic choice of prices for final goods. This will occur in our model. In addition, for *vertically* integrated groups, we again expect that profits are increased through strategic choice of prices for intermediate inputs. This can be understood as follows.

It is well-known that if both the upstream and downstream firms are monopolies, then integration eliminates the so-called "double marginalization" of prices and raises profits. The same result holds when the downstream firm is competitive but uses the input in variable proportions (see the references in Perry, 1989, 191-192). A subsequent literature (see Dixit, 1983, Mathewson and Winter, 1983, and Perry and Groff, 1985) has considered forward integration from a monopolist to a downstream industry that is monopolistically competitive. They argue that the benefits of integration can be *equivalently achieved* through price-based methods of vertical restraint, or "nonlinear pricing," such as franchise fees, royalties, and resale price maintenance. Thus, these price-based methods of vertical restraint apparently eliminate the need for vertical-integration through ownership.

In our model we will suppose that firms *within* a business group can act in this manner, effectively selling the intermediate input at marginal cost while covering fixed costs through transfers between firms. That is, even though the upstream and downstream firms are not fully-owned by single company, we suppose that their membership within a business group confers the communication and controls necessary to achieve the same result: marginal-cost pricing for internal sales. The ability to achieve this outcome, and thereby maximize joint profits, amounts to our definition of a business group.

In contrast, we do *not* suppose the group firms can engage in nonlinear pricing for sales *outside* of the group. The reasons for this is that the optimal type of pricing contract for external sales would be quite complicated. In our model, *business groups not only sell inputs to unaffiliated firms, but also compete with unaffiliated firms in the downstream market.* Thus, even if a group could extract the full surplus on input sales to an unaffiliated downstream firm (through nonlinear pricing), it would still normally want to *restrict* those sales to limit the competition it faces with that firm in the downstream market. There may be some form of vertical-restraint that would limit this competition, such as a the purchase of an input bringing with it an agreement to limit sales of the final good, but this is more complex than the situation analyzed by the literature cited above. Indeed, Dixit (1983, 94) concludes his paper with the observation: "Most importantly, it was assumed that the upstream firm was a monopolist. In most actual contexts there are several such firms, and strategic interactions among them are important. Questions of whether each downstream firm will be tied to one upstream firms or can diversity across them make the analysis difficult." This is precisely the situation that we will be modeling, with business groups and unaffiliated firms selling in *both* upstream and downstream markets. This complexity forces us to ignore price-based methods of vertical restraint for sales *outside* of a group; instead, we shall simply assume linear pricing and solve for the optimal markup on outside sales. This approach is also taken by Pepall and Norman (2001), for much the same reasons as us.

A second explanation sometimes given for business group is their use of "related resources," interpreted broadly to include all externalities or scale and scope economies between the activities of the group (Mehra, 1994). This is probably important for the business groups in Taiwan, given their narrow focus on particular upstream products, and may also motivate integration into related industries for the Korean *chaebol*. It does not appear to provide an explanation for the wide diversification in the largest groups in Korea, however.

A third explanation often given is that groups might correct for some market failure, either in financial markets, or because of transactions costs (Chang and Choi, 1988; Levy, 1991), or in the allocation of entrepreneurial ability (Leff, 1978). Failure of financial markets is often cited as an explanation for the "main bank" groups in Japan, and are undoubtedly important.[9] Financial ties to banks seem to be less important in South Korea and Taiwan, but at the same time, the groups actively transfer funds between affiliate firms through "affiliate payment guarantees" on bank loans and the sale of commercial paper from one affiliate firm to another (Yoo, 1999). For example, in Korea the major firms (*churyok kiop*) in a business group guarantee the bank loans made by their subsidiaries (*chahoesa*) in the group. Because only large-sized firms enjoy accessibility to bank loans, the major firms in a business group play the role of

[9] See Aoki and Patrick (1994), Hoshi, Kashyap and Sharfstein (1990a, 1991), Lincoln, Gerlach and Ahmadjian (1994) and Weinstein and Yafeh (1995, 1998).

financial provider for all other affiliates (Yoo 1995, pp. 180-186).[10] Thus, the Korean groups indeed provide aspects of an "internal" capital market. Indeed, there is a fundamental reason in our model for such internal transfers: 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.

Thus, even in our market-power model, there is a special reason to expect financial transfers between firms, and that these transfers will lead to some inefficiency. We are *not* suggesting here that the market-power explanation encompasses the financial market failure explanation for groups: on the contrary, the main bank groups in Japan and conglomerate groups found elsewhere are likely to diversify into unrelated areas as they seek investment opportunities for internal funds, and this may well have little to do with market power. Rather, we are arguing that in any model that stresses market power in vertical sales, we should *also* expect to see financial transfers to cover losses, which results in some inefficiency due to the attendant principle-agent problem within the group. We shall refer to this inefficiency as "governance costs," and discuss how it is modeled in the next section.

Before turning to the model, it is useful to consider what the objective of a group should be. This depends on why the group exists. Under the financial market failure explanation, institutions within the group (call them banks) are allocating loans. The objective of these banks presumably involves some tradeoff between risk and return, but need not be identical to the

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[10] 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,

objectives of the group firms. There is a substantial empirical literature investigating the effect of group membership on profits, particularly through resolving capital markets imperfections, and results vary across countries.[11] Perhaps the most pessimistic hypothesis, advanced by Weinstein and Yafeh (1998), is that the banks in Japan are acting as monopsonists in charging excessive interest rates to group firms, thereby funneling off profits. Without taking a stand on the generality of this result, it appears that for groups arising due to financial market imperfections, the bank and group may have conflicting objectives.

Turning to the market-power explanation for groups, this type of conflict need not arise. For firms within a group that are jointly exercising market power in a downstream market, Clayton and Jorgenson (2000) have recently shown that the cross-holding of equity will induce them to internalize the effects of their quantity decision on other firms, thereby raising joint profits. In other words, the cross-holding of equity will move the group towards maximizing *joint* profits. For groups that are selling intermediates, the same objective may apply, subject to the costs we have noted of making transfers to the upstream firms to cover their losses. We will adopt *joint profit maximization* as the objective of a group in our model, in part because it greatly simplifies the analysis. We recognize, however, that this hypothesis may be more appropriate to the strong central control exercised by the family-run groups found in Korea (Chang, 1999), than to the more flexible family firms in Taiwan (Hamilton and Kao, 1990; Wong, 1985).

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

[11] It is known that group membership may offset liquidity constraints otherwise faced by firms: see Hoshi, Kashyap and Sharfstein (1990a, 1991) for Japanese bank-centered groups, and Perotti and Gelfer (2001) for Russian financial groups. However, this does not necessarily mean that profits are increased for the groups. For Japan, studies including Caves and Uekusa (1976) and Weinstein and Yafeh (1995) find that the firms affiliated with groups in Japan are not more profitable than unaffiliated firms. Khanna and Rivkin (2001) use a broader cross-country study and find that group membership raises profits in six countries and lowers it in five, though capital market imperfections are not correlated with the performance of groups. In addition, Khanna and Palepu (2000a) find a non-linear relationship between affiliate profitability and the diversification of Indian groups.

3. A Model of Business Groups

We will 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. 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. 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. At discussed above, the running of a group can be expected to have some costs of bargaining and agency, associated with distributing the group's profits among affiliate firms. This is very much in the spirit of the diseconomies of size 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.[12] Modeling these "governance costs" in any detail would lead us into financial details about the relationship

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[12] 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.

between groups and banks, which is well beyond the scope of our market-power based model.[13] 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).

