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The Effects of Domestic Mergers on Exports: A Case Study of the 1998 Korean Automobile Industry

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Abstract

This paper examines the economic consequences of a horizontal merger between Korean automakers that took place in 1998, with a particular emphasis on export market behavior. Estimates of structural demand and supply reveal that the merger enhanced production efficiency of the merged party by 6.3 percent. Simulations, based on these estimates, indicate that while the merger increased domestic prices, it also tripled the export volume of the merged party. Moreover, the effects of the merger are found to differ by auto model according to the model's pre-merger export status. It is shown that efficiency gains from the merger are likely to increase export volumes for models that were already exported prior to the merger, and to offset domestic market power for those that were not exported even after the merger. Finally, the paper compares the actual merger's effects to those of an alternative counterfactual merger, finding that the actual merger brought greater benefits to producers and fewer to domestic consumers.

Keywords: Horizontal merger; efficiency; export; industrial policy; automobiles

JEL classification: F14; L13; L41; L52; L62

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1 Introduction

In the aftermath of the economic and financial crisis triggered by the 2008 bankruptcy of Lehman Brothers, there has been renewed interest in industrial policy, which, when broadly defined, refers to a variety of measures through which governments support business and industry. One key type of government intervention falling within this category is the creation of "national champions." National champions can emerge in a number of ways, such as through the granting of state aid, the encouragement of domestic mergers, or opposition to a takeover of a domestic company by a foreign entity (OECD, 2009). The creation of national champions with market power, however, is often at odds with government competition policies. Indeed, governments sometimes attempt to bend merger control processes, which are typically meant to focus the attention of the competition authorities on consumer welfare.

Considerable debate still exists, especially in Europe, as to whether or not national champions are justified. Some researchers favor fostering national champions through mergers based on the reasoning that mergers allow firms to realize economies of scale and to reallocate production towards the most efficient plants (for example, Krugman, 1984; Zhang and Chen, 2002). Others argue against national champions for the reason that domestic rivalry — enabled by domestic market competition — places firms under considerable pressure to improve and innovate, ultimately leading to expanded output and improved export performance (for example, Sakakibara and Porter, 2001; Clougherty and Zhang, 2005 and 2008). Resolving the debate between the industrial policy view and that focused on competition policy depends on a crucial first step: understanding the mechanism by which a merger that creates a national champion contributes to market performance and national welfare.

This paper contributes to this effort through a unique quantitative study of the 1998 horizontal merger between Hyundai and Kia Motors in South Korea to create a national champion with a market share of more than 60 percent. Notably, despite the Korean competition authority's grave concern over a substantial increase in market power, it approved the merger on the grounds that it would "rationalize the industry and enhance international competitiveness." This paper thus uses this merger as a case study to illustrate the trade-off between market power and efficiency gains, both of which are associated with the creation of a national champion through a merger. Casual observations of the dataset indicate that this merger was marked by both market power and efficiency gains: the newly merged company steadily increased the average price of its passenger cars by 12.4 percent over the ten years following the merger. At the company's production and export volumes tripled, in stark contrast with those of other Korean automobile manufacturers, which experienced little growth.

As there are no obvious ways to perform controlled experiments regarding the 1998 Korean automobile merger, we instead follow the literature to conduct a set of two-step counterfactual simulations. First, we use observed data from the pre- and post-merger periods and apply an economic model to recover parameters of underlying economic primitives that were invariant in the merger. We model major firms' strategic behavior in both domestic and export markets and estimate parameters of consumer demand and marginal costs for each auto model. In the second step, the model is used to simulate changes in equilibrium outcomes based on a counterfactual situation in which the two automakers did not merge. We also simulate a counterfactual in which a company other than Hyundai acquired Kia. We simulate merger outcomes for both domestic and overseas shipping and undertake a welfare analysis of the Hyundai-Kia merger.

Our estimation results, based on data from 1996 to 2009, indicate that the merger decreased the marginal costs faced by the merged company by 6.3 percent. This efficiency gain was presumably due to standardizing auto parts and integrating formerly independent production platforms. While such enhanced production efficiency would be expected to increase output, its effect on domestic prices would depend on the export status of the car model under study. With an oligopolistic domestic market and a competitive overseas market, the efficiency gains from the merger should relax at the margin for goods consumed only domestically, but not necessarily for those that are also exported. Our simulation exercise demonstrates that the merger raised the average domestic price of passenger cars by 14.2 percent. The price increase would have been even higher had the companies been more export-oriented. In such a case, the increase in producer surplus, half of which was attributable to improved export performance, would not have made up for the lost consumer surplus, leading to a 1.6 percent decrease in the total surplus averaged over the full study period. Interestingly, the merger's market outcomes and welfare consequences would have differed substantially under counterfactual scenarios in which other companies acquired Kia. For example, had Daewoo merged with Kia, the consumer surplus would have been higher but the producer surplus lower. This finding implies that the Korean Fair Trade Commission's (KFTC) decision in the Hyundai-Kia merger privileged producers over consumers; its judgment thus appears to favor industrial policy, not competition policy.

This paper contributes to the literature on ex-post evaluation of horizontal mergers and competition policy in an open economy. Several studies have focused on evaluating efficiency gains and welfare consequences of horizontal mergers. Pesendorfer (2003), for example, employs a static model to examine the effects of capacity investment on merger outcomes in the U.S. paper and pulp market, finding evidence of an associated efficiency increase. Other works that explicitly quantify efficiency effects include Benkard, Bodoh-Creed, and Lazarev (2010) on airlines, Stahl (2014) on television stations, and Jeziorski (2014) on radio stations. To our knowledge, however, this paper is the first to extend the analysis to a context in which exports comprise a distinctive characteristic of the market. Neglecting this feature in an export-oriented industry could lead to incorrect judgments regarding how efficiency gains are reached as an equilibrium outcome of a merger.[1] In particular, the paper identifies that, as the merged parties export greater variety of pre-merger goods, the efficiency gains from the merger may contribute less to offsetting domestic market power and more to improving export performance. This finding provides new insight for the formation and enforcement of antitrust laws: more attention should be paid to the export status of goods when analyzing a market in which exports are a salient feature.

This paper is also related to a small but important literature on competition policy in open economies. While the theoretical implications of the interaction between competition and trade

[1] Clougherty (2002) analyzes how the expansion of the network of domestic flight routes due to mergers affected competition over international routes in the U.S. airline industry. However, it focuses only on the impact on the foreign market and provides little insight into evaluating a merger. Yoshimoto (2011) also examines the Hyundai-Kia merger, but with a narrow focus: a sensitivity test of simulation methods on the domestic merger, not accounting for the export market.

policies have been discussed (for example, Horn and Levinsohn, 2001), quantitative evidence has been scarce in this literature. A recent exception is Breinlich, Nocke, and Schutz (2014), which calibrates a cross-industry model to examine the effects of coordination between American and Canadian competition authorities in counterfactual scenarios. While the paper's focus is limited to a particular merger event that was not influenced by foreign authorities, it provides a finding contrasting with the literature's frequent claim that import competition mitigates the increased market power arising from a merger. As our demand estimates demonstrate, this occurs because Korean and foreign cars were poorly matched substitutes in the eyes of Korean consumers.

The rest of this paper is organized as follows. Section 2 provides an overview of the Korean automobile industry in the late 1990s with a particular focus on the Hyundai-Kia merger. It also provides a preliminary analysis of the impact of the merger based on reduced-form regressions. Section 3 presents a competition model of the domestic and overseas markets. We discuss methods for identifying and estimating the structural model in Section 4 and then present the estimation results in Section 5. These results provide a basis for the analysis of Section 6, in which we assess the effects of the merger on market outcomes and economic welfare. This section also assesses counterfactual merger scenarios, in which companies other than Hyundai acquire Kia. Section 7 concludes, followed by a data appendix.

