Ownership and Control in Outsourcing to China

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Abstract. In this paper, we examine the organization of export processing operations in China. During the 1990s, export processing accounted for over 50% of China's total exports. We observe China's processing exports broken down by who owns the plant and by who controls the inputs that the plant processes. To account for how parties organize export processing in China, we apply two influential theories of the firm, the incentive-systems model and the property-rights model. In the incentive-systems framework, we show that it is often optimal for the same party to own the processing factory and to control the inputs used in export processing. In the property-rights framework, we show that the gains to giving one party factory ownership tend to be greater when that party lacks control over inputs. In the empirical analysis, we find that multinational firms engaged in export processing in China tend to split factory ownership and input control with factory managers in China. Chinese ownership of export processing factories is more common when the foreign buyer (the multinational) controls the inputs than when the processing factory (the factory manager) controls the inputs. This evidence is consistent with the property-rights approach but is strongly inconsistent with the incentive-systems model.

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1. Introduction

Over the last several decades, much of the developing world has adopted trade policies that favor export production. Typically, the early periods of export-led development involve *export processing*. In this arrangement, firms import parts and components from abroad, process these inputs into finished goods, and then export the final products. In the 1970s, Hong Kong, Singapore, and Taiwan assembled and exported footwear, clothing, and other consumer goods (Findlay and Wellisz, 1993). In the 1980s, China, Mexico, and much of Southeast Asia developed extensive export processing operations (Grunwald and Flam, 1985; Yeats, 2001). And in the 1990s, Central America, Eastern Europe, and South Asia joined the fray.

Multinational enterprises mediate a substantial amount of processing trade involving developing countries (Barba et al., 2002; Borga and Zeile, 2002; Feenstra and Hanson, 2002). These firms design the goods to be produced and distribute final outputs. Where multinationals differ is in how much control they exert over actual processing activities. One source of variation is in terms of who owns the processing factory. While Dell subcontracts the assembly of its personal computers to independent firms in many locations, Intel uses wholly-owned subsidiaries in China, Costa Rica, and elsewhere, to assemble its microchips. Another source of variation is in terms of who controls processing decisions. Dell maintains tight control over who buys what from whom along its PC supply chain. Mattel, in contrast, grants the subcontractors that make its plastic dolls latitude in choosing from whom to purchase raw materials.

In this paper, we examine the organization of export processing operations in China. During the 1990s, processing exports accounted for over 50% of China's total exports. By virtue of the country's trade regulations, we have unusually detailed data on trade flows under different contractual arrangements. We observe China's processing exports broken down by *who owns*

the plant and by *who controls the inputs* that plants process. Since the early 1980s, China has permitted foreign ownership of export processing plants. It stipulates that all processing plants (whether Chinese or foreign owned) operate according to one of two regimes: a *pure-assembly* regime, in which a foreign buyer supplies a plant in China with inputs and hires the plant to process them into finished goods, all the while retaining ownership over the inputs; and an *import-and-assembly* regime, in which a plant in China imports inputs of its own accord, processes them, and sells the processed goods to a foreign buyer. We use these data to assess the factors that shape ownership and control decisions in China's export processing sector.

To account for how export processing is organized in China, we turn to two influential theories of the firm. To begin, we develop an incentive systems (IS) model, in the spirit of Holmstrom and Milgrom (1994), where a principal designs a contract to influence an agent's effort supply choice. Our framework is somewhat simpler than that of Holmstrom and Milgrom in that we do not explicitly allow for uncertainty in the principal's observation of the agent's effort. Instead, we suppose that there is some maximum effort level that can be contracted over, which is less than the first-best. This approach is also taken in the IS model of Grossman and Helpman (2002c). Like Holmstrom and Milgrom and Grossman and Helpman, we find that the contractual instruments the principal uses to influence the agent's effort level are complementary: when it is optimal for the principal to give the agent ownership of the factory, it is also optimal to give the agent control over input purchases, so that factory ownership and input control tend to be concentrated in the hands of a single party.

Next, we allow imperfections in the contractual environment to be severe and develop a property-rights (PR) model, in the spirit of Grossman and Hart (1986) and Hart and Moore (1990). In their framework, parties use control rights over productive assets to ameliorate hold-

up problems created by incomplete contracts. When a multinational transfers ownership of a processing factory to a subcontractor, it improves the subcontractor's bargaining power and so her incentive to invest in projects that are specific to the multinational. But giving up these control rights weakens the multinational's own bargaining power and investment incentives. We use this PR approach to show that the gains to giving one party factory ownership tend to be *greater* when that party *lacks* control over input purchases. The direct empirical implication is that a multinational will be less likely to own the processing factory when it controls input purchases. This is the opposite of what the IS model predicts.

To preview our empirical results, we find that multinational firms engaged in export processing in China tend to split factory ownership and input control with factory managers in China. Chinese ownership of export processing factories is more common when the foreign buyer (the multinational) controls the inputs than when the processing factory (the factory manager) controls the inputs. This evidence is consistent with the property-right model but is strongly inconsistent with the incentive-system framework.

Our findings are relevant to several bodies of literature. One is work on the role of exports in industrialization (Amsden, 1989; Wade, 1992). In the 1980s, Hong Kong, Singapore, and Taiwan graduated from export processing to original equipment manufacture (OEM) by backward integrating into the production of parts and components (Gereffi and Korzeniewicz, 1994; Orru et al., 1997). In the 1990s, some firms then graduated to own-brand production by forward integrating into marketing and sales (Chiu, et al., 1997; Hamilton, 1999). The expansion of East Asian firms up and down the supply chain helped their economies industrialize. Moving beyond simple export assembly to other activities is often linked to the accumulation of human

and physical capital. Little is known about whether the contractual environment also influences organization changes during export-led development.

A second body of literature to which our work relates is empirical work on modern theories of the firm. Despite intense theoretical interest in the IS and PR models, few papers have tested them.[1] Even fewer have compared the predictions of one framework against the other. A notable exception is Baker and Hubbard (2000a,b) who examine contractual arrangements in U.S. trucking. They exploit the introduction of on-board computers in trucks, which changed the costs of monitoring truck drivers, to sharpen predictions from theory and to surmount the lack of data on key determinants of organizational choice. They find evidence consistent with both the IS and PR models. Similar in spirit to Baker and Hubbard, we exploit observing ownership decisions in different contractual environments – i.e., China's two processing regimes – to test theory. Our results differ from theirs in that we find little support for the IS model in this context.

A third body of literature to which our work relates is theories of ownership decisions in global-production arrangements. Several recent papers build general equilibrium models of trade around specific theories of the firm. Grossman and Helpman (2002a, 2002b) and Antras (2001) use the PR approach to develop general-equilibrium models of global outsourcing and intra-firm trade, while Grossman and Helpman (2002c) apply the IS framework to model managerial compensation in global production. Marin and Verdier (2001) and Puga and Trefler (2002) extend the Aghion and Tirole (1997) theory of delegating authority in organizations to general equilibrium contexts. While we do not examine the general-equilibrium implications of these

[1] For surveys of the theoretical literature, see Hart (1995) and Tirole (1999) and for surveys of the empirical literature, see Baker and Hubbard (2001) and Whinston (2001).

models, our results are relevant for assessing which underlying framework best describes how parties organize global production.

The remainder of the paper is organized as follows. In section 2, we describe institutional features of export processing in China. In section 3, we present models of export processing. In section 4, we give empirical results. And in section 5, we conclude.

2. Export Processing in China

Export processing plays a major role in China's foreign trade. Table 1 shows that over the years 1997-1999, which spans our sample period, processing exports accounted for 53.7% of China's total exports. Export processing in China is broadly similar to that in other countries. It involves a firm in China importing intermediate inputs, processing the inputs, and then exporting the finished goods. The inputs are imported duty-free (as are any investment goods used in export processing) as long as these goods are only used to produce exports. As discussed in the previous section, China has two regulatory regimes for export processing.

The Pure-Assembly Regime.[2] In this arrangement, a foreign firm supplies a factory in China with materials from abroad (Naughton, 1996). The factory in China, whose role is relatively passive, receives orders from and delivers processed goods to the foreign client, who then sells the goods outside China. While the factory takes possession of the imported materials during processing, the foreign firm retains ownership over them. The foreign firm pays the factory in China a fee for its processing services. To obtain clearance from Chinese customs to import materials and to export processed goods, the terms of the transaction between the Chinese factory and the foreign firm must be stipulated in a written contract and presented in advance to

[2] The pure-assembly arrangement is translated as either "processing and assembling" or "processing with supplied materials" in Chinese statistics. The import-and-assembly arrangement is translated as "processing with imported materials." We use our own terms for these arrangements in order to define them more clearly.

Chinese customs officials for approval.[3] Legally, the processing factory may use imported materials for the sole purpose of meeting its obligations to the foreign client.

The Import-and-Assembly Regime. In this arrangement, the processing factory in China plays a more active role. Table 1 shows that this regime is the more common form of export processing, accounting for 68.5% of processing exports over the 1997-1999 period. The factory imports materials of its own accord and takes ownership of these materials during processing. It may broker deals to process goods for multiple foreign firms (World Bank, 1994). Thus, the factory in China controls both the import of inputs and the export of processed goods (though usually not the marketing and sale of the good to end users). Legally, Chinese customs treats processing plants under this regime as bonded warehouses – facilities that are permitted to import inputs duty free under the proviso that they export all output. Bonded goods cannot be transferred to another party without the approval of Chinese customs. To become a bonded warehouse, a plant must apply to the Chinese government and have warehouse facilities and accounting personnel that meet government standards.[4] Under either regime, exporters are required to submit monthly reports on the status of their contracts and to verify that the contract has been completed within a month of having exported the finished goods.

There are several important distinctions between the two processing regimes. One relates to controls rights over imported materials. Under pure-assembly, the foreign buyer of the processed goods owns the materials used in processing. Without the consent of this buyer, the factory in China cannot legally use the imported materials to process goods for another client.

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[3] The contract must specify the materials (and any equipment) to be imported, the processing activities to be performed, the fees to be paid, and the ports of entry and exit, among other items. See "Regulations Concerning Customs Supervision and Control over the Inward Processing and Assembling Operation (Amended)," Customs General Administration, October 5, 1990, http://www.moftec.gov.cn.

[4] See "Measures on the Administration of the Customs of the People's Republic of China for Bonded Warehouse Factory Engaged in Processing Trade," Customs General Administration, April 6, 1988, http://www.moftec.gov.cn.

Under import-and-assembly, in contrast, the processing factory owns the imported materials. It may use them to produce for the foreign buyer of its choice, so long as the goods are exported. A second distinction between the two regimes is that they are subject to different approval processes and regulations. In particular, import-and-assembly factories are required to make greater investments in inventory storage and management. This suggests that a processing plant cannot costlessly or quickly change from one regime to another.