It will be important to specify the sequence of decisions in this model. One possibility is to consider a three-stage game, where the price and number of *final goods* for groups, (q_{bi}, N_{bi}), $i=1,\ldots,G$, and the *price* for unaffiliated downstream firms, q_{cj}, $j=1,\ldots,N_c$, are determined in the *third stage*; the price and number of *intermediate inputs*, (p_{bi}, M_{bi}), $i=1,\ldots,G$, and the *price* of unaffiliated upstream firms, p_{cj}, $j=1,\ldots,M_c$, are determined in the *second stage*; and the *number of groups and unaffiliated firms* G, M_c, and N_c are determined in the *first stage* to ensure non-positive profits. This formulation would ensure that when group i sells its intermediate inputs externally at the price of p_{bi}, it will take into account the effect of this on the final goods price q_{bj} of all other groups, $j\neq i$, since these are chosen at a later stage. But this formulation leaves out the possibility that a group can exercise some vertical restraint over its downstream firms, such as resale price maintenance, and thereby *commit* to certain prices for final goods. Since resale price maintenance is a common assumption within models of wholesalers-retailers (see Ordover, *et al*,

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13 Theoretical models of financially interlinked groups include Kim (1999) and Ghatak and Kali (2001). In empirical work, Hoshi, Kashyap and Scharfstein (1990b) investigate firms that *left* bank-centered groups following deregulation in 1983, and suggest that one reason this may have occurred was due to conflicting objectives of the banks and shareholders, where the banks are too conservative. Along different lines, Khanna and Palepu (2000b) investigate Indian groups, and find that groups with greater internal financial transfers (and therefore less transparency) are less attractive targets for foreign investment

1990, 1992, and Chen, 1999), we will want to give the same degree of control to business groups, and shall incorporate it into our model.

Rather than considering a resale price ceiling or floor, we will instead allow for a *pricing rule*, whereby business group i commits to price its final goods at the markup μ_{bi} over marginal cost. Denoting marginal costs by ϕ_{bi}, the final goods prices are then $q_{ib} = \mu_{bi}\,\phi_{bi}$, where μ_{bi} is chosen optimally at the *second stage* of the game (given the choices of the other groups). There is now little reason to distinguish the second and third stage, and we will collapse these decisions into a *single stage*, where the strategies chosen are $(p_{bi}, M_{bi}, \mu_{bi}, N_{bi})$ for each business group i=1,…,G, the prices p_{cj}, j=1,…,M_c for upstream unaffiliated firms, and the markups μ_{cj} for downstream unaffiliated firms, j=1,…,N_c. Given these optimal strategies, the number of groups and unaffiliated firms are determined at a prior stage to ensure non-positive profits.

Making this setup explicit, the business groups i=1,…,G each maximize joint profits,

$$\max_{\{p_{bi}, M_{bi}, \mu_{bi}, N_{bi}\}} \Pi_{bi} = N_{bi}[y_{bi}(\mu_{bi}-1)\phi_{bi} - k_{yb}] + M_{bi}[\tilde{x}_{bi}(p_{bi}-1) - k_{xb}] - \alpha, \qquad (1)$$

where: N_{bi} is the number of final goods, produced with fixed costs k_{yb}; y_{bi} is the output of each final good, produced with marginal cost ϕ_{bi} and sold at the price $q_{ib} = \mu_i\,\phi_{bi}$; M_{bi} is the number of intermediate inputs, produced with fixed costs of k_{xb}; $\tilde{x}_{bi}$ is the quantity sold *outside* the group of each intermediate input, at the price p_{bi} and produced with marginal costs of unity; and α is the level of fixed "governance costs" associated with the running of a business group. These governance costs may also depend on the size of the group, measured by the numbers of products

N_b and M_b, then this will be a reason for the fixed costs k_{yb} and k_{xb} for business groups to *exceed* those for unaffiliated firms, as we shall provide for.

In addition to the external sales of inputs at the price p_{bi}, the group will sell its inputs internally at marginal costs of unity, and we will denote the *internal* quantity sold by x_{bi}. 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 on the amount of the transfer*, though they can depend on the numbers of upstream and downstream firms, as noted above. It is this simplifying assumption that allows us to ignore the transfer in the specification of (1).[14]

The marginal cost of producing each output variety for the group j=1,…,G is assumed to be given by the CES function:

$$\phi_{bj} = w^{\beta}\left(M_{bj} + \sum_{i=1, i\neq j}^{G} M_{bi} p_{bi}^{1-\sigma} + \sum_{i=1}^{M_c} M_{ci} p_{ci}^{1-\sigma} \right)^{\left(\frac{1-\beta}{1-\sigma}\right)}, \qquad (2)$$

where: w is the wage rate, and labor is a proportion β of marginal costs; M_{bj} inputs are purchased internally at the price of unity; M_{bi} inputs are purchased from the other $i=1,\ldots,G$, $i\neq j$ groups, at the price of p_{bi} ; and M_{ci} inputs are purchased from unaffiliated upstream firms at the

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[14] 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). This would still imply the maximization of groups profits overall, with the bargaining strength of individual firms then affecting their share of profits.

price of p_{ci}, i=1,…,M_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 j=1,…, M_c each choose their price to maximize profits:

$$\max_{p_{cj}} \; x_{cj}(p_{cj} - 1) - k_{xc}, \tag{3}$$

where: x_{cj} is the output of each intermediate input, sold at price p_{cj} and produced with marginal cost of unity and fixed costs k_{xc}. Similarly, the unaffiliated downstream firms j=1,…, N_c each choose their markup μ_{cj} to maximize profits:

$$\max_{\mu_{cj}} \; y_{cj}(\mu_{cj} - 1)\phi_c - k_{yc}, \tag{4}$$

where: y_{cj} is the output of each final good, produced with marginal cost ϕ_c and fixed costs k_{yc} and sold at price $q_{cj} = \mu_{cj}\,\phi_c$. The marginal cost of producing each output variety is:

$$\phi_c = \left(\sum_{i=1}^{G} M_{bi} p_{bi}^{1-\sigma} + \sum_{j=1}^{M_c} M_{cj} p_{cj}^{1-\sigma} \right)^{\left(\frac{1-\beta}{1-\sigma}\right)}, \tag{5}$$

where: M_{bi} are inputs purchased from i=1,…,G business groups at the price of p_{bi}, and M_{cj} inputs are purchased from unaffiliated upstream firms j=1,…,M_c at the price of p_{cj}. 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 (5), because the business groups are able to purchase their own inputs at the cost of unity.

Using the cost functions, we can also define the external sales of each intermediate input, $\tilde{x}_{bi}$, which appears in (1). Specifically, we differentiate (2) and (5) with respect to the price p_{bi}, multiply these by the outputs $N_{bj}y_{bj}$ and and y_{cj}, respectively, and sum these to obtain:

$$\tilde{x}_{bi} = \frac{1}{M_{bi}}\left[\sum_{j=1, j\neq i}^{G} N_{bj} y_{bj}\left(\frac{\partial \phi_{bj}}{\partial p_{bi}}\right) + \sum_{j=1}^{N_c} y_{cj}\left(\frac{\partial \phi_c}{\partial p_{bi}}\right)\right]. \qquad (6)$$

The term $(1/M_{bi})$ appears because $\tilde{x}_{bi}$ refers to the external demand for *each* intermediate input sold group i, of which there are M_{bi} in total. Substituting (6) into (1) gives the complete expression for profits of a business group.

With profits maximized as in (1), (3) and (4), we will restrict our attention to *symmetric* equilibria, where each business group produces the same number M_b of intermediate inputs and N_b of final goods, sold at prices p_b and markups μ_b, respectively. Similarly, unaffiliated upstream and downstream firms each have the same prices, denoted by p_c and $q_c = \mu_c\phi_c$, respectively. Then we choose the total number of business groups G, as well as the number of upstream and downstream products from unaffiliated firms, M_c and N_c final goods, such that profits for all these groups are non-positive. A key question of interest will be whether the solutions for G, M_c and N_c are unique or not: is there more than one configuration of groups and unaffiliated firms that are consistent with equilibrium?