2 Historical Background and Preliminary Data Analysis

The Korean automobile industry underwent considerable change in the 1990s and 2000s. In the aftermath of the 1997 Asian Financial Crisis, all the major automakers except Hyundai were faced with serious financial difficulties. Five major Korean automakers were present at the time of the crisis: Hyundai, Kia, Daewoo, SsangYong, and Samsung.[2] Kia went bankrupt in the summer of 1997 and was subsequently put out to tender by the Korean government and creditor banks.

[2]There are three other Korean automakers not listed here: Hyundai Precision, Daewoo Heavy Industry and Asia Motors. The first two were considered subsidiaries of the Hyundai and Daewoo Groups respectively, and Asia Motor was a subsidiary of Kia. In the analysis, we thus classify these three companies as belonging to Hyundai, Daewoo, and Kia, respectively.

After the third round of the tender process, Hyundai beat Daewoo[3] to acquire a greater-than fifty percent share of Kia's stock, paying the price of 1.18 trillion Korean Won (KW) following KFTC approval.[4] It was not clear at the outset whether Hyundai had won. In the two previous tender rounds, Kia creditors had rejected bids that were below the secret reserve price. Had the third round been annulled, the winner might have been Ford, which was Kia's biggest shareholder.[5] Since it was nearly impossible to anticipate at that time that Hyundai would acquire Kia, the Hyundai-Kia merger can be naturally considered exogenous to the development of the Korean automobile industry.

In its review process, KFTC faced a trade-off between market power and the efficiency gain associated with the proposed Hyundai-Kia merger. On the one hand, the commission acknowledged that the merger would restrict market competition, as the two companies combined controlled more than 60 percent of the Korean passenger car market at the time of the merger. On the other hand, KFTC also recognized that the merging party would likely achieve production efficiency and enhance both domestic and overseas shipments by integrating the two manufacturing platforms and exploiting sales networks both within and outside of Korea. The latter possibility was a major consideration in the KFTC judgment, because Korean competition law at the time stated that, if the merger aims at the rationalization of industry or the enhancement of international competitiveness, the merger is approved under the condition that these impacts exceed any anti-competitive effect.[6] Eventually KFTC approved the merger,[7] and the renewed Hyundai-Kia Group (hereafter H-K) was established in December 1998, leading to the creation of a major global

[3] Samsung and Ford were disqualified because their bidding proposals demanded substantial write-offs of Kia's debts.

[4] After the write-off of 7.47 trillion KW of Kia's debt, Hyundai assumed the remaining debt of 1.93 trillion KW. The merger contract also demanded that Hyundai continue operating the Kwangju plant over the subsequent 15 years and maintain the pre-merger level of employment at the plant until 2000.

[5] *New York Times* (October 19, 1998)

[6] This quote is from Chapter 3, article 7, item 1 of the competition law and articles 13 and 14 of the enforcement decree. A concise summary of Korean competition law is offered by, for example, Yun and Hong (2005).

[7] While KFTC ordered that Hyundai cap price increases on trucks during the three years following the merger, no such restrictions were imposed on passenger cars, which are the focus of this paper.

automaker.

H-K outperformed after the merger in terms of both domestic and overseas sales. As presented in Figure 1, while favorable (real effective) exchange rates benefited all Korean automakers in the recovery from the Asian Financial Crisis, H-K's exports tripled and its domestic sales doubled towards the end of the study period in 2009. Figure 1 also shows the sales-weighted average of domestic prices deflated to the 1996 price. As is evident, H-K increased its average prices in lockstep with other companies. Import quantities increased, but only after the year 2000 and with a share of less than 10 percent. These market-level data thus offer somewhat puzzling evidence regarding the effect of the merger. While the increase in domestic prices is indicative of the presence of market power, H-K's sales in both domestic and overseas markets expanded considerably regardless of the price increase.

Following KFTC approval, Mong-Gu Chung, the eldest son of Hyundai's owner at the time, became the new H-K chairman[8] and replaced many of the existing executives with new ones, most of whom had worked for him in his previous roles at Hyundai-affiliated companies. H-K then launched an extensive restructuring and consolidation of its business operations (Lee and Cho, 2001). For example, the company integrated eight R&D centers into two: the Namyang R&D Center for passenger cars, and the Junju R&D Center for commercial vehicles. In 2000, the company launched a new business unit, Hyundai Mobis in 2000, which worked to standardize parts and modules between Hyundai and Kia. These efforts would help H-K to exploit scale economies that had not existed before the merger. As an example, Figure 2 shows the trend in platform integration within H-K from 1996 to 2009. In automobile production, the platform is a combination of an underbody and suspensions with axles. If the number of car models is kept constant, reducing the number of platforms should reduce the cost of production development and manufacturing while still producing a variety of car models with different external styles and interior options. As shown in Figure 2, the integration of production platforms began after the merger and accelerated around the year 2000, when Hyundai Mobis was established.

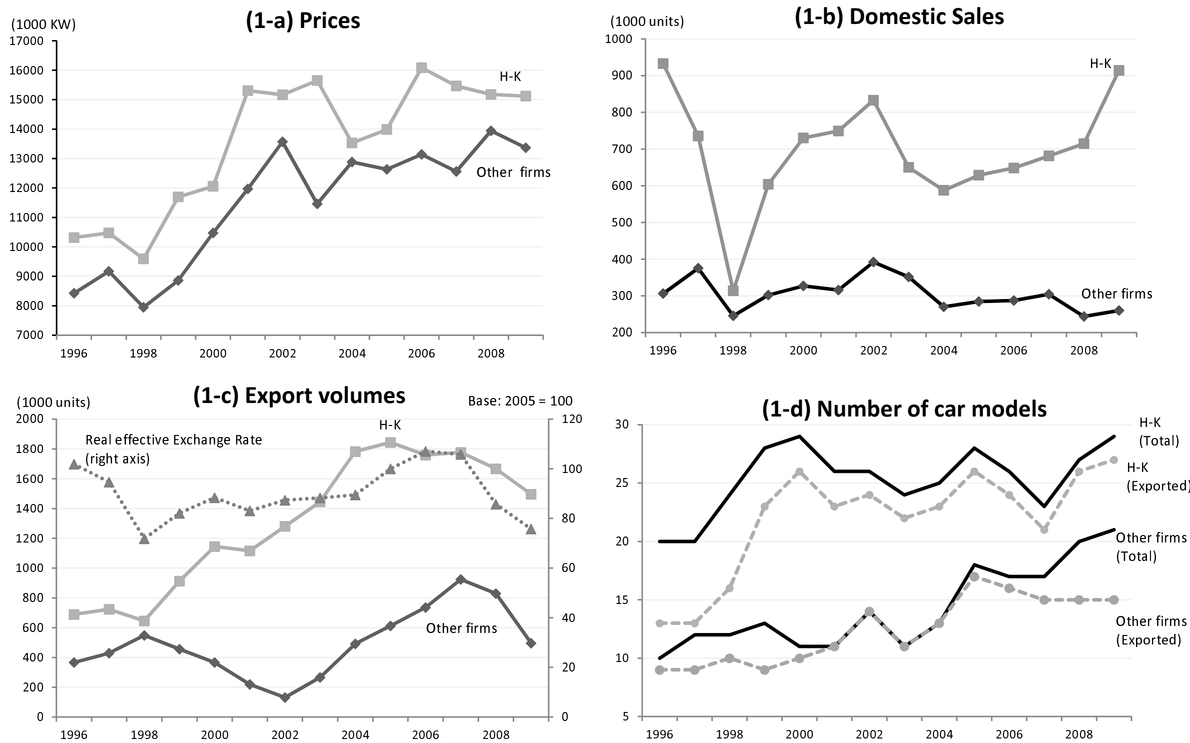
We define the variable $platform_{jt}$ as the number of car models sharing the same platform as

[8]Mong-Gu Chung succeeded Se-Young Chung, a younger brother of the then owner, Joo-Young Chung.

that of model $j \in J_t$ in year t, where J_t is the set of all car models available in year t. We regress car price and export volume on this variable, controlling for other automobile characteristics as well as firm- and year-specific components. Table 1 shows the results obtained from three specifications of ordinary least squares (OLS) estimation. The dependent variable in the first two specifications is the domestic price (for Korean models in (1-1) and for all models including imports in (1-2)); in the third (1-3), export volumes are instead used, with the value set to zero in a given year for models not exported during that year. Three non-price characteristics are included as explanatory variables: engine displacement size, horsepower, and fuel efficiency.