While the Chinese government requires parties to specify the terms of processing trade in detail, the costs of writing or enforcing contracts may be high. One source of contracting costs is variability in product quality. The effort that factory managers devote to meeting quality standards may be difficult to observe or to verify to third parties. If quality is not contractible, then any processing contract is likely to be incomplete. Another source of contracting costs is enforcement. It may be difficult for foreign parties to use Chinese courts to resolve contractual disputes. In response, they may choose not to contract over issues that are unenforceable. Whatever the source of contractual incompleteness, its presence creates distortions that agents may seek to address through how they organize production.

Processing factories may be owned by either Chinese or foreign interests. Foreign-invested enterprises (FIEs) play a major role in China's trade. Table 1 shows that FIEs accounted for 56.5% of China's processing exports over the years 1997-1999. The Chinese government recognizes two categories of FIEs, wholly foreign-owned enterprises and equity joint ventures in which a foreign interest has at least a 25% ownership stake.[5] One issue is whether a 25% ownership share gives a foreign party effective control over a processing factory.

[5] The government also recognizes cooperative joint ventures as a mode of inward foreign investment (Sung, 1998). These are often non-equity arrangements between a foreign firm and a domestic partner that account for a small fraction of exports. Since these arrangements may not involve foreign investment, we exclude them from our definition of foreign-owned plants. Counting them as foreign-owned plants does not affect the results (see note 15).

Standard definitions of whether an enterprise is foreign controlled set a lower ownership threshold. The U.S. government, for instance, defines as foreign-controlled any enterprise in which the ownership stake of a foreign interest is at least 10%. Following this precedent, we treat as foreign controlled both wholly owned factories and equity joint ventures.

Export processing began to take off in China in the late 1980s. Among the pioneers in the sector were Hong Kong trading companies that set up processing plants across the border in Guangdong Province and used Hong Kong as a base from which to manage their operations (Sung, 1991). Hong Kong continues to mediate a large fraction of China's processing trade. Table 1 shows that from 1997 to 1999, 54.7% of China's processing exports were re-exported through Hong Kong. Hong Kong traders provide a range of intermediation services, including finding foreign buyers, sorting and grading goods according to quality, labeling and packaging, and coordinating processing in China with processing in other countries (Naughton, 1997; Feenstra and Hanson, 2002). We shall examine whether processing exports re-exported through Hong Kong differ systematically from those shipped directly to destination markets.

3. The Model

We begin by formulating the problem faced by a foreign firm wanting to locate export processing operations in China. First, we consider an environment in the spirit of the incentive-systems (IS) approach in which parties face costs in contracting over *ex ante* decisions. Then, we consider an environment in the spirit of the property-rights (PR) approach in which no *ex ante* decisions are contractible. In either framework, parties choose who should own the factory used in production and who should control the purchase of inputs processed by this factory.

Consider a principal denoted by f (the foreign firm) transacting with an agent in China denoted by g (the factory manager). The project requires the parties to purchase one unit of an

input, to use a factory to process the input into one unit of a final product, and to market and to sell the final product. Timing is as follows: In period 0 the parties choose who should own the factory and who should control input purchases; in period 1 the parties simultaneously make effort investments; and in period 2 the parties undertake input purchases, input processing, and final sales. All actions are observable to the two parties but not verifiable to a third party.

The efforts undertaken in period 1 are as follows: e_1 = effort devoted to searching for a low-priced input, by *either* party f or g; e_2 = effort devoted to preparing the factory, by the *factor manager* g; e_3 = effort devoted to marketing the final good, by the *foreign firm* f. The subscripts on these effort levels denote the stages of production rather than the timing, since all efforts are undertaken in period 1, before production and sale. The price of the input in period 2 is given by the linear function $P\cdot(1-e_1)$, $P>0$, $0 \le e_1 \le 1$, so that more search effort lowers the input price. The cost of input processing in period 2 is given by $A\cdot(1-e_2)$, $A>0$, $0 \le e_2 \le 1$, so that preparation effort lowers processing costs in period 2. Revenues from final sales in period 2 are given by $B\cdot(1+\lambda e_2+e_3)$, where $0 < \lambda \le 1$, $0 \le e_3 \le 1$ and $B>(A+P)>0$, so that more preparation and marketing effort raises sales revenue. Combined period 2 profits are then,

$$\pi = B(1+\lambda e_2+e_3) - A(1-e_2) - P(1-e_1) > 0. \qquad (1)$$

Notice that we have introduced an element of *joint production* between input processing and sales revenue, with effort e_2 by the factory manager affecting both. It is perhaps obvious that effort by the manager can reduce factory costs, and an example (taken from Grossman and Helpman, 2002c) where such effort also affects final sales is when the project is "successful" (leading to positive sales) with some probability that is increasing in e_2. Joint production means

that it will be difficult to compensate the manager at the first-best level, reflecting the marginal contributions of her effort to both processing costs and final sales.

The period 1 effort investments, e_i, i=1,2,3, impose a cost on the parties involved. The variable $\delta_1 \in \{0,1\}$ indicates whether the foreign firm f ($\delta_1 = 0$) or the manager g ($\delta_1 = 1$) expends search effort e_1. We refer to this indicator variable as *control over input purchases*. The costs to the foreign firm are given by $C_f[(1-\delta_2)e_1, e_3] = \frac{1}{2}[(1-\delta_1)e_1^2 + e_3^2]$, and the costs to the manager are given by $C_g(\delta_1 e_1, e_2) = \frac{1}{2}(\delta_1 e_1^2 + e_2^2)$. The total surplus from the project is,

$$W = \pi - C_h[(1-\delta_1)e_1, e_3] - C_f(\delta_1 e_1, e_2), \qquad (2)$$

where first-best effort levels are $e_1^* = P$, $e_2^* = \lambda B + A$, and $e_3^* = B$.

In addition to input control, δ_1, we introduce the *ownership variable* $\delta_2 \in \{0,1\}$ to indicate whether the foreign firm f ($\delta_2 = 0$) or whether the manager g ($\delta_2 = 1$) owns the factory used to process the input. While this indicator variable does not appear in the profits (1) or surplus (2), ownership of the factory certainly affects the effort levels of f and g, as will be made clear below. With the effort levels depending on δ_1 and δ_2, the surplus in (2) also depends on these, which we write as $W(\delta_1, \delta_2)$. The goal of our analysis is to see how W varies with δ_1 and δ_2. In particular, if $W(0,0) + W(1,1) > W(0,1) + W(1,0)$ then W is strictly *supermodular,* so the highest values for W are obtained when δ_1 and δ_2 take on the *same* values. Then it is optimal for the same party to control the inputs and to own the factory (factory ownership and input control are "concentrated"). This is the case on which the IS literature focuses. Conversely, when $W(0,0) + W(1,1) < W(0,1) + W(1,0)$ then W is strictly *submodular*, so it is optimal for δ_1 and δ_2

to take on *different* values, meaning that one party controls the input purchases and the other owns the factory (factory ownership and input control are "dispersed"). We will argue that in our application the PR model leads to this outcome.

3.1 Partial *Ex Ante* Contractibility: An Incentive-Systems Model

In the environment we consider, *ex post* profits depend on *ex ante* actions by the foreign firm (the principal) and the factory manager (the agent). We first examine a setting in which parties may contract over these *ex ante* decisions, but imperfectly. As in Grossman and Helpman (2002c), suppose that the parties can choose between two types of *ex ante* contracts. The first is an *employment contract*, in which the foreign firm pays the manager an amount T in period 2 if the manager makes specified effort investments in period 1. In period 2, the foreign firm can verify the manager's preparation effort e_2 only up to some level $\bar{e}_2$, $0 \le \bar{e}_2 < A + \lambda B$. Similarly, if the parties choose to give the manager control over input purchases, in period 2 the foreign firm can verify the manager's search effort e_1 only up to some level $\bar{e}_1$, $0 \le \bar{e}_1 < P$. Notice that we assume that the maximum effort levels are *less than* the first-best. These effort thresholds levels capture tasks that are easy to document and so to verify to a third party. Technological problems in monitoring effort or delays in using courts to enforce contracts may make verifying the remaining hard-to-document tasks prohibitively costly.[6]

In the second type of contract, referred to as an *outsourcing contract,* the foreign firm agrees in period 1 to pay the manager a transfer price T in period 2 if the manager delivers one unit of the processed input to the foreign firm. It is costless to verify that one unit of the processed input has been delivered. Under this contract, the manager also absorbs the cost of

[6] An equivalent modeling strategy would be to suppose that the factory manager engages in a continuum of tasks and that the foreign firm can only monitor a fraction of these tasks. This setup is used by Grossman and Helpman (2002c), and our approach is a simplified version. Battigalli and Maggi (2002) develops a theory of contract incompleteness based on the costs of writing contracts.

processing inputs, so that the profits of the manager are $T - A(1 - e_2)$. This contract makes sense if the manager also *owns* the factory, but what if the manager is an employee of the foreign firm that owns the factory? In that case, we assume it is *impossible* to impose costs $A(1 - e_2)$ on the manager, so the outsourcing contract is infeasible for an employee. A similar assumption is made by Grossman and Helpman (2002c), and reflect the numerous practical and legal problems with shifting production costs onto employees.[7]

We begin with the situation where the *foreign firm* owns the processing factory (δ_2=0), in which case an employment contract is used. Depending on who has control over the input purchases (that is, depending on whether $\delta_1 = 0,1$), suppose that the foreign firm specifies the effort levels $\delta_1\tilde{e}_1 \le \delta_1\bar{e}_1$, and $\tilde{e}_2 \le \bar{e}_2$. Then the manager obtains a payoff of $T - \frac{1}{2}(\delta_1\tilde{e}_1^2 + \tilde{e}_2^2)$. She accepts this contract as long as it pays her at least as much as her alternative income, y_g. The foreign firm's problem is then to solve,

$$\max_{(1-\delta_1)e_1,\delta_1\tilde{e}_1,\tilde{e}_2,e_3,T} B(1+\lambda\tilde{e}_2+e_3) - A(1-e_2) - P[1-(1-\delta_1)e_1-\delta_1\tilde{e}_1] - \tfrac{1}{2}[(1-\delta_1)e_1^2+e_3^2] - T$$
$$\text{s.t. } T - \tfrac{1}{2}(\delta_1\tilde{e}_1^2+\tilde{e}_2^2) \ge y_g,\ \delta_1\tilde{e}_1 \le \delta_1\bar{e}_1,\ \tilde{e}_2 \le \bar{e}_2. \qquad (3)$$

Notice that the indicator variable δ_1 varies in (3) depending on whether the foreign firm ($\delta_1 = 0$) or the manager ($\delta_1 = 1$) controls the input decision. In either case, the cost of purchasing the inputs, $P[1-(1-\delta_1)e_1-\delta_1\tilde{e}_1]$, is subtracted from profits of the foreign firm since it owns the factory. We do not introduce a participation constraint for the foreign firm.