The possibility of multiple equilibria will depend on the optimal prices, of course, and we shall solve for these in the next section. But even before this, it useful to consider the possible configurations of groups and unaffiliated firms that can arise in 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 then 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: **(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 each product, 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 that will rule out merger 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.

4. Optimal Prices and Output

We assume that demand for the differentiated final products arises from a CES demand system with elasticity η, and that the final products are traded internationally. It follows that the demand for a single output variety from a business group can be written as:

$$y_{bi} = \frac{q_{bi}^{-\eta}(L + w^* L^*)}{[\sum_{j=1}^{G} N_{bj} q_{bj}^{1-\eta} + \sum_{j=1}^{N_c} q_c^{1-\eta} + N^*(q^*)^{1-\eta}]} \quad , \qquad (7)$$

where w*L* in the numerator is foreign income, and N* in the denominator is the range of foreign varieties, sold at the price of q*. Since the intermediate inputs are not traded, trade is balanced in the final goods sector. Due to trade-balance, the foreign wage and price in (7) are endogenous, and solving for their equilibrium values the demand expression is simplified as,[15]

$$y_{bi} = \frac{q_{bi}^{-\eta} L}{[\sum_{j=1}^{G} N_{bj} q_{bj}^{1-\eta} + \sum_{j=1}^{N_c} q_c^{1-\eta}]} \quad . \qquad (7')$$

This is identical to the expression for demand in a closed economy. That is, making use of the trade-balance condition, the total (domestic plus foreign) demand for each final product with trade in (7) is identical to the domestic demand in the absence of trade in (7'): while trade benefits consumers through increased product variety, it does not affect the pricing decisions of firms. It follows that the equilibria that we shall compute are equally valid in an open or a closed economy: the assumption of trade balance has eliminated any difference between these from the firms' point of view.

We shall use this demand system to compute optimal markups on final goods, and for convenience, express these in the *symmetric* equilibrium (dropping the subscripts distinguishing each group and unaffiliated firms). Given the CES demand function in (7), the optimal markup for each unaffiliated downstream firm equals:

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[15] Trade balance in final goods means that home import expenditure equals home exports. Denoting the denominator of (7) by D, trade balance is expressed as: $LN^*(q^*)^{1-\eta} / D = w^* L^* (\sum_{j=1}^{G} N_{bj} q_{bj}^{1-\eta} + \sum_{j=1}^{N_c} q_c^{1-\eta}) / D$. Using this equality in (7), we immediately obtain (7').

$$\mu_c - 1 = \left(\frac{1}{\eta - 1}\right). \qquad (8)$$

Substituting (8) into (4), profits become $[y_c/(\eta-1)]\phi_c - k_{yc}$, and setting these equal to zero we obtain the level of output:

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

While this expression for output under monopolistic competition is not that familiar, it follows directly from the markups in (8), and will be useful in computing equilibria.

Turning to the business groups, we solve for the number of final goods N_b, and the optimal markup μ_b for each group. Note that there is a natural limit on the range of varieties that any group will want to produce. Starting with a group of some size, if it were to develop another differentiated final product for sale to consumers, then this would involve the usual fixed costs, but the revenue received from the sale of the good would in part come by drawing demand away from other products sold by the same group. Thus, after it has reached some size a group would no longer find it profitable to expand its range of final goods, even though an unaffiliated firm might choose to enter the market.

Each business groups sells a positive range N_b of final products, and it follows from (7) that the elasticity of demand with respect to a change in the price of its products is,

$$\frac{\partial y_{bi}}{\partial q_{bi}} \frac{q_{bi}}{y_{bi}} = -[\eta + s_{ybi}(1-\eta)], \qquad (10)$$

where s_{ybi} denotes the market share of its products:

$$s_{ybi} = \frac{N_{bi} q_{bi}^{1-\eta}}{(\sum_{j=1}^{G} N_{bj} q_{bj}^{1-\eta} + \sum_{j=1}^{N_c} q_{cj}^{1-\eta})}. \tag{11}$$

Using symmetry, the optimal markup of price over marginal cost therefore equals,

$$\mu_b - 1 = \frac{1}{[\eta + s_{yb}(1-\eta) - 1]} . \tag{12}$$

To determine the optimal number of output varieties, we can differentiate (1) with respect to the number of varieties sold by a single group, and set this equal to zero, obtaining:[16]

$$y_b(\mu_b - 1)\phi_b - k_{yb} - s_{yb} y_b (q_b - \phi_b) = 0. \tag{13}$$

The first terms on the right of (13) are the direct gain in profits from selling another output variety, less the fixed costs of production. However, expanding product variety will also have the effect of reducing the demand for other varieties sold by the same group, which is the last term on the right of (15). The optimal choice for the number of product varieties will just balance these two effects.

Notice that combining (12) and (13) we obtain, $[y_b \phi_b /(\eta - 1)] - k_{yb} = 0$. Therefore, we obtain the final output of a downstream group firm:

$$y_b = (\eta - 1) k_{yb} / \phi_b . \tag{14}$$

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[16] To derive (13), we differentiate (7') with respect to the number of varieties sold by a single group, obtaining $dy_{bi} / dN_{bi} = -y_{bi} q_{bi}^{1-\eta} \Big/ (\sum_{j=1}^{G} N_{bj} q_{bj}^{1-\eta} + \sum_{j=1}^{N_c} q_{cj}^{1-\eta}) = -s_{ybi} y_{bi} / N_{bi}$. Using this and symmetry, we readily obtain (13) by differentiating (1).

Thus, we obtain the same general formula for output for the business groups in (14) and unaffiliated downstream firms in (9), though with the business group having lower marginal costs ($\phi_b < \phi_c$) and higher fixed costs ($k_{yb} \geq k_{yc}$), their output is correspondingly *higher*. Intuitively, the economies of scale inherent in a vertically-integrated group lead it to produce longer production runs.

While business groups sell a higher quantity of each final good, it is also the case that their *sales revenue* from each final variety exceeds that of an unaffiliated downstream firm. This can be seen by comparing (9) and (14), obtaining $\phi_b y_b = (\eta - 1)k_{yb} \geq (\eta - 1)k_{yc} = \phi_c y_c$. With the markup over marginal costs higher for the group than an unaffiliated firm [compare (8) and (12)], it immediately follows that $q_b y_b > q_c y_c$, so that the *sales revenue* from each downstream product produced by a business group exceeds that for an unaffiliated downstream firm. This result has important implications for *total variety* of final goods in the economy.

To determine downstream variety, we close the model with the full employment condition. There are several ways to write this, but one that will be convenient is the equality of national product measured by the value of final goods, and total wage income received. The latter is just L, or the labor supply. The former is the total value of final goods produced by business groups and any nonaffiliated downstream firms, so that,

$$L = GN_b q_b y_b + N_c q_c y_c. \tag{15}$$

If there are only business groups in equilibrium, then product variety is $GN_b = L/q_b y_b$, whereas if there are only unaffiliated firms then product variety is $N_c = L/q_c y_c$. With $q_b y_b > q_c y_c$ as shown above, it follows immediately that *an economy that includes business groups will have lower* *variety of final goods than an economy with the same parameters but composed entirely of unaffiliated firms.* This generalizes the result of Perry and Groff (1985), and is a hypothesis that can be tested empirically, as discussed in section 6.

We next solve for the prices of the upstream unaffiliated firms. The elasticity of demand facing the upstream firms is σ, so that the markup of the optimal price over marginal costs equals:

$$p_c - 1 = \left(\frac{1}{\sigma - 1}\right) . \tag{16}$$

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

$$x_c = (\sigma - 1) k_{xc} . \tag{17}$$

Again, we obtain a simple expression for output under monopolistic competition, which will be useful in computing equilibria.