Two observations can be made based on these simple reduced-form regression estimates. First, the estimated coefficients on most of the observed characteristics are statistically significant. Second, the estimated coefficients on $platform_{jt}$ indicate that efficiency gains from integrating the platforms significantly impacted export volumes but not domestic prices. Why did efficiency gains from platform integration have greater influence on exports than on domestic prices? To tackle this question, the next section introduces a structural model describing consumer purchasing behavior and firm pricing and exporting behavior in the Korean automobile industry of the 1990s and 2000s.

Figure 1: Prices, Domestic sales, and Exports



Notes: Other firms include Daewoo, Ssangyong and Samsung. Imports are not included in this figure.

Figure 2: Trend in platform integration of H-K models

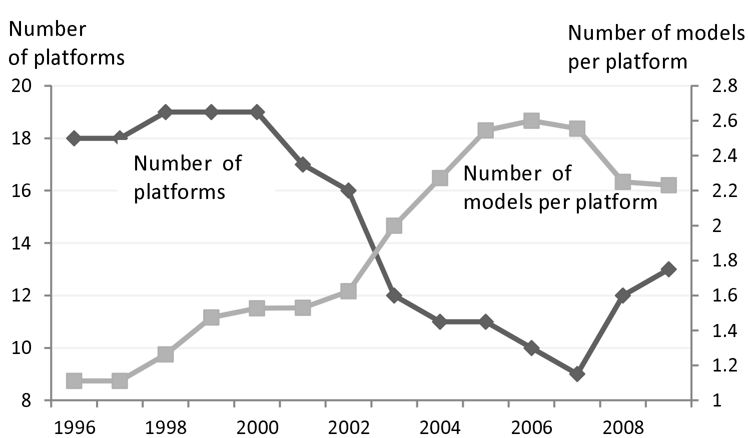


Table 1: Effects of Platform on Domestic Prices and Export Volumes

	(1-1) Domestic Prices			(1-2) Domestic Prices			(1-3) Export Volumes		
	Coef.	S.E.		Coef.	S.E.		Coef.	S.E.	
Engine displacement size	0.959	0.053	***	1.135	0.067	***	-3.389	0.948	***
Horsepower	0.256	0.052	***	0.103	0.059	*	-1.182	0.868	
Fuel efficiency	-0.399	0.073	***	-0.671	0.096	***	2.291	1.351	*
platforms	0.009	0.008		0.010	0.007		0.729	0.084	***
Constant	-9.534	0.539	***	-9.482	0.769	***	30.600	10.250	***
Sample	Domestics and Imports			Domestics			Domestics		
R-squared	0.86			0.86			0.33		
Number of observations	973			555			555		

Notes: The superscripts, ***, * indicate significance at the 99-, and 90-percent confidence levels, respectively. A dependent variable in each model are in the logarithmic form, so are the first three explanatory variables in each model. The estimated coefficients of year dummies and make dummies are omitted from the table. Since some models had no exports in the study period, we add the value of one to the variable of export volume. Heteroskedasticity-robust standard errors are used.

3 Model and Estimation Methods

This section describes our model for the Korean automobile market during the period from 1996 to 2009. We first provide an overview of the estimation model and then delve into its details. Hereafter we omit the time subscript t from variable names unless there is ambiguity.

3.1 Overview of the Model

A carmaker is assumed to maximize total profit. The profit maximization problem faced by a given firm is conceptualized as follows (see also Figure 3). At each point in time, a firm must decide the quantity of cars to sell in both domestic and overseas markets. Since there is no obvious product differentiation between domestically consumed and exported cars, we can assume that their marginal production costs are the same. We assume that (i) cars sold domestically are differentiated by model and (ii) exported cars are competitively supplied in the world market.

Assumption (i) is consistent with the observation made in Section 2 that non-price component plays a role in shaping the Korean market. This product differentiation generates a downward-sloped domestic demand curve: for each domestic and imported car model, demand decreases with price. Assumption (ii) is based on the fact that the share of Korean exports in the world market was only 5.6 percent at its peak, with its import share accounting for a mere 0.15 percent of global production during the study period. This small-economy assumption plays an important role in ensuring that the merger has no terms of trade effects. We will verify the validity and robustness of this assumption in Sections 5.3 and 6.1.

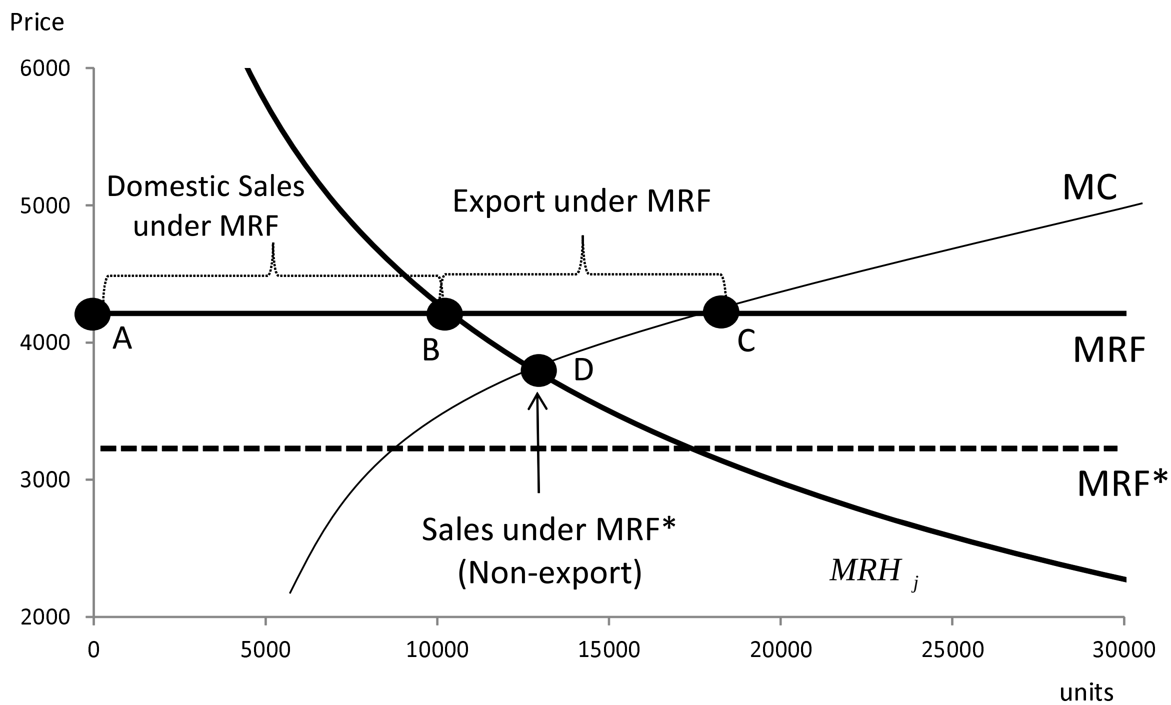
The five abovementioned Korean firms dominated the domestic industry, and imported cars accounted for a small share of total domestic sales. The degree of market power determines the slope of the domestic marginal revenue curve. Firm f supplies car model j on the domestic market as long as the marginal revenue gained from selling in the domestic market, MRH_j, exceeds the (flat) marginal revenue obtainable in the competitive foreign market, MRF_j. Once MRH_j equals MRF_j, the firm starts exporting model j; the firm stops producing the model altogether when the marginal cost of production, MC_j, exceeds MRF_j. The cost structure is described in Section 3.3. As depicted in Figure 3, firm f therefore produces quantity AC of model j and exports amount BC. MRH_j shifts leftward with an increase in the market shares of other competing car models, including imports. In reality, some Korean car models were exported and others sold only in the domestic market. As depicted in Figure 3, the demand condition does not affect output at the margin for the car model, but does alter the allocation of domestically produced cars in terms of domestic and foreign shipments.