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[7] For example, an outsourcing contract for an employee would have to specify all relevant costs that the employee is to bear. If some production costs, such as maintenance or purchasing replacement parts, or hard to specify in advance, then the contract would be incomplete and fail to give the employee-manager proper incentives. In addition, the law may prohibit exposing employees to undue risk. If there is uncertainty associated with production, an outsourcing contract may leave an employee with a negative wage in some states of the world. *Ex post*, courts may be likely to negate such provisions.

Using our assumptions that $0 \le \bar{e}_2 < A + \lambda B$ and $0 \le \bar{e}_1 < P$, it is readily verified from (3) that the foreign firm will set $\delta_1 \tilde{e}_1 = \delta_1 \bar{e}_1$, and $\tilde{e}_2 = \bar{e}_2$, so that effort levels up to the maximum are specified for the manager. When δ_1=1, so the manager controls the input purchases, these effort levels are $\bar{e}_1$ and $\bar{e}_2$, as summarized in the lower-left cell of Table 2. In contrast, when δ_1=0 the foreign firm controls input purchases, and it chooses the first-best level of effort e_1 = P, as shown upper-left cell of Table 2. Clearly, under an employment contract, giving the foreign firm control over input purchases improves effort investments in input search. This occurs because the input costs $P[1-(1-\delta_1)e_1 - \delta_1 \tilde{e}_1]$ are always subtracted from the foreign firm's profits in (3) (such costs cannot be subtracted from manager's wages under the employment contract), so these costs are minimized only when the foreign firm *also* controls the input decision.

Now, consider the situation where the manager owns the processing factory (δ_2=1). In principle, the foreign firm might still try to arrange an employment contract, and compensate the manager up to some maximum effort levels. But since the foreign firm has no legal presence in the factory, it would be that much more difficult to verify these effort levels, and we suppose that the degree to which they can be compensated is unacceptably low; accordingly, an outsourcing contract is used instead, whereby the manager is paid T for delivery of the processed input. Her payoff is $T - A(1-e_2) - \delta_1 P(1-e_1) - \frac{1}{2}(\delta_1 e_1^2 + e_2^2)$, which is reduced by the cost of the inputs $P(1 - e_1)$ if she controls that decision (δ_1=1).[8] Then the foreign firm's decision problem is,

[8] Alternatively, we could suppose that the factory manager is charged for the inputs regardless of who controls that decision, so that her profits are $T - A(1-e_2) - P(1-e_1) - \frac{1}{2}(\delta_1 e_1^2 + e_2^2)$. Then when the foreign firm controls the input purchases, it will just adjust the transfer T to offset their cost to the manager while still satisfying her participation constraint, and the solution to (4) is otherwise unchanged.

$$\begin{aligned} &\max_{(1-\delta_1)e_1,e_3,T} \; B(1+\lambda e_2+e_3)-(1-\delta_1)P(1-e_1)-\tfrac{1}{2}[(1-\delta_1)e_1^2+e_3^2]-T \\ &\text{s.t. } \{e_1,e_2\}=\arg\max_{e'_1,e'_2}\left\{T-A(1-e'_2)-\delta_1 P(1-e'_1)-\tfrac{1}{2}(\delta_1 e'^2_1+e'^2_2)\right\}, \end{aligned} \tag{4}$$

which is also subject to the manager's participation constraint.

When $\delta_1 = 0$, the foreign firm controls input purchases. As summarized in the upper-right cell of Table 2, this yields the first-best levels of e_1 and e_3 along with $e_2 = A$, which is less than its first best value, $e_2^* = A + \lambda B$. The manager internalizes the impact of e_2 on processing costs but not on sales revenue. When $\delta_1 = 1$, the manager controls input purchases. As summarized in the lower-right cell of Table 2, this yields an outcome *identical to* the preceding case.

Thus, in the control problem (4) where the manager owns the factory and an outsourcing contract is used, the effort levels are *independent of control of the input.* The reason for this is that both parties are receiving an income stream: the foreign firm receives profits net of the transfer because it distributes the final good; whereas the manager receives the transfer T net of factory and input costs. Whether one party or the other controls the input decision, and therefore bears the costs of the inputs, makes no difference as the choice of effort e_1: it is chosen at its first-best level to maximize profits for either party. The efforts e_2 and e_3 are also unaffected (though e_2 is not at the first-best). It follows that input control has no effect on total surplus, which is denoted by $W(0,1) = W(1,1)$ when the manager owns the factory (δ_2=1).

Recall that when the foreign firm owns the factory and an employment contract is used (δ_2=0), the effort devoted to input search e_1 *does* depend on input control, and e_1 is chosen optimally only when the foreign firm also controls the input decision. Denoting this welfare by $W(0,0)$, it cannot be ranked in general with $W(0,1) = W(1,1)$ under the outsourcing contract,

since e_2 is chosen at a second-best level under the two contracts. This can be seen by computing the values of surplus in Table 2, and comparing these values across ownership types:

$$W(0,0) - W(0,1) = [(\lambda B + A) - \tfrac{1}{2}(\bar{e}_2 + A)](\bar{e}_2 - A), \tag{5a}$$

$$W(1,0) - W(1,1) = [(\lambda B + A) - \tfrac{1}{2}(\bar{e}_2 + A)](\bar{e}_2 - A) - \tfrac{1}{2}(\bar{e}_1 - P)^2. \tag{5b}$$

As shown in (5a), the value of surplus with foreign versus manager ownership (when the foreign firm controls the input), or W(0,0) – W(0,1), depends on whether $\bar{e}_2 >< A$. The case where the foreign firm owns the factory but the manager controls the input decision results in surplus W(1,0). This cannot be ranked in general with W(1,1), as shown by (5b), but we know that W(1,0) < W(0,0), since when the foreign firm owns the factory then it should also control in the input decision to obtain efficient effort in input search e_1.

Taking the difference between (5a) and (5b), we obtain:

$$W(0,0) + W(1,1) - W(0,1) - W(1,0) = \tfrac{1}{2}(\bar{e}_1 - P)^2 > 0. \tag{6}$$

It follows from (6) that the objective function $W(\delta_1, \delta_2)$ is strictly *supermodular*, so that higher values result when δ_1 and δ_2 take on the *same* values.[9] Supermodularity obtains from the fact that when the foreign firm owns the factory, it must *also* control the input decision to obtain first-best search effort (whereas either party optimally searches under an outsourcing contract).

The result in (6) cannot be tested directly, because we do not observe the value of surplus from outsourcing activity; instead, we will observe the *proportion of trade* accounted for by each ownership and control regime. To move from the value of surplus in (6) to the frequency of

[9] This is the same result obtained by Holmstrom and Milgrom (1994) in a more general model.

contractual regimes in our data, we adopt a simple stochastic specification. In particular, we will suppose that ownership and control in our data are chosen to maximize $\ln W(\delta_1, \delta_2)$ *plus* a random error that varies across contractual types. Denoting these random errors by ε_{ij}, $i,j \in \{0,1\}$, the probabilities that each control/ownership pair (δ_1, δ_2) is chosen are:

$$\begin{aligned} \Pr(i, j) &= \text{Prob}[\, \ln W(i, j) + \varepsilon_{ij} \geq \ln W(i', j') + \varepsilon_{i'j'},\ i'j' \in \{0,1\}\,] \\ &= \text{Prob}[\, \varepsilon_{i'j'} - \varepsilon_{ij} \leq \ln W(i, j) - \ln W(i', j'),\ i'j' \in \{0,1\}\,] \\ &= \int_{\varepsilon_{i'j'} - \varepsilon_{ij} \leq \ln W(i,j) - \ln W(i',j')} dF(\varepsilon), \end{aligned} \tag{7}$$

where $F(\varepsilon)$ is the joint distribution function of ε. The random errors ε_{ij}, $i,j \in \{0,1\}$ represent unobserved (to the researcher) cost factors associated with ownership and input control. These include the cost of incorporating a domestic or foreign-owned firm in China, the cost of setting up a specific type of processing plant (pure assembly versus important and assembly), or other fixed costs associated with establishing an export processing operation. It is appropriate to think of each (f,g) pair as having a different draw of ε_{ij}, $i,j \in \{0,1\}$, which influences their optimal choice over ownership and control.

Let us further assume that ε_{ij}, $i,j \in \{0,1\}$, are distributed as i.i.d. extreme value. Then it is well known (see e.g. Train, 1986, p. 15) that the probabilities in (7) take on the logit form:[10]

$$\Pr(i, j) = \omega_{ij} \equiv \frac{W(i, j)}{W(0,0) + W(0,1) + W(1,0) + W(1,1)}, \quad i,j \in \{0,1\}. \tag{8}$$

[10] Note that $W(i,j) > 0$ from our assumption that $B > (A+P) > 0$, so $\pi > 0$ in (1). Our derivation of (8) and statement of Proposition 1 assumes just a single vector of parameters $(A,B,P,\lambda, \bar{e}_1, \bar{e}_2)$. But Propositions 1 and 2 can be extended to having a distribution of parameters $(A,B,P,\lambda, \bar{e}_1, \bar{e}_2)$, provided that these are independent of ε_{ij}, $i,j \in \{0,1)$. This extension corresponds to what is called "mixed logit," and is available on request.

That is, the probability of observing each (δ_1,δ_2) type is proportional to the surplus obtained from that contractual form. Because we have established above that $W(0,0) > W(1,0)$, it follows that $\omega_{00} > \omega_{10}$. Furthermore, since $W(0,1) = W(1,1)$, then $\omega_{01} = \omega_{10}$. The probabilities all sum to unity, so we therefore have:

Proposition 1

In the incentive-systems model, the frequency of each control/ownership type is:

$$\Pr(0, 0) = \omega_{00} > \omega_{10}, \qquad \Pr(0, 1) = (1-\omega_{00}-\omega_{10})/2 > 0,$$

$$\Pr(1, 0) = \omega_{10} > 0, \qquad \Pr(0, 1) = (1-\omega_{00}-\omega_{10})/2 > 0,$$

so that,

$$\Pr(0,0) + \Pr(1,1) - \Pr(0,1) - \Pr(1,0) = \omega_{00} - \omega_{10} > 0.$$

Thus, ownership tends to be given to the same party that controls input purchases.