Finally, we turn to the optimal range of inputs developed by each group (M_b) and the price for external sale of these inputs (p_b). Choosing M_b to maximize profits in (1), the following result is derived in the Appendix:

$$x_b + \tilde{x}_b = (\sigma - 1) k_{xb} , \tag{18}$$

where $\tilde{x}_b$ is the quantity of each inputs sold *externally* to the business group, and x_b is the quantity sold *internally*. Comparing this expression with (17), we see that group firms sell the same *total* quantity of each input as do unaffiliated upstream firms in the case when their fixed costs are the same, $k_{xb} = k_{xc}$. This is a rather remarkable result, considering the fact that group firms charge different prices for the sales of the intermediate input to firms within and outside its own group. Indeed, there is no guarantee that group firms will find it optimal to sell to outside firms at all: the optimal price for outside sales may be $p_b = +\infty$. By definition this situation cannot arise in a *U-group* equilibrium, since in that case there are no unaffiliated upstream producers, so that if the business groups decided to not sell intermediate inputs then no unaffiliated downstream producers could survive (and the equilibrium would be one of *V-groups*). Thus, to determine whether the groups will choose to sell to other firms, we focus on the case of either *V-groups* or *D-groups*, so that $N_c = 0$:

Lemma

Suppose that $N_c = 0$. Then each group will sell inputs to the other groups if and only if,

$$G > \left(\frac{\sigma}{\sigma - 1}\right), \tag{19}$$

in which case the optimal prices are given by:

$$\left(\frac{p_b - 1}{p_b}\right) = \frac{1}{[\sigma + s_{xb}(1-\sigma)]}\left(\frac{G}{G-1}\right). \tag{20}$$

In (20), s_{xb} is the share of total sales of intermediate inputs made by each business group, given by,

$$s_{xb} = \left[\frac{M_b p_b^{1-\sigma}}{M_b + (G-1)M_b p_b^{1-\sigma} + M_c p_c^{1-\sigma}}\right]. \tag{21}$$

The term $[\sigma + s_{xb}(1-\sigma)]$ is the elasticity of demand for input varieties from one group. Equation (20) differs from the standard Lerner formula by the extra term $G/(G-1) > 1$. This reflects the fact that when a group sells an input, it will give competing firms a cost advantage, thereby lowering profits in the final goods market. Accordingly, it will charge a higher price than usual. If G is too small, so that (19) is violated, then profits will continually increase as p_b is raised and the group optimally chooses $p_b = +\infty$. In this situation the groups sells none of their inputs externally, and $\tilde{x}_{bi} = 0$ in (6) for i=1,…,G.

With this description of business groups' pricing and output decisions, it becomes possible to compute equilibria for the economy. In addition to the equations above, the complete model consists of a number of business groups G, and nonaffiliated firms M_c and N_c, such that the profits earned by each group are non-positive. In the Appendix, we show how a small number of (nonlinear) equations characterize equilibria in each of the three configurations: **(1)** ***V-groups*** - the business groups prevent entry of unaffiliated producers in both the upstream and downstream sectors; **(2)** ***D-groups*** - business groups are the only firms in the downstream sector, while purchasing inputs from unaffiliated upstream firms; **(3)** ***U-groups*** - business groups are the only firms in the upstream sector, but also compete with unaffiliated downstream firms. We solve these equations from a wide range of starting values in order to check for possible equilibria. As noted at the end of the previous section, we will chose the fixed governance costs intentionally to try and rule out the complex case where all types of firms coexist, though we will still indicate the parameters under which that situation arises.[17]

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[17] See note 20, as well as the area of Figure 1 labeled with the question mark.

5. Computation of Multiple Equilibria

The above Lemma shows that the prices charged by business groups for the intermediate inputs depends on the number of groups, or the degree of concentration in the upstream sector. Furthermore, as we have already argued, the gains from vertical-integration are that intermediate inputs can be sold at their marginal cost, leading to greater efficiency. But now there is a circularity in the argument: the incentive to vertically-integrate is strongest when there is a high degree of concentration in the upstream sector, but this concentration could simply reflect that presence of a *small* number of business groups dominating that sector. Conversely, if there were a *large* number of business groups (and unaffiliated firms) selling in the upstream market, then the markups would be correspondingly lower, as would be the incentive to vertically-integrate. This kind of circular reasoning is precisely what gives rise to multiple equilibria in any economic model, and ours is no exception. When we solve for the equilibrium number of groups, we therefore expect to observe both equilibria with a small number of business groups that are highly integrated, and those with a large number of groups (and unaffiliated firms) that are less integrated.

This equilibria that we find are illustrated by the points in Figures 1 and 2. All these equilibria are obtained using the parameter values α=0.2, β=0.5, $\eta \leq 5$, $k_{xb}=k_{yb}=5$, L=1000, and incremental values of σ from unity to 3.5.[18] The value for k_{xc} and k_{yc} are set at 5 initially, and adjusted to be lower if needed to prevent unaffiliated firms from merging with business groups.

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[18] Initially, we used η=5 for all equilibria. 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 η, especially when the elasticity of substitution for inputs itself was low. Accordingly, all our equilibria are computed with η=5 for $\sigma \geq 2.65$, and equal to with $\eta=1.9\sigma$ for $\sigma \leq 2.60$.

The line $G=\sigma/(\sigma-1)$ is illustrated in Figure 1 as "G=S/(S-1)", and groups will not sell to each other for equilibrium points below this line. Multiple equilibria occur if, for a *given* value of σ, we find *more than one* equilibrium.

5.1 Occurrence of V-Groups

The *V-group* equilibria are illustrated by triangles. Beginning in the lower-left corner of Figure 1, the V-group equilibria are shown by the (approximately) straight line that slopes upward to meet the G=S/(S-1) curve at about $\sigma=2.5$. For higher values of σ the V-group equilibria crosses the G=S/(S-1) curve, at which point the groups begin selling inputs to each other. In this range, it is quite possible to find *multiple solutions* for G, at a given value of σ, as shown by the "S-shaped" graph of the V-group equilibria bending back on itself around $\sigma=3.2$, and then again sloping upward around $\sigma=2.8$. This is our first finding of multiple equilibria.

We have numerically checked the stability of the equilibria along all portions of the V-group graph. To do so, we allow an exogenous increase in the number of business groups G, and calculate the corresponding profits of a group Π_b after allowing all other variables to adjust to their equilibrium values. If these profits are negative, then some business groups would be induced to leave and the economy would return to its initial equilibrium, so the system is *stable*; but if the profits are positive following an increase in G, then even more groups would enter, and the initial equilibrium is *unstable*. The result of this calculation is that all equilibria along the lower-portion of the V-group graph are stable, whereas the middle-portion where the graph bends back on itself are unstable, and then the top-portion where it again slopes upward is stable.

The contrast between the various branches of the V-group graph can also be seen in Figure 2, where we illustrate the equilibrium price p_b charged by the business groups for external sales of the intermediate inputs. As the V-group graph crosses the G=S/(S-1) curve at about σ=2.5, the price charged for the intermediate inputs falls from +∞ to finite levels. It continues to fall as the V-group graph bends back on itself (along the unstable portion), and then bends forward again. The stable portion corresponds to either very high or very low prices for the intermediate input, whereas the unstable branch corresponds to an intermediate price.

The occurrence of these multiple equilibria, with a small and large number of business groups, respectively, corresponds quite closely to the intuition for multiple equilibria described in the beginning of this section. We have also checked that at all the V-group equilibria illustrated, the profits of both upstream and downstream unaffiliated firms are negative when they have fixed costs of $k_{xc}=k_{yc}=5$ or slightly less. The point at which unaffiliated firms begin to earn positive profits occurs at the top-portion of the V-group graph, where it makes a transition to the U-group equilibria, as described next.