The model offers theoretical insights into the market outcomes of the merger. We expect that the merger will rotate MRH_j clockwise as market power rises and shift MC_j downward as efficiency grows. In this model setting, it is interesting to note that the merger outcome differs depending on the export status of the car models. We will first focus on car models that are consumed solely in the domestic market and not exported. In this case, a firm domestically supplies increased production volumes due to efficiency gains from the merger until the point at which MRH_j meets MRF_j. This thus lessens market power in the domestic market.

The result is different for those models that are already exported. In this case, the increased production volume is shipped abroad, since MRF_j exceeds MRH_j at the margin. This implies that the merger would only strengthen domestic market power with the efficiency gains improving only export performance. This theoretical implication depends crucially on the small-country assumption mentioned above; we check the robustness of the results to alternative assumptions featuring a downward-sloped MRF_j in Section 6.1.

In the next section, we describe the supply side to derive an equilibrium relationship, paying particular attention to the firm's exporting behavior. In Section 3.3, we then turn to a model of consumer demand and production costs of Korean cars.

Figure 3: Model Overview



3.2 Equilibrium Relationship

Here, we construct a car supplier's profit-maximization problem, and solve the first-order conditions. We assume that firms compete over prices to supply Korean customers with cars featuring differentiated attributes (Indeed, Korean firms manufactured an average of over 40 models in a given year during the study period.) We thus consider a multi-product differentiated Bertrand model.

Consider a situation in which a multi-product firm f $(= 1, \cdots, F)$ maximizes total profit with respect to prices and export volumes for the set of cars manufactured by firm f, denoted by $\mathcal{F}_f$. We focus on the firm's pricing and exporting decisions, considering the decision of which cars (i.e., bundles of characteristics) to produce each year as exogenous to the analysis. The profit maximization problem faced by a domestic firm is given as:

$$\max_{\{p_j, q_j^E\}_{j \in \mathcal{F}_f}} \sum_{j \in \mathcal{F}_f} \left[p_j q_j^D(P) + MRF_j q_j^E - TC_j(q_j^D(P) + q_j^E) \right] \text{ s.t. } q_j^E \geq 0, \tag{1}$$

where $q_j^D(P)$ is demand for domestic car j $(= 1, \cdots, J_D)$, and $P \equiv (p_1, \cdots, p_J)'$ is a vector of prices for all cars sold in Korea, including both domestic and imported vehicles. Since inventory data are not available for study, we ignore inventory throughout the remainder of the analysis. Note that $J_D < J$ and that $J - J_D$ is the number of imported car models.[9] The export volume of car model j, q_j^E, is constrained to be non-negative. Seventeen foreign manufacturers exported a total of 108 car models to Korea during the study period (compared with 114 models sold by domestic manufacturers), with a peak market share of less than 5 percent. Imported cars' prices were three times those of domestically produced cars, and the minimum vehicle size was twice as large. The market for imported cars thus seems to be independent of the market for domestic cars; indeed, cross-price elasticities between domestic and imported cars are estimated as negligibly small, as will discussed in Section 5.1. We thus take prices for imported cars as exogenous in the analysis that follows.

Total and marginal costs of model j are denoted respectively by TC_j and MC_j. As discussed in Section 3.1, we assume no product differentiation between domestically consumed and exported cars. The equilibrium conditions for domestic car $j \in J_D$ are solved to be:

$$q_j^D(P) + \sum_{r \in \mathcal{F}_f} (p_r - MC_r) \cdot \frac{\partial q_r^D(P)}{\partial p_r} = 0, \tag{2}$$

$$q_j^E \cdot (MC_j - MRF_j) = 0, \tag{3}$$

[9]During our study period, imported cars were produced by foreign manufacturers, with virtually no imports observed for Korean automakers.

$$MC_j - MRF_j \geq 0, q_j^E \geq 0. \quad (4)$$

Note that all Hyundai and Kia models have been under the same ownership since 1999.[10] The marginal cost MC_j is recovered from Eq. (2) based on the demand estimates obtained in Section 5.1. To preview the result, we find that the estimated MC, the j-th element of which is MC_j, increases with the volume of production, which satisfies a second-order condition for profit maximization. Using the MC estimates and data available, we use a censored model to estimate the export price MRF_j for model j when it is exported, as discussed in Section 5.3.

3.3 Estimation Models

This subsection describes the model we will estimate to explain the dynamics of the Korean car market. We first introduce a demand system.We follow a seminal work of Berry, Levinsohn, and Pakes (1999, hereafter BLP) and use a standard random-coefficient discrete choice model of consumer behavior. We estimate domestic consumer demand for Korean cars at the model level, incorporating key car characteristics. We then turn to a production cost model in section 3.3.2. Efficiency gains accrued thanks to the merger are also specified in this section.

3.3.1 Demand

In this subsection, we describe the standard BLP type random coefficient logit demand model with aggregate data. In any given year, we take the existing car owner to be the purchasing entity: each owner has unitary demand for a new car model. A car model is either Korean or imported. We define the size of the purchasing entity as the number of households in Korea divided by the average timespan for which a given car is held. We denote the market size by M_t. Each consumer i is assumed to maximize her indirect utility at time t by choosing car model j among $J_t + 1$ alternatives, including the option to not purchase a new car. The indirect utility function u_{ijt} is specified as

[10]SsangYong and Daewoo were sold under the same ownership in 1998 and 1999. As we discuss in Section 6, the sector has seen three other recent mergers: Renault acquired Samsung (2000), and Daewoo was acquired by GM (2002), and SsangYong was merged into Shanghai Motors (2005).

$$
\begin{aligned}
u_{ijt} &= (X'_{jt}\beta + \xi_{jt}) + \left[\alpha_{it} p_{jt} + \sum_{l} \sigma_l x_{jlt} \nu_{il}\right] + \epsilon_{ijt} \\
&\equiv \delta_{jt} + \mu_{ijt} + \epsilon_{ijt}
\end{aligned} \tag{5}
$$

The vector X_{jt} contains the observed characteristics of car model j in year t, including engine displacement, horsepower, fuel efficiency per 1000 KW and the constant term, already introduced in Section 2. The utility function contains ξ_{jt}, an unobserved product quality of car model j with the property that $E[\xi_{jt}] = 0$. (In the next section, we discuss certain econometric issues associated with ξ_{jt}.)

To enable richer substitution patterns, allow different consumers to have varying intensities of preferences for different car characteristics. We rely on a random-coefficient utility specification and include μ_{ijt} on the right-hand side of Eq. (5); this can be considered as the deviation of mean utility. For each characteristic of X_{jt}, consumer i has a taste ν_{il}, which we assume to be drawn from an i.i.d. standard normal distribution. The parameter to be estimated, σ_l, captures the variance in consumer taste for characteristic X_{jlt}.

The term α_{it} is consumer i's sensitivity to changes in the real price, p_{jt} (in 1996 constant KW). Drawing from Berry, Levinsohn, and Pakes (1999), we assume that the distribution of α_{it} varies with income, and takes the form of $\alpha_{it} = \alpha / y_{it}$, where y_{it} is consumer i's income and α is a parameter to be estimated. We thus model price sensitivity as being inversely related to income. While we lack data on individual consumers' incomes, we are able to use the empirical distribution for Korean household incomes in year t, $dG_t(y)$ as obtained from the Korean Statistics Bureau (1996-2009). Consumers with similar demographic attributes tend to rank products similarly and thus share similar substitution patterns. The inclusion of α_{it} in Eq. (5) presumably allows for more realistic substitution patterns than under the traditional logit model.