3.2 No *Ex Ante* Contractibility: A Property-Rights Model

We turn next to an environment in which no *ex ante* contracts are feasible. Consistent with the property rights (PR) approach, we assume that costs associated with writing or enforcing contracts make it impossible for the parties to write a contract in period 1 that specifies how gains from trade will be divided in period 2. This is the key difference we consider between the IS and PR models. In the absence of *ex ante* contracts, the two parties divide the *ex post* profits π in (1), using Nash bargaining. Let π_f and π_g be threat-point payoffs available to party f, the foreign firm, and party g, the factory manager, if Nash bargaining breaks down. Under Nash bargaining, the ex-post profits π will be allocated between the two parties according to,

Party f receives: $\pi_f + (\pi - \pi_f - \pi_g)/2 = (\pi + \pi_f - \pi_g)/2$, (9)

Party g receives: $\pi_g + (\pi - \pi_f - \pi_g)/2 = (\pi + \pi_g - \pi_f)/2$. (10)

It follows that each party will choose effort levels to maximize the difference between these payoffs and the costs of supplying effort:

Party f solves: $\max_{(1-\delta_1)e_1, e_3} (\pi + \pi_f - \pi_g)/2 - C_f[(1-\delta_1)e_1, e_3]$, (11)

Party g solves: $\max_{\delta_1 e_1, e_2} (\pi + \pi_g - \pi_f)/2 - C_g(\delta_1 e_1, e_2)$, (12)

where the foreign firm f chooses e_1 when $\delta_1=0$, while the factory manager g chooses e_1 when $\delta_1=1$. Notice that the threat points may depend on the effort levels, which will be taken into account when solving (11)-(12). In addition, the threat point will depend on the control of the inputs and ownership of the factory, δ_1 and δ_2. The effort levels solving these can be substituted back into (2) to compute the total surplus conditional on the control of inputs and ownership of the factory, $W(\delta_1, \delta_2)$. Then the optimal ownership and control structure is obtained by choosing (δ_1, δ_2) to maximize W. This will be compared to the solution for $W(\delta_1, \delta_2)$ in the IS model.

To determine the optimal control and ownership structure, we must specify the threat-point payoffs, π_f and π_g, and then solve for optimal effort levels under the four possible regimes. These are shown in Table 3. First, consider the case where the foreign firm f controls the input and owns the factory, so that $(\delta_1,\delta_2) = (0,0)$ in the upper-left cell of Table 3. In the disagreement point, the foreign firm's threat is to fire the manager, hire a new one on the spot market, and continue with production. In so doing, the foreign firm would end up with a manager who has

not made the appropriate effort investments, so that processing costs are A instead of $A(1 - e_2)$. Thus, threat-point revenues from production (Be_3) are a function of f's effort only. The threat point for the manager is to quit working for the foreign firm and find a job with another employer. We assume that this employer would not value the manager's effort investments for the former project, so the manager would receive a flat income, y_g. Using these specifications of π_f and π_g and of ex-post profits under joint production in (2), we solve (11)-(12) to obtain the optimal effort levels shown in Table 3. Notice, in particular, that the effort level $e_2 = (\lambda B+A)/2$ is less than its first best value of $(\lambda B+A)$.

The case $(\delta_1,\delta_2) = (0,0)$ is particularly simple because the foreign firm retains ownership of the factory, and since it also made the input decision, the manager has no property rights. In order to discuss other cases in Table 3, we need to introduce some assumptions on how effort levels made in period 1 can affect threat-point payoffs in period 2. Generally, we will assume that *inputs controlled by either party can be utilized at the same cost in another factory.* For example, if the manager controls the input, and has a disagreement with the foreign firm who owns the factory, then the manager can still utilize the inputs at costs $P(1–e_1)$ elsewhere.[11] However, the prior effort e_2 that the manager has committed to the processing of inputs can be only *partially transferred* to another factory. For example, the time devoted to becoming a good manager in one location, through gaining knowledge of production or personnel, can be of some help elsewhere. Likewise, the effort e_3 that the foreign firm commits to marketing (such as advertising) can be *partially transferred* to another factory.

[11] Thus, these costs really do reflect search for the lowest-priced inputs, and *not* their customization to the needs of a particular foreign firm. In this respect our model differs from the conventional "holdup" problem, where the customization of a input means it cannot be easily transferred to another buyer.

The first of these assumptions means that the input costs $P(1-e_1)$ are subtracted from the threat-point payoffs π_f or π_g, depending on who controls this decision. But since these are *also* subtracted from total profits in (1), and the objective functions of the two parties in (11) and (13a) are averages of π and π_f, or π and π_g, it follows that *effort e_1 devoted to input search is always chosen at its first-best level $e_1=P$, regardless of ownership and control.* This is shown in all the cells of Table 3, where a glance at the threat-point payoffs π_f or π_g will show that $P(1-e_1)$ is subtracted from one or the other. Recalling that e_1 was *not always* chosen at is first-best in the IS framework (i.e., not when the manager controls the input decision and works under an employment contract), this demonstrates one difference between the IS and PR results.

What about the other efforts? To determine these, we need to describe the threat-points in greater detail. Consider the case where manager owns the factory, in the second column of Table 3. If the foreign firm controls the input, and there is disagreement, the foreign firm would have to turn to the spot market to rent a factory (at some cost R) and to hire a manager (who would not have made prior effort investment, so processing cost is A rather than $A(1 - e_2)$). The foreign firm's investments in marketing would be less productive with a rented factory, and so only generate revenue $\hat{B}e_3$, where $0 < \hat{B} \leq B$.[12] The threat point for the manager is to buy inputs on the spot market at price $\hat{P} \geq P$ and sell the processed inputs on the spot market (rather than through f), generating revenues $\hat{T}$. The payoffs for the two parties and resulting effort levels are shown in the upper-right cell, and both e_2 and e_3 are at sub-optimal levels.

[12] We use a caret to denote values that apply in the threat-point payoffs.

Continuing with the case where manager owns the factory, in the second column, suppose now that the manager *also controls* the input decision. What difference does this make? As we have already argued, this simply moves the input costs from one party to the other, but has no impact on the optimal choice of e_1. Given that the effort e_1 does not interact with any other efforts chosen by the parties, and there is no other change to the payoffs, it follows that the effort levels are *independent of control of the input*. Thus, the surplus obtained when the manager owns the factory is $W(0,1) = W(1,1)$, independent of δ_2, as we also found for the IS model.

Thus, our first general result is that *when the manager owns the factory, changing input control does not affect effort levels under either the IS or PR model.* To see where this result is coming from, note that the foreign firm *always* owns the final good, so the case where the manager owns the factory is really a case of "dispersed ownership." We are arguing that under either the IS or PR model, dispersed ownership gives sufficient incentives for *either* party to choose the first-best level of input search, so that input control has no efficiency effect (but only changes the distribution of the surplus). This will not be the case, however, when ownership of the final good and factory is "concentrated" in the foreign firm.[13]

Turning to this case, suppose that the foreign firm owns the factory, in the first column of Table 3. We have already discussed the case $(\delta_1,\delta_2) = (0,0)$, where the foreign firm also controls the input. Alternatively, when the manager controls the input, then the foreign firm's threat point is to hire a manager on the spot market (yielding input costs A, as before) and to buy inputs on the spot market (at price $\hat{P}$). But now the manager's control of the inputs gives her outside

[13] In an expanded model, we could introduce a further variable $\delta_3 \in \{0,1\}$ to indicate whether the foreign firm f or manager g markets the final good; the latter case would occur when the manager is establishing her own brand-name, rather than acting as an OEM producer for the foreign firm. Then having $\delta_1 = \delta_3$ would indicate "concentrated ownership" by one party or the other.

options that she did not have with foreign control, where her disagreement payoff was simply y_g. We suppose that her threat point is now to rent a factory on the spot market (at cost R) and sell the processed inputs on the spot market (for revenues $\hat{T}$). The manager's prior effort investments would be less productive, yielding input costs $(A - \hat{A}e_2) \geq A(1 - e_2)$, with $0 < \hat{A} \leq A$. The important point to notice is that the prior investments e_2 by the manager to reduce input costs *continue to have value* in the threat-point, at the marginal rate of $\hat{A} > 0$. Because of this, we obtain effort $e_2 = (\lambda B + A + \hat{A})/2$ with manager control which *exceeds* $e_2 = (\lambda B + A)/2$ with foreign control of the inputs. Thus, manager control is preferred when the foreign firm has ownership, so that W(0,0) < W(1,0) in the first column of Table 3 .

This gives us our second general result: *under foreign ownership in the PR model, the manager's incentives for processing effort e_2 are improved by having input control*. This can be contrasted with our earlier result: *under foreign ownership in the IS model, the incentives for search effort e_1 are improved by the foreign firm also having input control.* In the PR model it makes sense for the manager to have control rights over some production decision (i.e., having input control under foreign ownership), whereas in the IS model there is a complementarity between giving the foreign firm both ownership and control.

Computing the value of surplus W, using the effort levels in Table 3, we obtain:

$$W(0,0) - W(0,1) = \tfrac{1}{8}(B - \hat{B})^2 - \tfrac{1}{8}(2\lambda B + A)A \qquad (13a)$$

$$W(1,0) - W(1,1) = \tfrac{1}{8}(B - \hat{B})^2 - \tfrac{1}{8}(2\lambda B + A - \hat{A})(A - \hat{A}), \qquad (13b)$$

so that,

$$W(0,0) + W(1,1) - W(0,1) - W(1,0) = \tfrac{1}{8}(2\lambda B + A - \hat{A})(A - \hat{A}) - \tfrac{1}{8}(2\lambda B + A)A < 0, \qquad (14)$$

where the sign follows from $0 < \hat{A} \leq A$. Thus, total surplus is strictly *submodular* in the ownership/control variables, which is the opposite of what we obtained for the IS model.

To obtain a testable proposition for the PR model, we again consider a stochastic specification where the probabilities of observing each control/ownership pair are determined as in (7), which is solved as $Pr(i,j) = \omega_{ij}$ as in (8). So the frequency of each contractual type of proportional to the surplus obtained from it. We have already found that $W(0,0) < W(1,0)$, so that $\omega_{00} < \omega_{10}$. In addition, we argued above that $W(0,1) = W(1,1)$, independent of input control like the IS model, so that $\omega_{01} = \omega_{11}$. Then since the probabilities sum to unity, we obtain:

Proposition 2

In the property-rights model, the frequency of each control/ownership type is:

$$Pr(0, 0) = \omega_{00} > 0 , \qquad Pr(0, 1) = (1-\omega_{00}-\omega_{10})/2 > 0,$$

$$Pr(1, 0) = \omega_{10} > \omega_{00} , \qquad Pr(1, 1) = (1-\omega_{00}-\omega_{10})/2 > 0,$$

so that,

$$Pr(0,0) + Pr(1,1) - Pr(0,1) - Pr(1,0) = \omega_{00} - \omega_{10} < 0.$$

Thus, ownership tends to be given to the party that *does not* control the inputs.

In the first empirical test, we compute the relative likelihood of concentrated versus dispersed control/ownership to see whether the predictions of either Proposition 1 or 2 are supported by the data. In this application we will examine the probability mass in each control/ownership cells, and as a summary statistic, consider the sign of $V \equiv Pr(0,0) + Pr(1,1) - Pr(0,1) - Pr(1,0)$, which is positive for the IS model and negative for the PR model.