5.2 Occurrence of U-Groups

With $N_c > 0$, the equilibrium number of business groups is shown along the U-group graph in Figure 1. This is a natural extension of the stable portion of the V-group graph for values of σ exceeding 2.8, and arises because the profits of unaffiliated downstream firms in the V-group equilibrium then become positive. In the U-group equilibrium, these downstream firms enter until they earn zero profits. We have adjusted the value for $k_{yc}<5$ along these equilibria so that it is just unprofitable for the business groups to take over the downstream unaffiliated firms and pay the higher fixed costs of $k_{yb}=5$.[19] The presence of the downstream unaffiliated firms

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[19] The U-group equilibria illustrated in Figure 1 were calculated for values for k_{yc} ranging from 4.73 to 4.82. We have also confirmed that the profits of the upstream unaffiliated firms are strictly negative along these equilibria, and

means that the business groups themselves are not strongly vertically-integrated. This is reflected in a low price for the intermediate input, as shown along the U-group graph in Figure 2.

5.3 Occurrence of D-Groups

As the third form of economic organization, the D-group equilibria with $M_c > 0$ are illustrated near the top of Figure 1. Beginning at the left this equilibrium first appears around σ=1.8, where the other parameter values are the same as used above.[20] We choose k_{xc} slightly less that 5 so that it is unprofitable for business groups to take over the upstream unaffiliated firms and face the slightly higher fixed costs of k_{xb}=5. For higher values of σ the number of groups declines along the D-group graph, and up to the value σ=2.8 we have confirmed that the D-group equilibria are stable, in the sense that a slight increase (decrease) in the number business groups will lower (raise) their profits from zero.[21] The fact that these equilibria occur at the *same values of σ* as some of the V-group configurations is another finding of multiple equilibria.

For $\sigma > 2.8$, which we have labeled with a *question mark* in Figure 1, we find an alternative equilibria that satisfies all the conditions of a stable D-group equilibrium except for one: profits of the *downstream* unaffiliated firms are positive along this branch, so that they would want to enter. In these region, therefore, we expect to see business groups coexisting with both upstream and downstream unaffiliated firms. We have not solved for the complete equilibrium conditions in this case, and it lies outside the configurations we are focusing on.

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that these equilibria are stable, with a slight increase (decrease) in the number of groups leading to negative (positive) group profits. The U-group equilibria continue to exist for higher values of σ beyond those illustrated in Figure 1.

[20] For $\sigma < 1.8$, there appear to be equilibria where business groups, and upstream and downstream firms all enter. We did not attempt to compute these equilibria.

[21] For $1.8 \leq \sigma \leq 2.8$, we actually find multiple D-group equilibria, but only the stable equilibria are graphed.

To summarize what are admittedly complex pictures, for a range of values for the elasticity of substitution σ, there is more than one stable equilibrium structure of business groups. Thus, for σ between about 1.8 and 2.8, there is either a "high concentration" equilibria shown by the V-groups in Figure 1, with a small number of large business groups; or a "low concentration" equilibria shown by the D-groups, with a large number of smaller groups. Alternatively, for σ in the range from about 2.8 to 3.2, there is either a "high concentration" equilibria again shown by the V-groups in Figure 1 (with $G<4$); or a "low concentration" equilibria shown by the U-groups (with $G>12$). The finding of *multiple equilibria* is not very sensitive to the parameters we have used, which were chosen mainly to rule out the simultaneous occurrence of unaffiliated upstream and downstream firms, and therefore simplify the computations. We feel that the multiplicity of equilibria is a generic feature of our model, and arises from the interaction of *price of intermediates* and the *number of groups:* with a large number of small groups, there is an incentive to price low, which supports this equilibrium; and with a small number of large groups, there is an incentive to price high, again supporting the equilibrium.

5.4 Characteristics of the Groups

To gain a further understanding of the various equilibria, we compute some variables of interest. In Figure 3 we display the total sales of each business groups in the various equilibria, computed as the sales of intermediate inputs within and outside the group (the former are priced as marginal cost of unity), plus the sales of final goods. In the equilibria with a small number of V-groups, the groups are quite large in terms of sales. This is especially true when $G < \sigma/(\sigma-1)$, so that the groups do not sell inputs to each other. We think that these strongly-integrated V-groups are suggestive of the "top five" groups in South Korea, which have exceptionally high sales, as discussed in section 2. In comparison, the U-groups and D-groups are both quite small in terms of sales, more like the groups in Taiwan.

In our discussion of the actual groups in South Korea and Taiwan, we stressed that the "top five" groups in Korea have higher *internalization,* measured by the ratio of internal sales to total sales by each group. We have computed the same ratio for the various equilibria, and show this in Figure 4. For σ in the range from 1.8 to 2.8, where both D-groups and V-groups occur, the V-groups in the "high concentration" equilibria always have higher internal sales ratios. Similarly, for σ in the range from 2.8 to 3.2, , the V-groups in the "high concentration" equilibria have higher internal sales ratios than either the (unstable) V-groups or U-groups in the "low concentration" equilibria. In other words, having a small number of large groups means that these groups are strongly vertically-integrated.

At the same time, by virtue of their large size, the V-groups in our model are diversified across a wide range of intermediate and final varieties. This is shown in Figure 5, where we graph the Herfindahl index of product diversification for a single group, computed over all intermediate and final varieties.[22] As is apparent from this figure, the V-groups are producing the greatest range of product varieties, and this is true for both intermediate and final goods (similar figures are obtained if we consider group diversification over inputs and outputs separately). Thus, the market power that we have built into our model leads not only to vertical integration, but also to horizontal diversification as groups increase their prices across multiple markets (Bernheim and Whinston, 1990). As we noted at the end of section 2, there may well be *other* reasons for horizontal diversification (such as the group acting as a source of capital) that we

[22] This is defined as $1-\sum_i s_i^2$, where s_i is the share of total group sales devoted to *each* intermediate or final product variety.

have left out of our model, but it is noteworthy that that market power alone is enough to explain a substantial degree of horizontal diversification, in addition to vertical integration.

Despite the fact that the V-groups are diversified over the greatest number of products, it *does not* follow that these equilibria will have the greatest *economy-wide* product variety. Indeed, as argued in section 3, we expect an equilibria with business groups to have a *lower* overall number of final products than would occur without such groups, because the groups sell a higher quantity and value of *each* variety. We did not derive any prediction about the economy-wide number of intermediate inputs, however. In Figures 6 and 7 we show the economy-wide number of intermediate and final goods, respectively. We see that the extent of *input* variety is highest in the V-group equilibria, but that the reverse result holds for *output* variety: the number of final goods is lower in the V-group equilibria than that obtained with either D-groups or U-groups.[23] Thus, despite the horizontal diversification of the large V-groups, these equilibria display the feature that the *economy overall* is more specialized. We think that this fits the anecdotal characterization of many South Korean groups as wanting to become “world leaders” in specific products, such as cars (the Hyundai), microwave ovens or dynamic random-access memory chips, so that the economy becomes quite specialized in these products. 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.

Finally, we consider the prices charged for the final goods. Since Spengler (1950), it has been thought that vertical integration of successive monopolies would bring welfare gains to consumers in the form of lower prices, i.e. the integrated firm would sell a higher quantity of the

[23] Product variety is higher in the D-group equilibria than the U-group equilibria in Figure 7 because the former is computed for smaller values of η (see note 18). Aside from this feature, product variety would be quite comparable across the D-group and U-group equilibria.

final good, at a lower price, than would the non-integrated industry. This has resulted in the "Chicago view" that vertical integration, and more generally, vertical controls on downstream suppliers, are not harmful to the consumer. Rather, public policy should focus on limiting the exercise of market power through horizontal integration. This reasoning survives an extension to oligopoly settings (Greenhut and Ohta, 1979), though Ordover et al (1990, 1992) argue that when vertical integration results in the *foreclosure* of an upstream firm, then it is possible that the downstream price of the integrated firm might also rise.