The outside good in our model, not purchasing a new car, includes alternatives such as buying a used car or using public transport. It is impossible to distinguish between changes in the constant term in Eq. (5) and those in the mean and variance of consumer taste for the outside good. However, the constant term in $X_{jt}\beta$ allows us to control for possible bias arising from the existence of the outside good. Let ϵ_{ijt} represent the idiosyncratic taste of consumer i for product j, and follow the extreme value type-I distribution. This assumption leads to the following closed-form probability of consumer i choosing brand j:

$$s_{ijt} = \frac{\exp(\delta_{jt} + \mu_{ijt})}{1 + \sum_{k=1}^{J_t} \exp(\delta_{kt} + \mu_{ikt})}. \tag{6}$$

The market share of car model j, denoted by s_{jt}, is obtained by

$$s_{jt} = \int_{y_{it}} \int_{\nu} s_{ijt} dF(\nu) dG_t(y_{it}), \tag{7}$$

where $dF(\nu)$ represents the joint normal density of taste shocks ν. To approximate the integral, we draw 1000 random observations from the household income distribution. We form a generalized method of moments (GMM) estimator using the moment condition of ξ_{jt}. The instruments and estimation algorithm used are explicated in the next section.

3.3.2 Marginal Costs

Marginal costs are assumed to depend on output levels, observed product characteristics, efficiency gains from the H-K merger, model- and year-specific cost-shifters, and unobserved productivity levels. Marginal costs, in logarithmic form, are given by:

$$\ln MC_{jt} = \gamma_Q \ln q_{jt} + \gamma_W W_{jt} + \gamma_S platform_{jt} + \omega_j + \nu_t + \eta_{jt}. \tag{8}$$

To ensure the existence of an equilibrium, we allow MC_{jt} in Eq. (8) to vary with production volume q_{jt}. Under the assumption of no differentiation between domestically consumed and exported cars, q_{jt} equals the sum of the quantities shipped domestically and overseas, $q_{jt}^D + q_{jt}^E$. We add a vector of product characteristics W_{jt}, engine size, horsepower, and fuel efficiency, all in logarithmic form. The key variable of interest is $platform_{jt}$, as introduced in Section 2. The estimation includes year- and model-specific components (ω_j and ν_t, respectively). The final term in Eq. (8) is an error term η_{jt}, which can be viewed as productivity differences that are unobserved by the researcher. We allow η_{jt} to follow an AR(1) process, $\eta_{jt} = \rho\eta_{jt-1} + e_{jt}$. Note that a negative shock in η_{jt} would lower MC_{jt}, leading to increased production. This makes the variable

q_{jt} endogenous in the estimation of Eq. (8). Moreover, when productive firms are more or less likely to integrate production platforms, the variable, $platform_{jt}$, is also endogenous. We discuss these potential endogeneity issues in the next section.

4 Instruments

This section addresses identification issues arising when estimating the models for demand (7) and marginal cost (8) introduced in the previous section.

In the demand estimation, we follow Berry (1994) to assume that X_{jt} and ξ_{jt} are not correlated with one another, and use the sum of the firm's other car models and of the models offered by competing firms as instruments for the price variable. While the assumption helps us greatly reduce the number of instruments required for the estimation, it may be inaccurate: observed characteristics may be positively correlated with brand image or other attributes for which we lack data. Indeed, as will be discussed in the next section, the model fits the data rather poorly. We thus try to be cautous about interpreting demand estimates in Section 5.1, and in predicting the model in Section 5.4. We employ the algorithm proposed in Dube, Fox, and Su (2012) to minimize the GMM objective function under the constraint that the observed market shares are equal to the predicted ones.[11] The parameters to be estimated are α, β and σ_l in Eq. (5).

Turning to the marginal cost estimation, we are concerned that the unobserved productivity, η_{jt}, may be negatively correlated with the production volume, q_{jt}. To account for this endogeneity, we remove η_{jt} by taking the quasi-difference of Eq. (8) as follows:

$$\begin{aligned}\ln MC_{jt} &= \rho \ln MC_{jt-1} + \pi_1^Q \ln q_{jt} + \pi_2^Q \ln q_{jt-1} + W_{jt}'\pi_1^W + W_{jt-1}'\pi_2^W \\ &+ \pi_1^S platform_{jt} + \pi_2^S platform_{jt-1} + (1-\rho)\omega_j + (\nu_t - \rho\nu_{t-1}) + e_{jt}, \qquad (9)\end{aligned}$$

where $\pi_1^l \equiv \gamma_l$ and $\pi_2^l \equiv -\rho\gamma_l$ for $l \in \{Q, W, S\}$. We apply the minimum distance estimator to

[11] We implement the estimation algorithm using the KNITRO solver in Matlab. We use an analytical gradient and Hessian matrix to facilitate the optimization and set a tolerence of 1E-06 for changes in both the parameter vector and the objective function. Knittel and Metaxoglou (2014) discusses practical issues in estimating a random coefficient logit model using market-level data.

recover the estimates of ρ and γ_l from the non-linear restrictions in π_1^l and π_2^l. This estimator also allows us to conduct the specification test, discussed in the next section.

While the estimator can eliminate the model-specific components in Eq. (9), it can also give rise to two other endogeneity concerns. One involves the variable of MC_{jt-1} if the transformed error term containing e_{jt-1} is serially correlated. We thus take the first difference of the equation and apply the following moment conditions proposed by Arellano and Bond (1991):

$$E\left[\Delta e_{jt} \ln MC_{jt-s}\right] = 0, \quad \text{and} \quad E\left[\Delta e_{jt} \ln q_{jt-s}\right] = 0, \quad \text{for all } t > s \geq 2. \tag{10}$$

According to Blundell and Bond (1998), the first-differenced GMM estimator introduced in Eq. (10), referred to as GMM-DIF, becomes less informative, as ρ increases towards unity or the relative variance of ω_j increases. We employ the system GMM estimator, GMM-SYS, defined by the following moment conditions, along with Eq. (10):

$$E\left[\left(\widetilde{\omega}_j + e_{jt}\right) \Delta \ln MC_{jt-1}\right] = 0, \quad \text{and} \quad E\left[\left(\widetilde{\omega}_j + e_{jt}\right) \Delta \ln q_{jt-1}\right] = 0,$$

where $\widetilde{\omega}_j \equiv (1-\rho)\omega_j$.[12]

Another variable of concern in terms of potential endogeneity is the number of car models sharing the same platform, $platform_{jt}$. Considering platform integration as a type of technology adoption, there are two hypotheses regarding the relationship between firm productivity and platform integration. First, more productive firms may be more likely to integrate platforms. For example, Caselli (1999) argues that skills-biased technology tends to be adopted by firms with high levels of human capital, because skills and technology are complementary under strong learning-by-doing conditions. Assuming that firms with more skilled workers are more productive, this hypothesis implies that more productive automakers are more likely to integrate platforms. The alternative hypothesis, related to technology leapfrogging, is that less productive firms are more likely to integrate platforms. For example, Jovanovic and Nyarko (1996) find an "overtaking" equilibrium in which less productive plants switch technologies more frequently than more

[12]When estimating the dynamic panel models, we collapse the empirical moments by summing over both time and car model dimentions (as in Roodman, 2009).

productive ones, which are more experienced with regard to old and familiar technology and thus less willing to adopt the new technology. This hypothesis suggests that less-productive firms are more likely to adopt platform integration. In either case, the severity of the potential endogeneity depends on the size of the productivity difference between firms that do and do not integrate platforms.

Figures 1 and 2 suggest that the former hypothesis may be a better fit for Korean automobiles in the 1990s and 2000s. H-K began integrating platforms before its rivals as productivity improves thanks to the merger. Such endogeneity could result in an overestimation of the effect of $platform_{jt}$, but this concern is alleviated substantially by our specification, which includes model- and year-specific cost shifters. We thus take the $platform_{jt}$ variable as being exogenous in the estimation; in the next section, we consider an alternative approach to check the robustness of using this variable to capture the efficiency gains from the H-K merger.

5 Estimation Results

This section presents the results of estimating Eqs.(7) and (9) based on annual data covering 1996 to 2009, as such is the availability of model-specific data for both domestic and overseas sales. In this section, we first discuss estimates for demand, and then turn to marginal cost; data sources are described in the appendix.