In a second test, we shall examine how V varies with observed variables in a regression framework. For the PR model, we can solve for $V = \omega_{00} - \omega_{10}$ using (8) and (13b) as:

$$V = \frac{\frac{1}{8}(2\lambda B + A - \hat{A})(A - \hat{A}) - \frac{1}{8}(2\lambda B + A)A}{[W(0,0) + W(1,1) - W(0,1) - W(1,0)]}. \qquad (15)$$

Consider differentiating (15) with respect to any of the productivity parameters A, $\hat{A}$, B, and $\hat{B}$. The numerator of (15) is decreasing in A, $\hat{A}$, B, and does not depend on $\hat{B}$, while the denominator is increasing in all these parameters (i.e., a higher productivity of effort raises total surplus). We therefore obtain:[14]

Proposition 3

Define $V \equiv Pr(0,0) + Pr(1,1) - Pr(0,1) - Pr(1,0)$ for the PR model. Then:

$$\frac{\partial V}{\partial A} < 0, \ \frac{\partial V}{\partial \hat{A}} < 0, \ \frac{\partial V}{\partial B} < 0, \ \frac{\partial V}{\partial \hat{B}} < 0. \qquad (16)$$

To motivate these results, consider comparing the contracts used in, say, state-owned enterprises versus private enterprises in China. We expect managers in state-owned enterprises to be less productive (lower A or $\hat{A}$), so (16) says that by excluding these enterprises from the dataset we should observe *lower* values of V (i.e., *more dispersed* ownership and control). Likewise, consider factories in China that use agents in Hong Kong to arrange the marketing of their goods. As we discuss below, we expect these Hong Kong traders to have higher

[14] While we have derived Proposition 3 for the PR model, a very similar result holds for the IS model. In that case, we see from (6) and (8) that $V = \frac{1}{2}(\bar{e}_1 - P)^2 / [W(0,0) + W(0,1) + W(1,0) + W(1,1)]$. The numerator is decreasing in the contractibility level $\bar{e}_1$, while the denominator is increasing in A, B, $\bar{e}_1$ and $\bar{e}_2$. Thus, V in decreasing in all these parameters for the IS model. Because we find that the data are more consistent with the PR model, however, we interpret the regression analysis based on Proposition 3 as applying to that model.

downstream productivity (higher B or $\hat{B}$), so when focusing on trade through Hong Kong, we again expect to see *lower* values of V. Essentially, moving towards more efficient environments has the effect of increasing the relative frequency of observations choosing $(\delta_1,\delta_2) = (0,1)$, that is, foreign ownership combined with Chinese control of the inputs, which puts more observations on the off-diagonal of our frequency matrix and lowers V.

4. Empirical Results

In this section we test the empirical predictions of the IS and PR models. Data are from the Customs General Administration of the People's Republic of China and show processing exports by year (1997-1999), destination country, four-digit SITC product, origin province in China (including trade zone status), customs regime (pure-assembly or import-and-assembly), firm type (foreign or Chinese-owned), and export status (direct export or re-export through Hong Kong). We have roughly 64,000 observations per year.

4.1 Testing Strategy

Both the IS and PR models make clear predictions about the likelihood of different input-control and factor ownership regimes. For the IS model, Proposition 1 states that the foreign buyer of the processed inputs is more likely to own the processing factory when it controls the inputs used in processing, or that concentrated input control and factory ownership is more likely than dispersed control and ownership. For the PR model, Proposition 2 states the opposite: concentrated control/ownership is less likely than dispersed control/ownership.

In the first test of these propositions, we compute the likelihood of concentrated input control and factory ownership relative to dispersed control/ownership. In principal, these should be computed as in (7), that is, the share of factories engaged in processing trade of each

contractual type. A problem we encounter is that we do not have firm-level data on factory ownership and control of inputs, but rather, have Chinese trade data on *exports by ownership and contractual types*. To make the connection between these data and Proposition 1 and 2, let $x(\varepsilon)$ be exports of each factory (i.e., with the unobserved cost vector ε), so that total exports are $X = \int x(\varepsilon)dF(\varepsilon)$. Then instead of (7) we observe:

$$S(i, j) \equiv \int_{\varepsilon_{i'j'} - \varepsilon_{ij} \leq \ln W(i,j) - \ln W(i',j')} [x(\varepsilon)/X]dF(\varepsilon). \qquad (17)$$

That is, we observe the *market share* of exports accounted for by each control/ownership regime, which depends on the relative exports $[x(\omega)/X]$ from each plant. We construct the quantity $CVD \equiv S(0,0) + S(1,1) - S(1,0) - S(0,1)$ to test the IS and PR models. We refer to CVD as *concentrated versus dispersed* input control and factory ownership. Using (17) to substitute for (7) in this hypothesis test relies on the assumption that the magnitude of exports from each type of factory are uncorrelated with the control/ownership regime. We have no way to test the validity of this assumption, but maintain it throughout our analysis.

4.2 Incentive Systems versus Property Rights

The IS model predicts that CVD will be positive and the PR model predicts that CVD will be negative. To test these predictions, the first two columns of Table 4 show the share of processing exports by input-control and factory-ownership regimes, averaged across the year-industry-destination market-origin province cells in our data. Reading down the first column, foreign-buyer control of the inputs (the pure-assembly regime) combined with foreign ownership of the factory accounts for an average of 6.8% of processing exports, while Chinese control of the inputs (the import-and-assembly regime) combined with foreign ownership of the factory

accounts for 49.8%. The difference in these two probability masses provides the key test of the IS versus the PR model, and the results are strongly supportive of the PR model. From Proposition 2, this model predicts greater probability mass in the lower-left cell than in the upper-left cell, which is clearly supported by Table 4. Under foreign factory ownership, Chinese input control is much more likely than foreign input control. The (unreported) difference between these two cell entries is highly statistically significant.

Now looking at the second column of Table 4, both Propositions 1 and 2 predict that the input-control decision is unimportant, so we should see approximately equal probability masses in the two rows. This is roughly borne out in the data, where foreign control of the inputs combined with Chinese ownership of the factory accounts for 24.8% of processing exports, while factory control of the inputs combined with Chinese ownership of the factory accounts for 18.7% of processing exports. While the (unreported) mean difference in these two shares is statistically significant, the numbers are similar in magnitude.

The first column of Table 4 also reports the value of concentrated versus dispersed control/ownership. CVD is negative and highly statistically significant, confirming that dispersed control/ownership is more likely than concentrated control/ ownership. In the full sample, the data support the PR model but reject the IS model. In unreported results, we performed similar calculations separately by year and found CVD to be stable over time.

We note that because CVD is constructed as a "double difference" across the rows and columns of Table 4, it is invariant to any variables that have equal effects on the elements of a row or column. For example, the ownership decision would be affected by the relative costs of incorporating a domestic versus a foreign enterprise in China, including the relative tax advantages; provided that these do not depend on control of inputs, they are "differenced-out" by

using CVD. Alternatively, the input-control decision would be affected by the costs of setting up a pure-assembly factory versus an import-and-assembly factory, and provided that these do not depend on ownership, such variables would not affect CVD. Thus, our results on concentrated versus dispersed control/ownership are robust to factors that are either specific to an ownership regime and common across input-control regimes, or specific to an input-control regime and common across ownership regimes.

4.3 Sources of Variation in Input Control and Factory Ownership Regimes

We now extend our core results to account for variation in the ownership types of Chinese firms, in how processing exports are delivered to destination markets, and whether exports are produced in one of China's special economic zones. So far, we have treated all Chinese firms as being of a common ownership type. In reality, the data distinguish between four types of Chinese owned-firms: private enterprises, collectives, Sino-foreign contractual joint ventures, and state-owned enterprises (SOEs). Collectives include town-and-village enterprises (TVEs) and urban collectives that are owned by communities or groups of households. They constitute a hybrid ownership form, somewhere between a public and private enterprise. In terms of management structure and performance, they share many features in common with private firms (Chen, 2000). A Sino-foreign contractual joint venture is a Chinese firm created in conjunction with a foreign firm, usually with majority Chinese ownership (Lin and Png, 2001).[15] In the case of export processing, this means that the foreign client with whom

[15] A Sino-foreign contractual joint venture may or may not involve foreign equity participation. We treat these firms as Chinese owned, but their ownership status is difficult to determine. While Chinese commercial law dictates that foreign equity joint ventures (discussed in section 2) must distribute profits according to the ownership share that each equity holder has in the concern, contractual joint ventures exercise considerable flexibility in how they distribute profits (Wang, 2000). In practice, contractual joint ventures appear to involve small foreign firms that have family ties or other links to the parties in China with whom they transact. Even where a contractual joint venture involves some foreign ownership, it may be, in effect, a Chinese family-owned enterprise. Most foreign

the Chinese firm will transact is designated at the time the firm is created. SOEs are wholly owned by government entities.

While SOEs may operate under either input-control regime, they are by definition Chinese owned (and so not subject to foreign ownership). Still, there is no *a priori* reason to exclude them from the analysis. A foreign firm engaged in export processing in China that chooses to contract with a Chinese owned firm (rather than use one of its own subsidiaries), may just as well choose an SOE as a private enterprise or a collective. Many SOEs have the flexibility to offer managers incentive pay schemes (Naughton, 1995), and use of these schemes appears to affect SOE performance (Goves et al., 1994 and 1995).[16] Still, it is natural to imagine that SOEs might differ from other Chinese-owned firms. In particular, the productivity of investment (A) or the attractiveness of outside options ($\hat{A}$) for managers may be weaker in SOEs than in other Chinese firms. According to Proposition 3, this would suggest that the share of outcomes with concentrated versus dispersed control/ownership would *fall* once SOEs were dropped from the sample (i.e., dispersed control/ownership regimes would become relatively more common in the data). To see how inclusion of SOEs affects our results, we drop them from the analysis in the second two columns of Table 4.

The distribution of exports across control/ownership regimes is qualitatively similar with or without SOEs in the sample. Naturally, excluding SOEs from the sample moves mass from the Chinese ownership column to the foreign ownership column. The share of processing exports associated with foreign input control and foreign factory ownership rises to 9.3% and the

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firms that use contractual joint ventures appear to be based in Hong Kong or Taiwan or to be owned by a Chinese national (who may use the joint venture as a vehicle to transfer profits abroad). Our results are robust to either defining contractual joint ventures as foreign-owned firms or to excluding them from the analysis.

[16] Some exports reported to be associated with SOEs may in fact be produced by other types of Chinese firms. During the 1980's and early 1990's, in many industries Chinese-owned firms (but not foreign-owned firms) were required to export goods through state-owned foreign trading companies (Naughton, 1996). While the government has since relaxed this restriction, some SOE exports in our sample may be produced by other Chinese firms.

share associated with Chinese input control and foreign factory ownership (which IS predicts should be small) rises to 73.4%.[17] Consistent with Proposition 3, excluding SOEs lowers the value of CVD, implying that outside of SOEs input control and factory ownership is more likely to be dispersed.

As reported in Table 1, slightly over half of processing exports from China are re-exported through Hong Kong. Re-exports are not simply goods transshipped through Hong Kong. They are goods that clear customs in Hong Kong and that are taken into possession (and subject to intermediation services) by firms based in Hong Kong. In the case of re-exports, Hong Kong traders typically grade them according to quality, package and label them, and arrange for their shipment to final destination markets (Sung, 1991).