In our model, the vertical integration of the V-groups *brings with it* a horizontal integration across product varieties. Thus, the question becomes: do the vertically *and* horizontally-integrated V-groups charge higher or lower prices that U-groups or D-groups? It turns out that the V-groups charge slightly *higher* prices. This is illustrated in Figure 8, where we graph the prices of final goods, q_b, at various values of σ. Except for a small range around $1.8 \leq \sigma \leq 2$, the prices charged by business groups are slightly higher, despite the fact that their marginal costs are lower than for unaffiliated firms. Thus, by treating the organization or business group as an equilibrium phenomena, we find that the *combined* vertical and horizontal integration of the groups tends to lead to higher prices for final goods.[24]

6. Conclusions

In this paper we have contrasted the differing groups structures in South Korea and Taiwan, and used this to motivate a market-power based model of business groups. This

[24] We confirmed in our calculations that with the rise in prices and fall in product variety due to V-groups, then welfare also falls (holding fixed the range of imported final goods). This result will be sensitive, however, to the CES specification of product variety, which means that unaffiliated firms produce the socially optimal variety. In an alternative "address" specification, Dixit (1983) and Mathewson and Winter (1983) find that vertical integration will raise welfare, despite the fall in product variety.

explanation is different from those most often associated with business groups in developing countries, and especially Korea, such as transaction costs or other market failures (e.g. Chang and Choi, 1988, Levy 1991). The reason we have taken this alternative approach is that in comparing Korea and Taiwan, where the groups differ dramatically in structure, it is unclear what features of these economies might lead to varying transactions costs. One of the authors (Hamilton and Biggart 1988; Hamilton, Zeile, and Kim, 1989; Orrù, Biggart, and Hamilton 1997) has written extensively on the sociological differences between the two economies, including patterns of inheritance, authority, etc. But we are not persuaded that these provide an adequate foundation for either transactions costs, or for the differing structure of the groups. As an alternative, we have developed a market-power reason for horizontal and vertical integration, which, as it turns out, leads to multiple equilibria in the group structure.[25] This seems like an appealing result to us because it gives room for sociological differences, as well as past policies, to play a role in the selection of equilibria.

We have found that the structure of business groups can be either strongly vertically-integrated (V-groups), or more weakly integrated and located primarily in either the upstream (U-groups) or downstream (D-groups) sectors. To provide some real-world context for these results, we note that the first of these structures (V-groups) seems to describe the largest *chaebol* in South Korea, whereas the second (U-groups) describes the groups in Taiwan. In another paper (Feenstra, Hamilton and Huang, 2001), we develop this comparison more systematically. Rather than simply "pick" a particular equilibrium as applying to one country and another equilibrium for the second, we consider a whole range of elasticities of substitution $1.8 \leq \sigma \leq 6.6$. For each

[25] Our criticism of the transactions cost approach does not apply to McLaren (2000), however, because he starts in a setting where two countries are *ex ante* identical in their transactions costs, but still can have differing equilibria. Fung and Friedman (1996) also find multiple equilibria in their evolutionary model of business groups.

value of σ, if there are two equilibria then we assign the one with the smaller number of business groups to the "high concentration" set, and the one with the larger number of groups to the "low concentration" set (if there is a unique equilibria then they are in both sets). By this method, the "high concentration" set include both V-groups and U-groups, whereas the "low concentration" set includes both U-groups and D-groups. For each of these sets, we re-graph Figures 3-5, but now measuring observable sales on one axis and horizontal or vertical integration on the other. Then we systematically compare these graphs (visually, and with simple summary statistics) obtained from our theoretical model to the actual group data for South Korea and Taiwan. There is a surprising degree of conformity between the "high concentration" equilibria and the actual data for Korean *chaebol,* and also between the "low concentration" equilibria and the actual data for Taiwanese groups.

Of course, simple pointing out a connection between our theoretical results and the group structure in different countries is not enough to confirm our theory in any sense. Rather, it would be desirable to take a particular implication of the theory, and test it using data from countries with particular group structures. We can think of two such applications, one of which we have performed. In Feenstra, Yang and Hamilton (1999), we measure the product variety of exports from South Korea, Taiwan, and Japan to the United States. We find that Taiwan exports greater product variety to the U.S. than does Korea for the economy overall, and also in most industries, especially those downstream. This fits our characterization of the V-groups equilibria as having lower economy-wide product variety than either U-groups or D-groups (as in Figure 7). We also compare the product variety from each of these countries to that from Japan. Since Japan is much larger than either Taiwan or Korea, in order to apply our model in that case we must consider the impact of country size on product variety. It is readily verified that larger country size (higher L) leads to an increase in product variety. Thus, Japan can be expected to have greater product variety than either Taiwan or South Korea, which we also confirm empirically.

A second application is suggested by the research design of Ghemawat and Khanna (1998). They argue that the response of business groups to large "competitive shocks" can provide information on the initial rationale for the groups. One such shock that has hit South Korea in 1997 was the Asian financial crisis, which led to an unprecedented wave of bankruptcies and restructuring. A very simple way to capture this in our model might be a reduction in demand (i.e. country size).[26] A fall in demand would shift all the equilibria illustrated in Figure 1. In particular, some of the equilibria that were formerly multiple might become unique, so this could imply a large change in the organization of the groups; we might associate this with bankruptcy of some of the groups. In other words, the non-linearity evidence in the "S-shape" of Figure 1 suggests that with a continuous change in market size, we could have a discontinuous change in the equilibrium number of groups. Furthermore, this seems more likely to happen in the *boundary* of the stable and unstable region of V-groups. Our model therefore contains a prediction of which business groups would be most susceptible to large shocks: it is the *intermediate-sized* V-groups, as shown in the *unstable* region in Figure 1. In contrast, the larger V-groups shown in Figure 1 are stable, as are the smaller U-groups and D-groups: small shocks should therefore not have a large change on their structure.

If we accept the characterization of business groups in South Korea as V-groups, our model therefore predicts that the largest and smallest of these would not be affected by the crisis as much as the *intermediate sized* groups. Preliminary evidence from the 1997-99 suggest that, indeed, the intermediate-sized groups in South Korea have experienced the greatest difficulty. Lee (1999) lists 23 groups from the largest 60 *chaebol* that have gone bankrupt during 1997-98. None of these are in the top-five ranked *chaebol*, though his list does not include the recent and highly-publicized bankruptcy of Daewoo (or the current financial difficulties of Hyundai). Thirteen of the cases are among the top 6-30 ranked *chaebol* in 1996, so that *one-half* of these have gone bankrupt. The remaining 10 cases are from the next 31-60 ranked *chaebol*, so that *one-third* of these have gone bankrupt. Of these, several of the groups appeared in the list of top 6-30 groups in 1997 or 1998. Thus, there is some indication that bankruptcies are concentrated among the intermediate-size (top 6-30) *chaebol*, though Daewoo is a notable exception to this, and represents the first time that one of the top five *chaebol* has been allowed to fail.

In Taiwan, by contrast, the financial crisis has been much less severe, and bankruptcies among the business groups have been few. If we accept the characterization of the groups in that country as U-groups, these equilibria are entirely stable in Figure 1, so that we do not expect a temporary shock to have permanent effects. Summing up, we are suggesting that the model developed here may have some empirical content in terms of predicting which groups experience financial difficulty in the presence of large shocks, as we investigate in ongoing work (Feenstra, Hamilton, and Lim, 2002; Feenstra and Hamilton, forthcoming).

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[26] This has an equivalent effect in the model to an increase in governance costs α and all other fixed costs k_{ij}. That is, whenever α or k_{ij} appear in the equilibrium conditions, they appear as (α/L) and (k_{ij}/L), so that a fall in L is equivalent to a rise in the governance costs α and these other fixed costs.