5.1 Demand Estimates

Table 2 contains the results of three estimation results. Models 2-1 and 2-2 are based on a logit model that does not account for heterogeneity in consumer preferences. We thus replace α_{it} and σ_l with α and 0, respectively, in Eq. (5) for these two models. Model 2-1 employs the OLS method, whereas model 2-2 uses the two-stage least squares (2SLS) method, leveraging the instruments discussed in the previous section to control for possible endogeneity in p_{jt}. Finally, model 2-3 presents estimates based on the random-coefficient utility model, Eq. (5).

The 2SLS method is known to produce severely biased estimates if weak instruments are used.

We thus check the explanatory power of the exogenous variables included in the first stage of the estimation. The F-statistic for estimating the endogenous variable, price, in model 2-2 indicates that the instruments are not weak at the 99-percent confidence level. We obtain the estimated coefficients for model 2-2 by regressing the dependent variable onto the exogenous variables and fitted values of the price variable.

The price coefficient estimated via model 2-1 is both economically and statistically significant. Although many coefficient estimates are significantly different from zero, we are concerned about the endogeneity in price. If car prices are responsive to unobserved quality, the bias in the estimated price coefficient could be severe. The remaining specifications account for this bias. We use the instruments introduced in Section 4 to control for the endogeneity of the car price. Since we have more instruments than are needed to identify the equation, we use the J-statistic (i.e., the statistic for over-identifying restrictions) to test the instruments' validity conditional on the existence of a set of valid instruments that just identify the model. The statistics reported for models 2-2 and 2-3 support rejecting the hypothesis that the instruments are orthogonal to the error.[13] However, the estimated price coefficients reported for models 2-2 and 2-3 suggest the successful elimination of endogeneity involving a positive correlation with the unobserved quality. The implied own elasticity of demand with respect to price in the OLS estimation (-2.88) is 70 percent higher than those in the 2SLS (-4.86) and random coefficient (-5.32) estimations.

The mean estimated coefficients for the observed characteristics have the predicted signs with statistical significance. To assess the relative importance of each characteristic, we calculate the mean value of $X_j\beta$ for all j. The contribution of X_j to the mean consumer utility is 2.95 for horsepower, 1.88 for engine displacement, and 0.93 for fuel efficiency in model 2-2. Interestingly, the contributions are larger than those of model 2-1 for horsepower and engine displacement, but lower for fuel efficiency (which have estimated mean contributions in model 2-1 of 1.51, 0.81, and 1.36, respectively). Although in a multivariate context with simultaneity and numerous explanatory variables it is generally impossible to identify the sign of the bias in the OLS estimates, this

[13]Note that the statistic is known to reject the orthogonality restrictions too often in the finite sample (See, for example, Hayashi, 2000).

finding is consistent with the hypothesis that price is correlated positively with both horsepower and engine displacement, and negatively with fuel efficiency. Controlling for endogeneity in price would thus correct for bias in the estimated coefficients for the characteristics.

Model 2-3 is the estimates of the random-coefficient demand model, derived from Eq. (5). We allow for the variables for horsepower and fuel efficiency to have random coefficients and incorporate an income effect by dividing price by the sampled individual income, as discussed in Section 3.3.1. The magnitude of the estimated price coefficient thus cannot be directly compared to those found for the previous two models. Based on the finding for the endogenous price coefficient in model 2-1, we apply the instruments to estimate this model. The mean estimated own-price elasticity is similar to that found in model 2-2 and the mean estimated coefficient for engine displacement is positive and significantly different from zero. This latter finding is consistent with the common view that Korean consumers are shifting towards owning larger cars, particularly after the Asian crisis (e.g., CNB News, 2014). Still, over a fifth of the market was accounted for by small-sized cars, indicating diverse consumer tastes for car size.

Using the price estimate obtained from model 2-3, Table 3 presents the mean estimated own- and cross-price elasticities, classified by engine displacement size and make from 2004.[14] Note that own-price elasticities exceed one in absolute value, and that the larger the engine displacement, the more elastic the demand with respect to the model's own price. This may be because there is more variety are available in cars with larger engines, reflecting the average consumer's preference for larger cars, as discussed for the demand estimates. The (m, n) element of the elasticities matrix indicates the average elasticity of models in category n with respect to a price change for models in category m. While the logit model restricts all cross-price elasticities to be equal for a specific model, the random coefficient model allows these elasticities to vary with differences in price sensitivity between consumers who purchase the various car types. Cross-price elasticities are found to generally be small and asymmetric between domestic and imported cars. The estimated

[14] Engine displacement size in Korea is typically grouped into three categories: "small" represents engines smaller than 1,500 cc, "medium" covers the range between 1,500 and 2,000 cc, and "large" includes engines larger than 2,000 cc.

elasticities of imported-car sales with respect to domestically produced-car prices tend to be larger than those of domestically produced-car sales with respect to imported-car prices. Indeed, Table 3 shows that the average values are 0.056 for the former and 0.002 for the latter. This is similar to the finding for cross-price elasticities reported in Park and Rhee (2014)[15]; it is also consistent with the hypothesis that imported cars constitute a market different from that for domestically produced cars.

[15]Park and Rhee (2014) estimates a two-stage nested logit demand model using monthly data on passenger cars from 2006 to 2009.

Table 2: Demand Estimates

	(2-1) Logit (OLS)			(2-2) Logit (2SLS)			(2-3) Random Coefficient Logit		
	Coef	S.E.		Coef	S.E.		Coef	S.E.	
Price	-11.85	0.55	***	-20.04	1.29	***			
Price / Income							-89.52	7.90	***
Mean parameters (β):									
Engine displacement	6.28	1.31	***	7.82	1.52	***	8.03	1.96	***
Horsepower	4.89	1.74	***	17.50	2.50	***	4.58	4.12	
Fuel efficiency	12.20	2.05	***	8.33	2.18	***	-4.49	5.09	
Constant	-7.23	0.43	***	-7.30	0.47	***	-1.93	0.98	*
Std Deviations (σ)									
Horsepower							21.76	3.22	***
Fuel efficiency							2.22	16.58	
R-squared	0.48			0.38					
First stage F statistics				49.5***					
J statistic				99.7***			73.0***		
Mean Own elasticity	-2.88			-4.86			-5.32		
Correlation coefficient	0.41			0.40			0.29		
Number of observations	973			973			973		

Notes: The superscripts, ***, * indicate significance at the 99-,and 90-percent confidence levels, respectively. Fuel efficiency is kilometer per 1000 KW. The price variable in (2-1) and (2-2) is divided by 1e+5. The respective variables of fuel efficiency, horsepower, and engine displacement are divided by 100, 1e+3, and 1e+4, respectively. The Degrees of freedom of the first-stage F statistics are (7, 962), and those of J-statistics under (2-2) and (2-3) are 8 and 6, respectively. Heteroskedasticity-robust standard errors are used for (2-1) and (2-2). The correlation coefficient between the actual and predicted market shares are shown in the table.

Table 3: Mean Own and Cross Elasticities (as of 2004)

		Numbers of models	Own elasticities	Cross elasticities							
				H-K			Other Domestic			Imports	
				Small	Medium	Large	Small	Medium	Large	Medium	Large
H-K	Small	6	-2.87	0.018	0.016	0.011	0.016	0.018	0.011	0.006	0.004
	Medium	10	-3.49	0.084	0.099	0.094	0.072	0.101	0.093	0.063	0.056
	Large	9	-4.94	0.053	0.087	0.133	0.042	0.082	0.129	0.100	0.179
Other Domestic	Small	2	-1.60	0.026	0.020	0.011	0.025	0.022	0.012	0.007	0.004
	Medium	4	-2.78	0.063	0.074	0.072	0.052	0.073	0.069	0.041	0.040
	Large	7	-5.03	0.042	0.066	0.096	0.034	0.062	0.087	0.074	0.098
Imports	Medium	3	-5.82	0.001	0.001	0.002	0.001	0.001	0.002	0.003	0.003
	Large	33	-7.24	0.001	0.002	0.009	0.001	0.002	0.006	0.008	0.020

Notes: The table lists the sales-weighted averages of elasticities for each of the three categories by engine displacement. The (m,n) element in the cross-elasticities matrix indicates elasticity of model n with respect to a change in the price of model m. For each of the three category, "small" represents car size whose the engine displacement size less than 1,500 cc; "medium" is in the range between 1,500 and 2,000 cc; and "large" is over 2,000cc. Note that no small models were available for imports.