With regards to Chinese processing trade, contracting costs might differ for firms in Hong Kong relative to firms based in other countries. Hong Kong firms, due to their proximity to or family and cultural links with the mainland, might be subject to fewer problems with monitoring or enforcing contracts in China than other foreign buyers.[18] This would tend to make the IS model more relevant and the PR model less relevant for explaining Chinese processing trade involving Hong Kong. Alternatively, Hong Kong's status as an entrepôt might make the PR model more relevant. Due to their long history of entrepôt trade, Hong Kong firms may have a competitive advantage in export processing. Compared to firms in other countries, Hong Kong traders may be better positioned to select inputs, identify reliable suppliers in China, and market final goods. In such a case, Hong Kong firms would tend to have a relatively high marginal productivity of investment (B) in export processing activities and relatively strong outside

[17] For SOEs a higher share of exports have foreign input control (70.4%) than Chinese input control (29.6%).
[18] Naughton (1999) suggests Hong Kong firms engage in "property rights arbitrage." They use their specific knowledge of business conditions in China and the security of property rights in Hong Kong to broker deals with agents who want access to China's market but are wary about its insecure property rights.

options ($\hat{B}$). By the logic of Proposition 3, we would expect export processing involving Hong Kong to exhibit more dispersed input control and factory ownership.

Table 5 replicates the results in Table 4 separating Chinese processing exports into those shipped directly to destination markets and those re-exported through Hong Kong. For Hong Kong re-exports, there is more mass along the off-diagonal cells among dispersed input-control and factory-ownership regimes. Thus, for re-exports through Hong Kong, CVD is more negative, as is consistent with the PR model and Proposition 3. These results include exports associated with SOEs, but excluding them does not change the findings.

Over the last two decades, trade policies in China have varied substantially across regions of the country. In the early stage of China's economic opening, the government permitted foreign trade and investment only in Special Economic Zones (SEZs) located in the southern coastal provinces of Guangdong and Fujian. In the mid to late 1980s, after the spectacular growth of export production in the first SEZs, the government steadily expanded the number of regions in which foreign trade and investment were permitted. By the early 1990s, foreign trade and investment were allowed (subject to government approval) throughout the country (Demurger et al, 2001). Still, much export activity continued to be concentrated in SEZs and other trade zones. Advantages to being in a zone may include expedited treatment by customs of imported inputs and exported outputs, more freedom to import or export goods directly rather than through state-owned foreign trade corporations, greater opportunities to retain foreign exchange earnings, and access to various types of tax incentives. There are is also a separate court system set up to handle civil and commercial legal cases in trade zones (Wang, 2000). SEZs have been succeeded by second and third generation trade and development zones, including bonded areas, Economic and Technological Development Areas, and Hi-Technology

Development Areas, which may target specific industries or activities. At risk of blurring definitions, we refer to all of these zones as SEZs. These zones are managed by provincial governments and so may exhibit regional variation in their organization and effectiveness.

Being in a SEZ may affect the choice of input-control and factory-ownership regime in a variety of ways. If the court system that is specific to trade zones is more efficient and reliable than China's regular court system, then contracting costs might be lower in SEZs. This would tend to make the IS model more relevant in SEZs and concentrated control/ownership regimes more likely to be chosen. Another possibility is that firms in SEZs have more alternative trading partners. Since SEZs are the center of import and export activities in China, it might be relatively easy for a foreign firm or Chinese factory with a presence in an SEZ to find a new export supplier or foreign buyer. This would tend to strengthen the outside options of factory managers and foreign buyers – or, more precisely, to strengthen the returns to effort investments in their outside options ($\hat{A}$ and $\hat{B}$). By Proposition 3, this would tend to make concentrated input-control and factory-ownership less likely inside SEZs than outside SEZs.

To see how presence in a SEZ affects input-control and factory-ownership outcomes, Table 6 replicates the results in Table 4 breaking out processing exports by whether or not they are produced in one of China's Special Economic Zones (SEZs). Inside SEZs, foreign factory ownership is relatively more likely, with 80.9% of processing exports coming from foreign owned factories inside of SEZs compared to only 51.0% outside of SEZs. Also, inside SEZs dispersed input control and factory ownership is relatively more common, such that CVD is lower inside SEZs than outside SEZs. This is again consistent with Proposition 3.

To summarize the findings in Table 4-6 parametrically, in Table 7 we report results from regressing CVD on a constant term, a dummy for whether or not processing exports are re-

exported through Hong Kong, a dummy for whether or not processing exports are produced in a SEZ, and the interaction of these two effects. We show results for all firms (column 1) and excluding SOEs (column 2). Consistent with Proposition 3, concentrated input-control and factory ownership is less likely when goods are re-exported through Hong Kong, produced in SEZs, or produced outside of SOEs. In columns 3 and 4, we introduce controls for industry, destination region, and origin region in China, which leaves the results unchanged.

4.4 Additional Results on Input Control and Factory Ownership Regimes

The results in Tables 4-7 show support for the PR model but not the IS model. We now examine other testable implications of the PR model. Proposition 3 states that concentrated versus dispersed input control and factory ownership is determined in part by the productivity of investments of the involved parties either in joint production (A,B) or in their outside options ($\hat{A}, \hat{B}$). To test this idea, we adopt the following reduced form specification for CVD,

$$CVD_i = [S_i(0,0) + S_i(1,1)] - [S_i(0,1) + S_i(1,0)] = \beta_0 + \beta_1 X_i + \mu_i, \qquad (18)$$

where i is a year-industry-destination country-origin province cell, X_i is a vector of variables that determine parties' investment productivities, and μ_i is a disturbance term. By Proposition 3, any factor that raises a party's investment productivity – either in joint production or in their outside options – makes concentrated control/ownership less likely and so lowers CVD.

Consider first factors associated with the investment productivity of the foreign firm. The investments by a foreign buyer in marketing and sales are likely to do more to raise the value of the project the higher is the quality of the good being processed. We thus expect CVD to be lower for higher quality products. One measure of product quality is the prevalence of

differentiated products within an industry. Many differentiated goods are branded, which involve specific investments by a firm in copyrights, trademarks, patents, and marketing. We measure product differentiation using Rauch's (1999) classification of SITC products.[19] A second measure of product quality is the variability in export prices across destination markets (within an industry). Greater price variability within an industry signals variation in product attributes, which are in part determined by firm investments in product quality. A third measure of product quality is the per capita income of the destination country. To the extent quality is income elastic, countries with higher incomes are likely to demand higher quality goods.

Factory managers' investment productivity may also be higher for higher quality goods, which would reinforce the negative correlation between product quality and CVD. Managers' investment productivity in their outside options is likely to depend on the demand for their services in these options. Demand for managerial labor is likely to be stronger in labor markets where there is a larger concentration of foreign firms, a larger manufacturing labor force, or a smaller concentration of SOEs (to the extent SOEs are constrained in the incentive packages they can offer managers). Taking the province as the relevant labor market for a manager, we capture these effects by including the share of foreign firms in total provincial processing exports, the share of SOEs in total provincial exports, and the share of manufacturing in total provincial employment.[20] We also include distance from a province to Hong Kong. Hong Kong plays an important role in distributing Chinese exports to the rest of the world and managers located

[19] This classification based on how the majority of five-digit products inside a three or four-digit SITC industry are sold. Homogeneous goods are those sold on organized exchanges, such as commodities markets; reference-priced goods are those whose prices are listed in published international trade journals; and differentiated goods are all other goods. The sale of homogeneous and reference-priced goods tends to occur through exchanges in which the identity of buyers and sellers is either well-known or unimportant. Differentiated goods are presumably those ill-suited to the impersonal exchange of standardized markets.

[20] To avoid introducing simultaneity into the regression, we calculate the foreign firm and SOE provincial export shares (and the foreign firm industry export share discussed below) for a given year-industry-destination-province cell excluding exports related to the cell.

relatively close to Hong Kong may have stronger outside options. To ensure we do not convolute the effect of distance to Hong Kong with other distance effects, we also include distance from the province to the destination market as a control.[21]

Tax and trade policies are also likely to influence foreign ownership. We include as controls the corporate income tax rate in the destination country and whether a good is subject to Multi-fiber Arrangement (MFA) quotas in the country to which it is shipped. By owning the processing factory in China, a multinational firm engaging in processing trade may be better able to transfer price. Higher corporate income tax rates in the source country for the foreign firm may make foreign ownership of processing factories in China more attractive. We proxy for tax rates in the source country for foreign investment with tax rates in the destination market for exports. A large fraction of China's exports are subject to MFA quotas. For a multinational firm importing MFA goods into a country from China, there may be gains to having these goods produced by arms-length manufacturers. Doing so may make it easier to ship the goods to the destination market through a third country, thereby possibly avoiding MFA quotas on China. In unreported results, we also included GDP in the destination country and GDP in the Chinese province as additional controls, but neither variable was precisely estimated.

Table 8 reports the regression results. Columns 1 and 2 show results using the full sample of exports; columns 3 and 4 exclude exports associated with SOEs; and column 4 also drops goods re-exported through Hong Kong. In addition to the variables mentioned above, we also include controls for whether goods are re-exported through Hong Kong and for whether goods are produced in SEZs (and the interaction of these two effects, which is not reported).

[21] There are additional factors that may influence the control/ownership regime in export processing. Foreign ownership may be influenced by unobserved industry characteristics related to technology, contracting costs, or industrial policy in China. To control for such effects, we include the share of foreign firms in total industry processing exports by year in China (see note 20).

Results for these variables are similar to those reported in Table 7 and we do not mention them further. Since many regressors vary by industry but not by other dimensions, we allow for correlation in the errors across observations that share the same four-digit industry.

Consider first the results on the full sample in column 1. Regarding foreign firms' investment productivities, CVD is negatively correlated with the three measures of product quality, which are export price variability, the prevalence of differentiated products, and per capita GDP in the destination country. Coefficients are precisely estimated for export price variability and destination-country per capita GDP, but not for differentiated products. That higher quality products appear to be subject to more dispersed control/ownership is consistent with Proposition 3. The results for export price variability and differentiated products are stable across specifications but, not surprisingly, destination-country per capita becomes imprecisely estimated one destination-region dummy variables are included in the estimation. These regional controls absorb much of the sample variation in per capita GDP.

Regarding managers' outside options, CVD is negatively correlated with the foreign firm share of provincial exports (in which the strength of managers' outside options is likely to be increasing) and positively correlated with the SOE share of provincial exports, the share of manufacturing in provincial employment, and distance from the province to Hong Kong (in which the strength of managers' outside options is likely to be decreasing). That stronger outside options for factory managers appear to be associated with more dispersed control/ownership is consistent with Proposition 3. Distance to Hong Kong is positive and precisely estimated in all specifications. The provincial manufacturing employment share is positive in all specifications but imprecisely estimated. The foreign firm export share is negative and imprecisely estimated in the first two columns but becomes precisely estimated (not surprisingly) once we exclude

exports associated with SOEs from the sample. Excluding SOEs also turns the SOE provincial export share negative (and statistically significant), which is counter to our expectations. Our presumption is that managerial options are weaker where SOEs are a more important source of demand for managerial labor. An alternative view is that since SOEs tend to be overrepresented in heavy industry, their presence may indicate stronger industrial labor demand (coming from those industries), which would be consistent with Proposition 3.