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Figure 1: Number of Business Groups

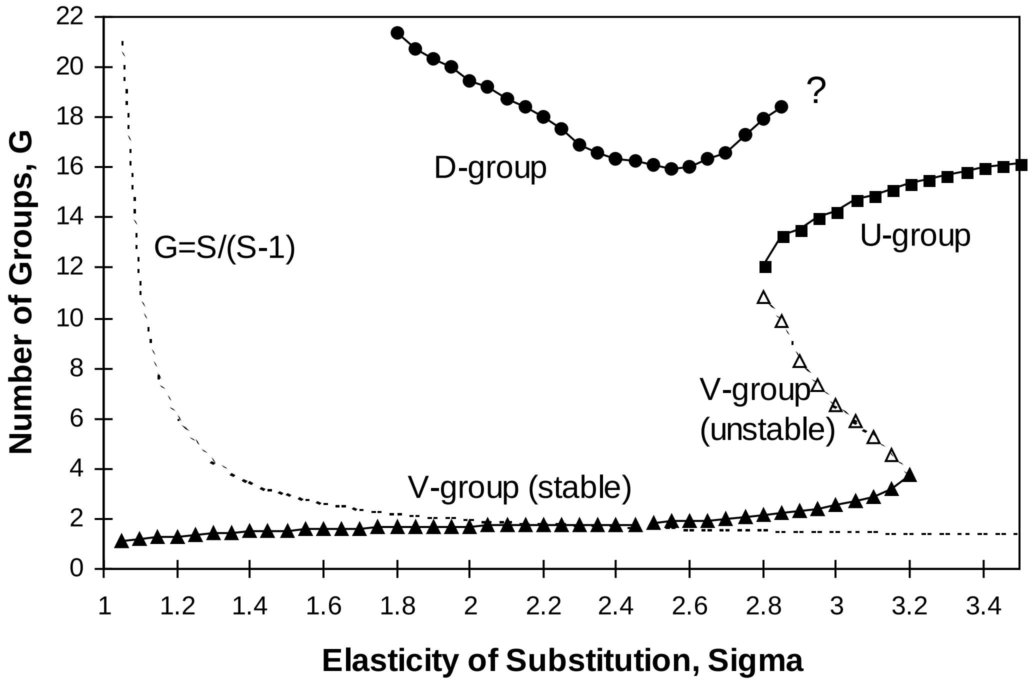

Figure 2: Price of Intermediate Input

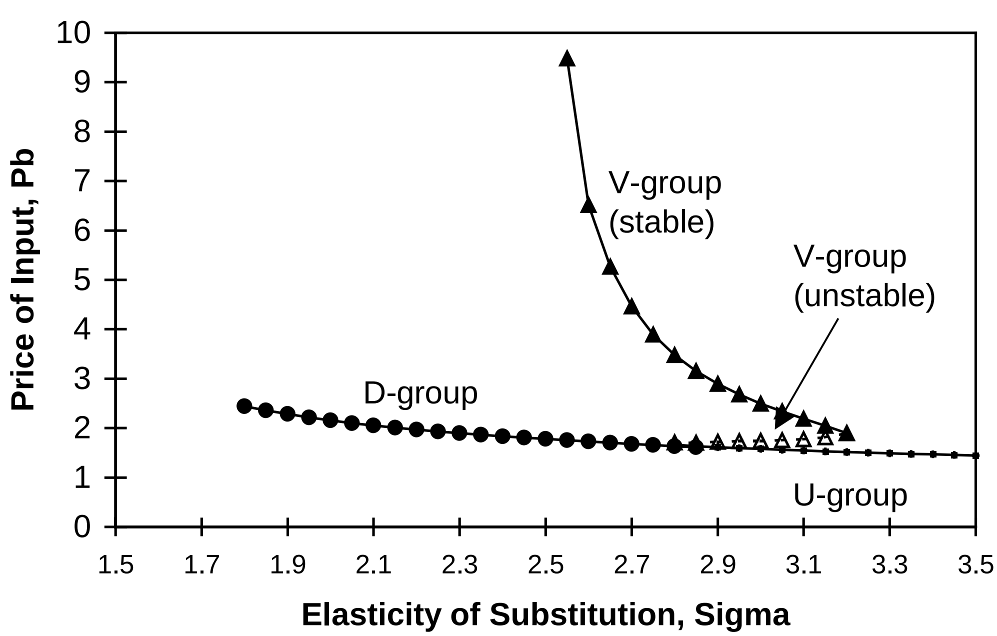

Figure 3: Sales of Business Groups

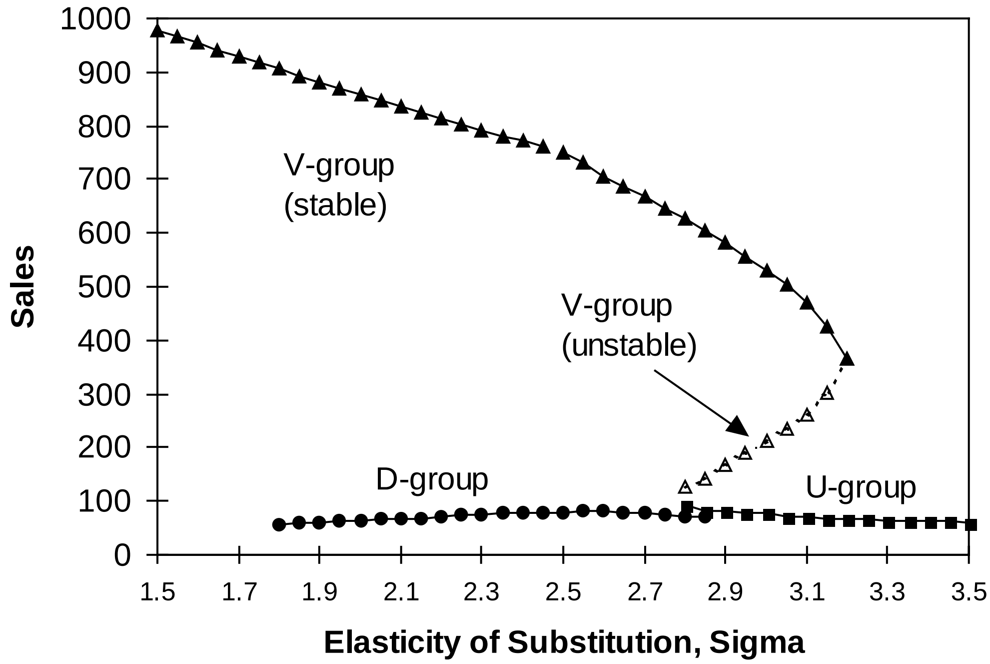

Figure 4: Internal Sales of Business Groups