5.2 Marginal Cost Estimates

Using the demand estimates in Table 2 and the first-order conditions in Eq. (2), we calculate the marginal costs, MC_j, in year t, and estimate Eq. (9). The resulting estimates are shown in Table 4 for three methods: OLS (model 4-1), within (fixed effects) estimator (model 4-2), and the system GMM estimators (using GMM-DIF for model 4-3 and GMM-SYS for models 4-4 and 4-5). Model 4-5 employs an alternative explanatory variable to $platform_{jt}$, as discussed later in this subsection. The estimates of ρ and γ_l are obtained from the minimum distance estimator using the non-linear restrictions in π_1^l and π_2^l.

The first three model estimates presented in Table 4 reveal poor performance of the production coefficient γ_Q. All three models present negative estimates with little statistical significance for the coefficient, indicating that the model introduced in Section 3 has no equilibrium in terms of determining firm output. Since the GMM-DIF estimator is known to be less informative when ρ is close to unity, we apply the GMM-SYS estimator to find that the estimated ρ in model 4-4 is indeed close to one and that the estimated production coefficient becomes positive and statistically different from zero. This implies that model 4-4 corrects for the downward bias in the estimates of the first three models.[16] Both the non-linear restriction test and the Hansen test indicate that the model fits the data well. The results of the AR(2) tests are consistent with the assumption that e_{jt} is white noise.

The coefficient on the engine displacement size variable is estimated to be significant and positive. The elasticity of marginal cost with respect to engine displacement size is estimated as 0.98, close to that estimated in the hedonic regression presented in Table 1. Given the estimates for marginal cost, it is interesting to ask how the price-cost margin changes depending on engine size. Table 5 presents the mean values of prices, estimated marginal costs, and estimated markup rates for domestically produced autos with three different engine sizes. Note that the price-cost markup decreases from 0.66 to 0.35 percent as engine size increases. This finding is consistent with the estimated own-price elasticities of demand shown in Table 3, in that demand is estimated as being more elastic between different types of larger-sized cars, indicating more severe competition within this size class.

The coefficient on the $platform_{jt}$ variable can be interpreted as capturing process innovation, a source of efficiency improvement. The estimate, which is negative and statistically significant, implies that the marginal cost of a given car model declines by 6.0 percent when one model is added to the same platform. To calculate the extent to which the H-K merger improved efficiency by consolidating production platforms, we need to know what would have happened to the values of $platform_{jt}$ in the absence of the merger. We assume that Hyundai and Kia would have simply divided platforms into their own independent entities across car models. As noted in Section 2, we found no evidence in trade journals or the media that other firms integrated production platforms in a fashion similar to H-K and can thus assume with reasonable confidence that other firms would

[16] The existing literature presents mixed results regarding estimated returns to scale in automotive manufacturing. For example, Berry, Levinsohn, and Pakes (1995), Petrin (2002), and Goldberg and Verboven (2001) report increasing returns to scale whereas Biesebroeck (2003) finds either constant or decreasing returns to scale for U.S. assembly plants.

have shared no common platforms across their brands (or with their rivals) in the absence of the merger. We estimate the effect of the merger on marginal costs through platform consolidation by taking the difference in values for $platform_{jt}$ between the actual and counterfactual scenarios. These estimates, averaged over car models, show that the efficiency H-K gained by integrating platforms accelerated over the years following the merger: the marginal costs declined by an average of 1.7 percent in 1999 compared to 4.6 and 8.6 percent in 2002 and 2005, respectively. This trend in efficiency gains is consistent with the observations of Section 2. As platform integration was predicated on H-K's extensive restructuring, it made solid but gradual progress, as indicated in Figure 2.

The estimated coefficient on $platform_{jt}$, however, might understate the overall efficiency gained from the merger: while platform integration represented a significant gain, it was probably not the only aspect of efficiency that improved through the H-K merger.[17] We thus re-estimate Eq. (9) while replacing $platform_{jt}$ with a dummy variable that indicates the H-K merger and takes 1 if model j was sold by H-K in the post-merger period and 0 otherwise. The estimates are shown under model 4-5 in Table 4. The estimated coefficient on the H-K merger dummy variable indicates that the merger decreased H-K's marginal costs by well over 60 percent. This estimate, however, is not an appropriate indicator of efficiency gains from the merger as it likely also captures negative productivity shocks and other ramifications of the Asian Financial Crisis. We thus use the estimates from model 4-3 in the subsequent sections, noting that the estimated efficiency gain from the H-K merger is likely understated.

Finally, to check model fit, we compare the calculated marginal costs obtained from Eq. (2) with the predicted marginal costs obtained from the mean estimates of Eq. (9) excluding the residuals. The last row of Table 4 shows that correlation coefficients between the marginal cost values are above 0.92, implying that the model fits the data well.

[17] Indeed, Lee and Cho (2001) uses accounting data to calculate the synergistic effect of the H-K merger in 1999 and 2000. It finds that H-K saved a total of 2,158 billion KW (in 1996 constant value), in contrast with our estimate of 732 billion KW. Such a comparison, however, may be inappropriate, as Lee and Cho (2001) includes savings in fixed costs that are not fully accounted for in this paper.

Table 4: Marginal Cost Estimates

	(4-1) OLS			(4-2) Within			(4-3) GMM-DIF			(4-4) GMM-SYS			(4-5) GMM-SYS		
	Coef.	S.E.		Coef.	S.E.		Coef.	S.E.		Coef.	S.E.		Coef.	S.E.	
Production volume	-0.024	0.022		-0.015	0.030		0.009	0.066		0.065	0.034	*	0.061	0.031	*
Engine displacement	1.514	0.325	***	0.866	0.296	***	0.510	0.286	*	0.983	0.339	***	0.933	0.304	***
Horsepower	-0.002	0.217		0.175	0.232		0.212	0.196		0.229	0.172		0.342	0.185	*
Fuel efficiency	-0.610	0.246	**	-0.700	0.232	***	-0.818	0.222	***	-0.195	0.270		-0.097	0.261	
Platforms	-0.043	0.018	**	-0.051	0.027	*	-0.033	0.019	*	-0.060	0.022	***			
H-K dummy													-0.665	0.093	***
ρ	0.879	0.048	***	0.260	0.038	***	-0.613	0.158	***	0.998	0.059	***	0.951	0.050	***
AR(2) test							-2.34**			-0.76			-0.90		
Hansen test							10.87			14.73			16.26		
Nonlinear restriction test	13.5**			1.45			2.63			8.31			9.51*		
Correlation coefficient	0.936			0.933			0.933			0.934			0.927		
Number of observations	436			436			334			436			436		

Notes: The superscripts, ***, **, * indicate significance at the 99-, 95-, and 90-percent confidence levels, respectively. A dependent variable of marginal costs are in the logarithmic form, so are the first four explanatory variables in each model. Horsepower is normalized by per weight. The estimated coefficients of year dummies are omitted from the table. The AR (2) test represents the Arellano-Bond test of serial correlation with the null hypothesis of no second-order autocorrelation in the differenced residuals. The Hansen test is the overidentification test for the GMM estimators. The nonlinear restriction test is the chi-squared test for the parameters restriction in Eq.(9). The test static of the AR (2) follows the standard normal distribution under the null. The Degrees of freedom of the Hansen test under (4-3), (4-4), and (4-5) are 17, 19, and 19 respectively, and that of the Nonlinear restriction test is 5. The correlation is between the marginal costs derived from the equilibrium conditions, Eqs.(2), (3), and (4), and the predicted ones obtained from the estimated parameters.

Table 5: Price, marginal cost, and markup by Engine Displacement

	Price 1000KW	Marginal Cost 1000KW	Markup
Small	6142	2288	0.66
Medium	11806	6831	0.44
Large	20816	13680	0.35

Notes: Each number in the table is the sales-weighted average. The markup is defined as the difference between price and marginal cost divided by price.