Several of the control variables also appear to influence the choice of control/ownership regime. CVD is negatively correlated with the foreign firm share of industry exports. This implies that industries more subject to foreign ownership in their export production are more likely to have dispersed input control and factory ownership. This is consistent with the results in Tables 1 and 4. In these two tables it is apparent that Chinese control of input purchases is more prevalent in the data than foreign control of input purchases. Thus, any factor that raises the likelihood of foreign ownership in an industry would tend to move mass to the lower-left cell of Table 4, which is associated with dispersed input control and factory ownership.

The positive and precisely estimated coefficient on the MFA dummy suggests that goods subject to MFA quotas are more likely to be produced under a regime of concentrated input control and factory ownership. In practice, it is Chinese input control and factory ownership that is the relatively more regime common for MFA goods. For foreign firms overseeing the export of goods subject to MFA quotas from China, such an arms-length arrangement may given them greater flexibility in avoiding binding quotas on Chinese goods. The other two control variables, distance from the province to the destination market and the destination country corporate income tax rate, are imprecisely estimated in all specifications.

In unreported results, we experimented with replacing the destination region dummy variables with destination country dummy variables, including provincial average wages and other measures of provincial labor productivity, introducing controls for Taiwan (which may be similar to Hong Kong in terms of its strong business ties to China) and for SEZs in Guangdong province (which are the oldest and most established SEZs in China), and placing additional restrictions on the industries or destination countries included in the estimation. None of these modifications changed our qualitative results.

5. Conclusions

This paper reports a new empirical finding: that the allocation of ownership and control in processing exports of China tends to be shared between foreign and local parties, with foreign firms likely to have ownership in the Chinese plant, but the Chinese parties having control over input purchase decisions. Based on anecdotal evidence, we expect that this pattern might apply in other developing countries as well, such as India. One goal of our paper has been to reconcile this finding with available theories of the ownership/control structure within a firm. We have drawn on two such theories: the incentive-systems (IS) model due to Holmstrom and Milgrom (1994), and the property-rights (PR) model due to Grossman and Hart (1986) and Hart and Moore (1990). Holmstrom and Milgrom show that the IS model leads to complementarity in the allocation of ownership/control instruments, so that a single party (either the principal or the agent) will tend to have both instruments. We find the same result in a simplified model of outsourcing, which does not introduce explicit uncertainty in the observation of the agent's effort, but instead supposes that there is a maximum effort level that can be compensated (as in Grossman and Helpman, 2002c).

The implications of the PR model for the allocation of ownership/control instruments are less clear-cut, but Grossman, Hart and Moore certainly establish that vertical integration (i.e., granting ownership to a single party) will not yield the first-best in general, due to incentive problems faced by the parties. In particular, each party must make some effort decisions *ex ante* that are impossible to compensate in an *ex post* contract, so that the parties must bargain over the surplus created. In the Nash bargaining solution, the surplus obtained by either party depends on the return available to them in the case of disagreement, and these threat-point payoffs also depend on their *ex ante* effort levels. By ensuring that both parties have adequate threat-point payoffs, this leads to more desirable *ex ante* effort choices.

In our simple model of outsourcing, we find that the PR model leads to a *sharing* of the ownership/control instruments between the parties, so as to raise their threat-point payoffs and effort choices. In the case where the foreign firm owns the plant, the local manager should control the input decision, and this is the arrangement that we observe most often in practice. The evidence from China therefore supports the PR model, and more so as we consider subsets of the data that focus on exports through Hong Kong, or that exclude the state-owned enterprises: in both cases, an even greater magnitude of exports occur in the foreign-ownership/local-control regime. Interestingly, in the case where the plant is Chinese-owned (less common in the data), both the PR and the IS models predict that control over the inputs is unimportant, in the sense that it has no efficiency effect. This subsidiary prediction of our model is also roughly borne out in the data, where the input control rights under Chinese-ownership are granted to either party.

References

Aghion, Phillipe and Jean Tirole, 1997, "Formal and Real Authority in Organizations," *Journal of Political Economy,* 105(1), 1-29.

Amsden, Alice H. 1989. *Asia's Next Giant: South Korea and Late Industrialization*. Oxford: Oxford University Press.

Antras, Pol. 2002. "Firms, Contracts, and Trade Structure." Mimeo, MIT.

Baker, George P. and Thomas N. Hubbard. 2000a. "Contractibility and Asset Ownership: On-Board Computers and Governance in U.S. Trucking." NBER Working Paper No. 7634.

Baker, George P. and Thomas N. Hubbard. 2000b. "Make versus Buy in Trucking: Asset Ownership, Job Design, and Information." Mimeo, Harvard University.

Baker, George P. and Thomas N. Hubbard. 2001. "Empirical Strategies in Contract Economics: Information and the Boundary of the Firm." *American Economic Review* 91(2), May, 189-194.

Barba Navaretti, Giorgio, Jan I. Haaland, and Anthony Venables. 2002. "Multinational Corporations and Global Production Networks: The Implications for Trade Policy." CEPR Report prepared for the European Commission Directorate General for Trade.

Battigalli, Pierpaolo and Govanni Maggi. 2002. "Rigidity, Discretion and the Costs of Writing Contracts," *American Economic Review,* September, 92(4), 798-817.

Borga, Maria and William Zeile. 2002. "Foreign Outsourcing and the Intrafirm Trade of U.S. Multinational Companies." Mimeo, U.S. Bureau of Economic Analysis.

Chen, Hongyi. 2000. *The Institutional Transition of China's Township and Village Enterprises*. Brookfield, VT: Ashgate.

Chiu, Stephen W.K., K.C. Ho, and Tai-Lok Lui. 1997. *City-States and the Global Economy*: *Industrial Restructuring in Hong Kong and Singapore*. Boulder, CO: Westview Press.

Demurger, Sylvie, Jeffrey D. Sachs, Wing Thye Woo, Shuming Bao, Gene Chang, and Andrew Mellinger. 2001. "Geography, Economic Policy, and Regional Development in China." *Asian Economic Papers,* forthcoming.

Feenstra, Robert C. and Gordon H. Hanson. 2002. "Intermediaries in Entrepôt Trade: Hong Kong Re-Exports of Chinese Goods." *Journal of Economics and Management Strategy*, forthcoming.

Findlay, Ronald. and S. Wellisz. 1993. "Five Small Open Economies: Hong Kong." In Ronald Findlay and S. Wellisz, eds., *Five Small Open Economies: A World Bank Comparative Study*, Oxford: Oxford University Press, pp. 16-92.

Gereffi, Gary and Miguel Korzeniewicz, eds. 1994. *Commodity Chains and Global Capitalism*. Westport, CT: Praeger.

Grossman, Sanford J. and Oliver D. Hart, 1986, "Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 94(4), August, 691-719.

Groves, Theodore, Yongmiao Hong, John McMillan, and Barry Naughton. 1994. "Autonomy and Incentives in Chinese State Enterprises," *Quarterly Journal of Economics*, 109(1): 183-209.

Groves, Theodore, Yongmiao Hong, John McMillan, and Barry Naughton. 1995. "China's Evolving Managerial Labor Market," *Journal of Political Economy*, 103(4): 873-92.

Grunwald, Joseph. and Kenneth Flamm. 1985. *The Global Factory: Foreign Assembly and International Trade*. Washington: The Brookings Institution.

Grossman, Gene and Elhanan Helpman. 2002a. "Integration versus Outsourcing in Industry Equilibrium." *Quarterly Journal of Economics*, 117(1), February, 85-120

Grossman, Gene and Elhanan Helpman. 2002b. "Outsourcing in a Global Economy." NBER Working Paper No. 8728.

Grossman, Gene and Elhanan Helpman. 2002c. "Managerial Incentives and the International Organization of Production." Mimeo, Princeton University and Tel Aviv University.

Hanson, Gordon H. 1995. ""Incomplete Contracts, Risk, and Ownership," *International Economic Review*, 36: 341-63.

Hart, Oliver D. and John Moore, 1990, "Property Rights and the Nature of the Firm," *Journal of Political Economy*, 98, 1119-1158.

Hart, Oliver D. 1995. *Firms, Contracts, and Financial Structure.* Oxford: Oxford University Press.

Holmstrom, Bengt and Paul Milgrom, 1994, "The Firm as an Incentive System," *American Economic Review*, 84(4), 972-991.

Lin, Chu-Chia and Ivan Png. 2001. "Monitoring Costs and the Mode of International Investment." Mimeo, National University of Singapore.

Marin, Dalia and Thierry Verdier. 2001. "Power Inside the Firm and the Market: A General Equilibrium Approach." Mimeo, University of Munich and DELTA.

Naughton, Barry, 1996, "China's Emergence and Prospects as a Trading Nation," *Brookings Papers on Economic Activity*, 2: 1996, pp. 273-343.

Naughton, Barry. 1995. *Growing Out of the Plan: Chinese Economic Reform, 1978-1993,* New York: Cambridge University Press.

Naughton, Barry. 1997. *The China Circle*. Washington, DC: Brookings Institution Press.

Naughton, Barry. 1999. "Between China and the World: Hong Kong's Economy Before and After 1997." In Gary Hamilton, ed., *Cosmopolitan Capitalists: Hong Kong and the Chinese Diaspora at the End of the Twentieth Century*. Seattle, WA: University of Washington Press.

Orru, Marco, Nicole Biggart, and Gary G. Hamilton. 1997. *The Economic Organization of East Asian Capitalism*. Thousand Hills, CA: Sage Publications.

Puga, Diego and Daniel Trefler. 2002. "Knowledge Creation and Control in Organizations." Mimeo, University of Toronto.

Sung, Yun-Wing. 1991. *The China-Hong Kong Connection*. Cambridge: Cambridge University Press.

Sung, Yun-Wing. 1998. *Hong Kong and South China: The Economic Synergy*. Hong Kong: City University of Hong Kong Press.

Tirole, Jean. 1999. "Incomplete Contracts: Where Do We Stand?" *Econometrica* 67(4), July, 741-781.

Train, Kenneth, 1986, *Qualitative Choice Analysis.* Cambridge: MIT Press.

Wade, Robert. 1992. *Governing the Market*. Princeton, NJ: Princeton University Press.

Wang, Kui Hua. 2000. *Chinese Commercial Law*. Oxford: Oxford University Press.

Whinston, Michael 2001. "Assessing the Property-Rights and Transaction Cost Theories of Firm Scope." *American Economic Review* 91(2), May, 184-188.

World Bank. 1994. "China: Foreign Trade Reform." Washington, DC.

Yeats, Alexander J. 2001. "Just How Big is Global Production Sharing?" in Sven W. Arndt and Henryk Kierzkowski (eds.), *Fragmentation: New Production Patterns in the World Economy*, Oxford: Oxford University Press.