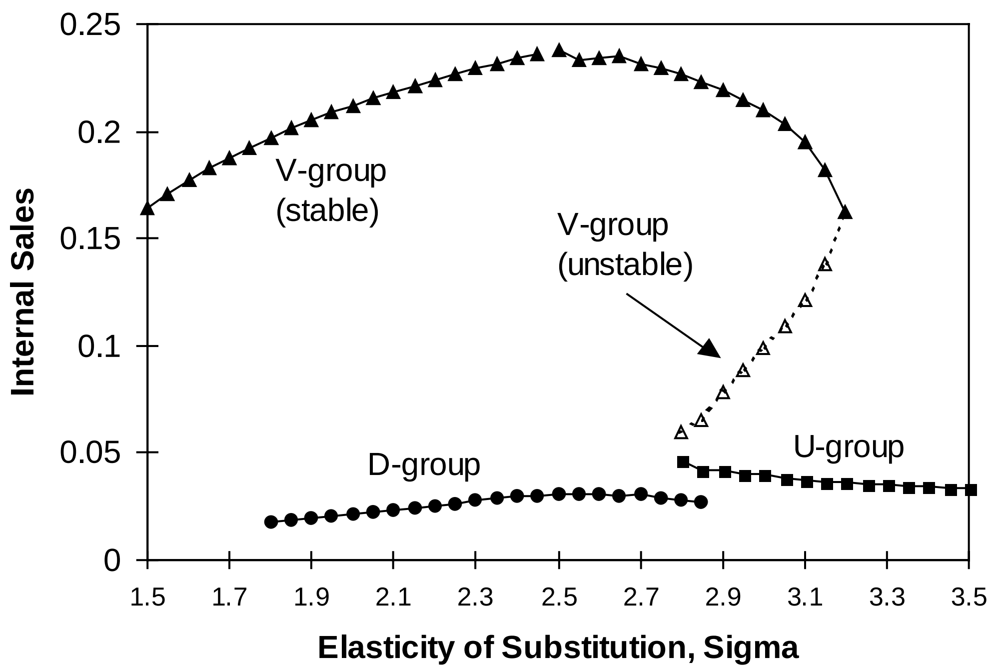

Figure 5: Diversification of Business Groups

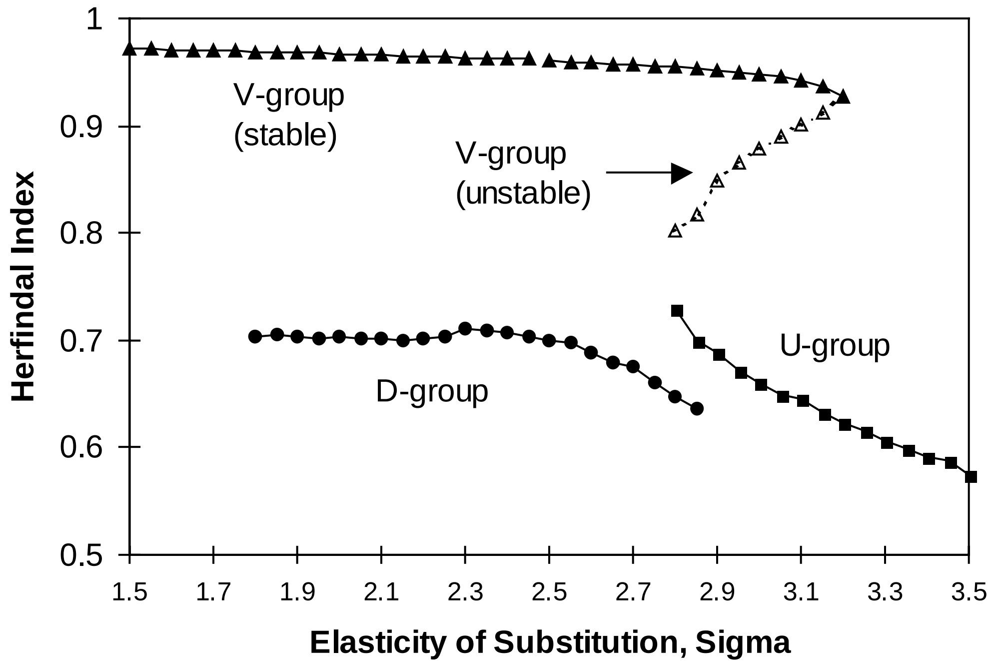

Figure 6: Economy-Wide Variety of Inputs

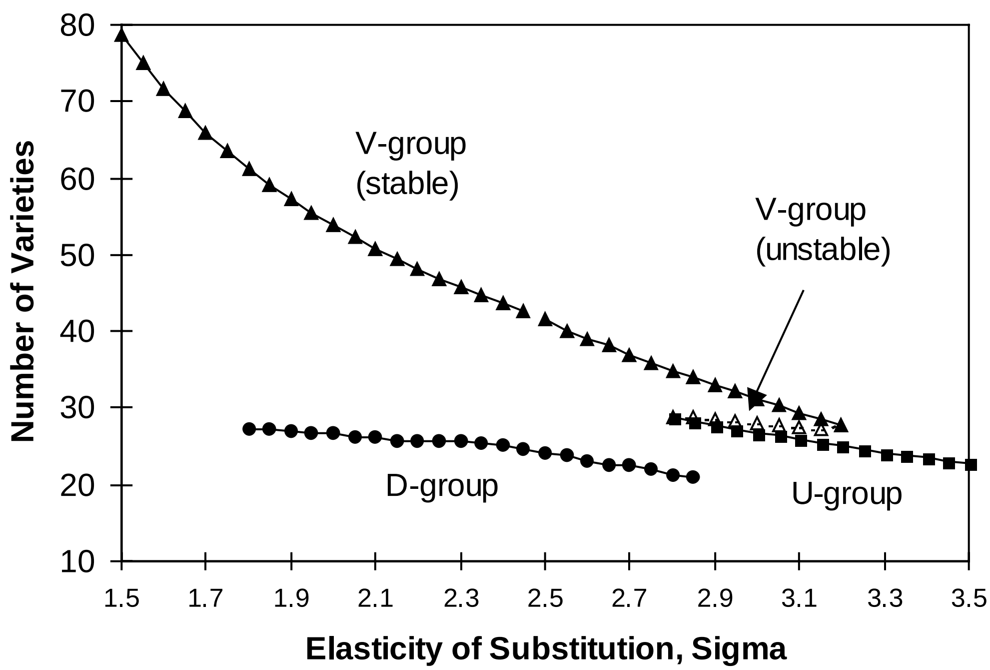

Figure 7: Economy-Wide Variety of Final Goods

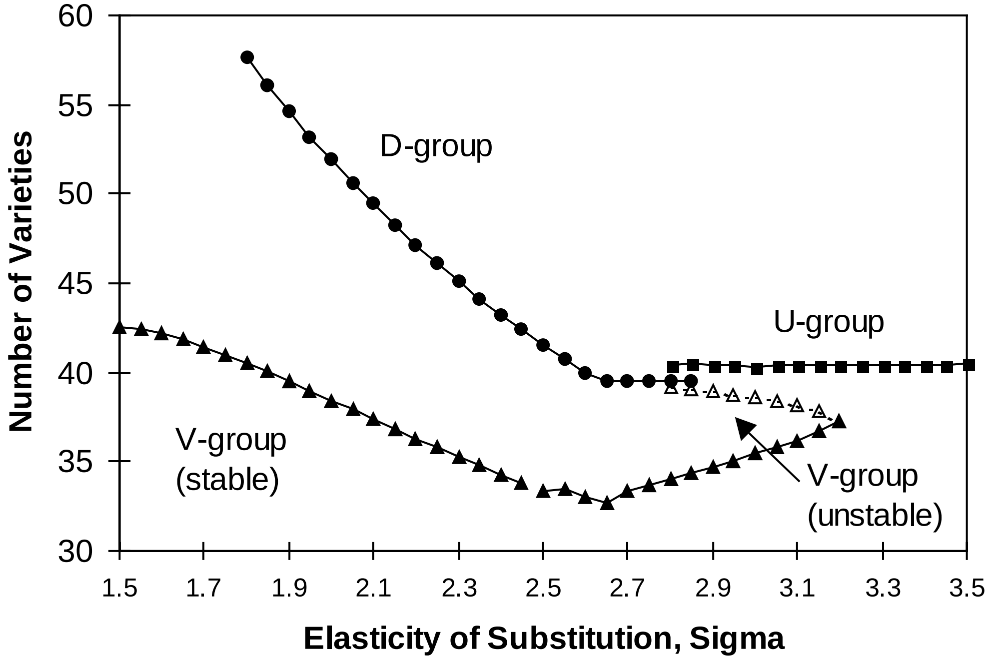

Figure 8: Price of Final Good