Table 1: Foreign Ownership, Export Processing, and Trade in China

Year	Processing Exports/ Total Exports	FIE Exports/ Total Exports	Share in Total Processing Exports of		
			Import-and-Assembly	Hong Kong Re-Exports	FIE Exports
1997	0.525	0.342	0.696	0.565	0.545
1998	0.545	0.370	0.694	0.562	0.566
1999	0.542	0.385	0.665	0.516	0.584

Notes: Columns (1) and (2) show processing exports and exports by foreign-invested enterprises, respectively, as a share of total China exports; columns (3)-(6) show as a share of total China processing exports, processing exports under the import-and-assembly regime, processing exports re-exported through Hong Kong, and processing exports by foreign-invested enterprises, respectively.

Table 2:

Optimal Effort Levels in the Incentive-Systems Model

	Ownership of the Factory	
	$\delta_2 = 0$, Foreign Firm f owns	**$\delta_2 = 1$, Factory Manager g owns**
$\delta_1 = 0$, Foreign Firm f controls inputs	**Employment contract:** $e_1 = P$ $e_2 = \bar{e}_2$ $e_3 = B$ $W(0,0) > W(1,0)$	**Outsourcing contract:** $e_1 = P$ $e_2 = A$ $e_3 = B$ $W(0,1) = W(1,1)$
$\delta_1 = 1$, Factory manager g controls inputs	**Employment contract:** $e_1 = \bar{e}_1$ $e_2 = \bar{e}_2$ $e_3 = B$ $W(1,0)$	**Outsourcing contract:** $e_1 = P$ $e_2 = A$ $e_3 = B$ $W(1,1) = W(0,1)$

Control of the Inputs

Table 3:

Threat-Point Payoffs and Optimal Effort Levels in the Property-Rights Model

	Ownership of the Factory	
	$\delta_2 = 0$, Foreign Firm f owns	**$\delta_2 = 1$, Factory Manager g owns**
$\delta_1 = 0$, Foreign Firm f controls inputs	$\pi_f = Be_3 - A - P(1-e_1)$ $\pi_g = y_g$ $e_1 = P$ $e_2 = (\lambda B + A)/2$ $e_3 = B$ $W(0,0)$	$\pi_f = \hat{B}e_3 - A - P(1-e_1) - R$ $\pi_g = \hat{T} - A(1-e_2) - \hat{P}$ $e_1 = P$ $e_2 = (\lambda B/2) + A$ $e_3 = (B+\hat{B})/2,$ $W(0,1) = W(1,1)$
$\delta_1 = 1$, Factory manager g controls inputs	$\pi_f = Be_3 - A - \hat{P}$ $\pi_g = \hat{T} - (A - \hat{A}e_2) - P(1-e_1) - R$ $e_1 = P$ $e_2 = (\lambda B + A + \hat{A})/2, \quad 0 < \hat{A} \le A$ $e_3 = B$ $W(1,0) > W(0,0)$	$\pi_f = \hat{B}e_3 - A - \hat{P} - R$ $\pi_g = \hat{T} - A(1-e_2) - P(1-e_1)$ $e_1 = P$ $e_2 = (\lambda B/2) + A$ $e_3 = (B+\hat{B})/2,$ $W(1,1) = W(0,1)$

Control of the Inputs

Table 4: Processing Exports by Input Control and Factory Ownership Regime

	All Firms		**Excluding SOEs**	
	Ownership of Factory		Ownership of Factory	
Control over Inputs	Foreign	Chinese	Foreign	Chinese
(processing regime)	S(0,0)	S(0,1)	S(0,0)	S(0,1)
Foreign Buyer (pure-assembly)	0.068 (0.002)	0.248 (0.006)	0.093 (0.003)	0.036 (0.003)
	S(1,0)	S(1,1)	S(1,0)	S(1,1)
Chinese Factory (import-and-assembly)	0.498 (0.005)	0.187 (0.003)	0.734 (0.004)	0.136 (0.003)
CVD [S(0,0) + S(1,1)] – [S(0,1) + S(1,0)]	-0.490 (0.008)		-0.541 (0.007)	

Notes: This table shows means for shares of processing exports by factory ownership (foreign versus Chinese) and input-control regime (pure-assembly versus import-and-assembly) by year, industry, destination country, origin province, and trade zone. The first two columns show results for 228,760 observations on the sample of all firm types; the second two columns show results for 174,071 observations on the sample of firms excluding state-owned enterprises. Heteroskedasticity-consistent standard errors are in parentheses.

Table 5: Processing Exports by Control/Ownership Regime and Export Route

	Direct Exports		**Re-Exports thru Hong Kong**	
	Ownership of Factory		Ownership of Factory	
Control over Inputs	Foreign	Chinese	Foreign	Chinese
(processing regime)	S(0,0)	S(0,1)	S(0,0)	S(0,1)
Foreign Buyer	0.125	0.131	0.020	0.344
(pure-assembly)	(0.004)	(0.004)	(0.001)	(0.008)
	S(1,0)	S(1,1)	S(1,0)	S(1,1)
Chinese Factory	0.504	0.240	0.492	0.144
(import-and-assembly)	(0.006)	(0.005)	(0.007)	(0.003)
CVD	-0.270		-0.671	
[S(0,0) + S(1,1)] –	(0.011)		(0.007)	
[S(0,1) + S(1,0)]				

Notes: This tables show mean shares of processing exports by factory ownership and input-control regime for goods shipped directly to destination markets (columns 1 and 2) and goods re-exported through Hong Kong (columns 3 and 4). See Table 4 for more details.

Table 6: Processing Exports by Control/Ownership Regime and Trade Zone

	Inside SEZs		**Outside SEZs**	
	Ownership of Factory		Ownership of Factory	
Control over Inputs	Foreign	Chinese	Foreign	Chinese
(processing regime)	S(0,0)	S(0,1)	S(0,0)	S(0,1)
Foreign Buyer	0.058	0.082	0.070	0.285
(pure-assembly)	(0.003)	(0.004)	(0.003)	(0.006)
	S(1,0)	S(1,1)	S(1,0)	S(1,1)
Chinese Factory	0.751	0.109	0.440	0.205
(import-and-assembly)	(0.007)	(0.004)	(0.005)	(0.004)
CVD	-0.666		-0.451	
[S(0,0) + S(1,1)] –	(0.011)		(0.009)	
[S(0,1) + S(1,0)]				

Notes: This tables show mean shares of processing exports by factory ownership and input-control regime for goods produced inside Special Economic Zones (columns 1 and 2) and goods produced outside Special Economic Zones (columns 3 and 4). See Table 4 for more details.

Table 7: Regression Results, Dependent Variable:
Concentrated versus Dispersed Control/Ownership

Intercept	-0.185	-0.378	-0.176	-0.372
	(0.012)	(0.012)	(0.023)	(0.023)
Hong Kong	-0.475	-0.196	-0.395	-0.167
	(0.015)	(0.015)	(0.015)	(0.016)
SEZ	-0.421	-0.339	-0.356	-0.250
	(0.020)	(0.019)	(0.022)	(0.018)
SEZ*Hong Kong	0.357	0.171	0.326	0.140
	(0.026)	(0.026)	(0.025)	(0.024)
Industry, Province, Destination, Year Controls	No	No	Yes	Yes
Sample	All firms	No SOEs	All firms	No SOEs
N	228,760	174,071	228,760	174,071
R^2	0.132	0.051	0.184	0.113

Notes: This table reports regression results for the variable CVD (concentrated versus dispersed input control and factory ownership), defined as [S(0,0) + S(1,1)] – [S(0,1) + S(1,0)], for observations on Chinese processing exports by year, industry, destination country, origin province, and type of trade zone. The variable Hong Kong equals one if the goods are re-exported through Hong Kong and the variable SEZ equals one if the goods are produced in a Special Economic Zone. Columns 2 and 4 exclude exports by state-owned enterprises from the calculation of CVD; columns 3 and 4 include dummy variables for the year, one-digit SITC industry, destination region, and origin province (excluded categories are 1997, SITC 8 (miscellaneous manufacturing), North America, and southern coastal provinces (Guangdong, Fujian, Hainan)).

Table 8: Regression Results on the Property Rights Model, Dependent Variable: Concentrated versus Dispersed Control/Ownership

Hong Kong Re-Export Dummy	-0.232	-0.227	-0.111	–
	(0.030)	(0.029)	(0.039)	
SEZ Dummy	-0.296	-0.289	-0.263	-0.247
	(0.041)	(0.040)	(0.038)	(0.035)
Export Price Variability	-0.026	-0.024	-0.020	-0.021
	(0.005)	(0.005)	(0.005)	(0.007)
Differentiated Product	-0.097	-0.004	-0.031	-0.059
	(0.091)	(0.092)	(0.085)	(0.104)
Destination Country Per Capital GDP	-0.082	-0.054	-0.004	0.008
	(0.017)	(0.032)	(0.035)	(0.041)
Foreign Firm Share of Province Exports	-0.291	-0.256	-1.831	-1.525
	(0.664)	(0.670)	(0.755)	(0.684)
SOE Share of Province Exports	0.141	0.236	-1.742	-1.364
	(0.693)	(0.702)	(0.777)	(0.728)
Province Manuf. Employment Share	0.083	0.119	0.133	0.227
	(0.140)	(0.137)	(0.146)	(0.142)
Province Distance to Hong Kong	0.146	0.144	0.103	0.081
	(0.032)	(0.032)	(0.035)	(0.035)
Province Distance to Destin. Market	-0.049	-0.044	-0.004	-0.113
	(0.020)	(0.036)	(0.044)	(0.052)
Foreign Firm Share of Industry Exports	-0.667	-0.683	-0.502	-0.419
	(0.109)	(0.108)	(0.099)	(0.170)
MFA Dummy	0.262	0.273	0.233	0.366
	(0.043)	(0.044)	(0.062)	(0.086)
1 - Corp. Tax Rate	-0.065	-0.021	0.039	0.008
	(0.050)	(0.043)	(0.049)	(0.074)
SOEs Excluded	No	No	Yes	Yes
Industry, Destination Region Controls	No	Yes	Yes	Yes
N	84,420	84,420	63,585	44,748
R^2	0.294	0.301	0.174	0.200

Notes to Table 8: This table reports regressions using CVD (concentrated versus dispersed control/ownership) as the dependent variable. All regressors except dummy variables are in logs. Columns 1 and 2 include the full sample and columns 3 and 4 exclude observations associated with state-owned enterprises. Column 4 also excludes exports that are re-exported or destined for Hong Kong. Columns 2-4 include dummy variables for the one-digit SITC industry and for ten destination country regions (North America, Latin America, Western Europe, Eastern Europe, Africa, Middle East, South Asia, Southeast Asia, East Asia, Oceania). Standard errors (in parentheses) are adjusted for correlation in the errors across observations that share the same four-digit SITC industry.