5.3 Estimation of MRF

In our model, the marginal revenue obtained from the foreign market, MRF_{jt}, plays an important role in terms of determining whether or not car model j is exported overseas. As discussed in Section 3, when MRF_{jt} lies above D in Figure 3, amount BC of model j is exported. Otherwise, the model is not shipped abroad. Since the production volume of model j is determined by C (i.e., the intersection of MRF_{jt} and MC_{jt}), we can calculate MRF values for those models that are exported by solving for the equilibrium of the model, Eqs. (2) and (3).

To verify the validity of the equilibrium values of MRF's, we examine free-on-board (FOB) car prices as noted in Korean customs data. The customs data are codified and aggregated under the Harmonized Commodity Description and Coding System (hereafter HS Code).[18] Using sales volume as weights, we aggregate our data to conform with the HS codes and compare them with the FOB prices. This comparison suggests a fairly good match, with a correlation coefficient of 0.83. If we remove the data for 1997, for which the customs data contain unreasonably high FOB prices, the correlation coefficient further increases to 0.91.

While we do not observe MRF values for cars that are not exported, we need to know the

[18]Note that HS Code changed in 2007. The old code aggregated FOB prices for cars into two categories: engine size at or below 1,500 cc, and otherwise. The new code identifies new cars separately (new and used cars are grouped together in the old HS), and creates a third category for engine size between 1,500 cc and 2,000 cc.

values for cases in which a rival firm began exporting car models that would not have been shipped abroad in the absence of the merger. This could happen (and indeed is observed in our simulation results, presented in the next section) if MRH were to rotate counter-clockwise in the counterfactual scenario. We impute these unobserved MRF values via the following censored Tobit model to estimate MRF_j (the time subscript is again omitted here):

$$\ln MRF_j = \begin{cases} \delta' Z_j + \varsigma_j & \text{if } MRF_j = MC_j \\ \text{not observed} & \text{if } MRF_j < MC_j \end{cases}. \tag{11}$$

We observe MRF_j for model j if it is equal to MC_j evaluated at the equilibrium output level and not otherwise. We assume that MRF_j consists of a set of explanatory variables, Z_j, including observed product characteristics and model-specific dummy variables, and an error term, ς_j. The small-country assumption states that MRF_j is constant regardless of the production volume, q_j. The results of estimating Eq. (11) are shown in Table 6, in which model 6-2 contains (logged) export volume as an explanatory variable whereas model 6-1 does not. The estimated coefficient on the variable is statistically indifferent from zero, corroborating the small-country assumption. The next section discusses how the results change when we relax this assumption.

The coefficients on engine displacement and fuel efficiency, estimated as significantly different from zero, indicate that larger car models, which usually have lower fuel efficiency, tend to have higher export prices.[19] To check model fit, we predict values for MRF_j excluding the residuals of ς_j and compare them with the MRF values. We find that the model fits the data reasonably well with a correlation coefficient of 0.89.

[19] We tested including the real effective exchange rate as an explanatory variable but found little effect on MRF_j.

Table 6: Estimates of Export Prices

	(6-1) Censored Tobit			(6-2) Censored Tobit		
	Coef.	S.E.		Coef.	S.E.	
Export volume				0.013	0.009	
Engine displacement	0.587	0.396		0.554	0.398	
Horsepower	0.343	0.236		0.334	0.237	
Fuel efficiency	-0.601	0.171	***	-0.540	0.176	***
Constant	-8.042	2.729	***	-8.089	2.739	***
Number of censored observations	74			74		
Correlation b/w predicted values and data	0.95			0.95		
Number of observations	551			551		

Notes: The superscript *** indicates significance at the 99-percent confidence level. Horsepower is normalized by per weight. The first four explanatory variables in the table are in the logarithmic form. The dummy variables specific to model are included in the estimation. Since some models had no exports in the study period, we add the value of one to the variable of export volume.

5.4 Model Predictions

To grasp how the model fits the data, we compare actual and predicted industry outcomes and market shares by engine size over the study period. Table 7 shows the results of this comparison, with the base model predictions on the left-hand side and the actual data on the right. To save space, we list only domestic sales market shares and export volumes by engine size.

We compute the predicted values using the estimated demand and marginal cost shown in Tables 2 and 4, along with the estimated marginal revenue from the foreign market. Analytically, this exercise is equivalent to solving the system of Eqs.(2), (3), and (4). Since the model fits the data well in terms of marginal cost (Table 4) but rather poorly in terms of demand (Table 2), we do not account for demand residuals when constructing the predicted values. The results, presented in Table 7, show that the model explains the data moderately well, suggesting that demand shocks do not significantly impact the predicted values. Industry output (i.e., the sum of domestic sales and export volumes) is predicted fairly accurately, and there is no significant bias in share prediction for either domestic sales or export volumes.

Table 7: Model Predictions

Predicted

	Prices (1000 KW)				Domestic Sales				Exports			
	Average	Small	Medium	Large	Total (1,000 units)	Small (%)	Medium (%)	Large (%)	Total (1,000 units)	Small (%)	Medium (%)	Large (%)
1996	8420	5079	9938	18978	894	43.08	46.21	10.71	1,552	67.21	29.10	3.70
1998	8685	5274	9611	21100	964	42.29	49.48	8.23	970	67.56	29.15	3.29
2000	11155	6077	13030	23212	985	41.77	47.29	10.95	1,689	44.18	38.97	16.85
2002	10155	7056	10216	18986	942	52.63	34.61	12.76	1,859	35.33	37.68	26.99
2004	10040	5921	9155	14039	889	30.60	35.93	33.47	2,341	32.80	45.18	22.02
2006	11420	5651	10871	19106	764	29.78	46.52	23.70	2,698	24.48	49.15	26.37
2008	11313	5619	9557	19423	797	31.08	39.38	29.55	2,788	27.91	46.87	25.22

Actual

	Prices (1000 KW)				Domestic Sales				Exports			
	Average	Small	Medium	Large	Total (1,000 units)	Small (%)	Medium (%)	Large (%)	Total (1,000 units)	Small (%)	Medium (%)	Large (%)
1996	10046	5032	10426	20440	1,239	47.55	40.43	12.01	1,056	76.40	21.89	1.71
1998	10619	5145	9490	18783	560	38.75	45.16	16.08	1,194	64.35	34.73	0.91
2000	14813	6726	14674	22551	1,059	25.78	48.55	25.67	1,512	54.88	37.13	7.99
2002	14475	6600	12101	21802	1,236	23.43	42.00	34.57	1,414	52.79	33.51	13.70
2004	13540	5274	10174	19171	874	13.16	50.51	36.33	2,275	40.73	40.47	18.80
2006	14400	4711	13065	21645	967	10.74	46.39	42.87	2,496	31.42	49.00	19.59
2008	14276	5548	11236	20857	1,010	17.99	46.72	35.29	2,496	33.23	43.77	23.00

Notes: To conserve space, the table presents the information every two years. For the entries of shares, "small" represents car size whose the engine displacement size less than 1,500 cc; "medium" represents the size in the range between 1,500 and 2,000 cc; and "large" represents the size over 2,000cc. The sum of domestic sales and export volumes equals to production volumes in our model.

6 Economic Consequences of the 1998 Merger

In this section, we assess the economic consequences of the H-K merger. On the basis of the results reported in the previous section, we evaluate the welfare trade-off associated with this merger by comparing to counterfactual situations including one in which no merger took place and two in which a company other than Hyundai merged with Kia. Under these counterfactual situations, the nature of supply and demand, as described in Section 3, should not change: as discussed in Section

2, the 1998 H-K merger was likely exogenous to the evolution of the Korean car market over the studied period. One issue that arises when evaluating the counterfactual scenarios is how to assess mergers occurring after the H-K merger. The Korean car market experienced substantial changes in the 2000s, as noted in Section 3. Here, we assume that these post-1998 mergers were exogenous (i.e., not triggered by the H-K merger). If, in contrast, these mergers stemmed from the H-K merger, our estimated efficiency gains, (and thus social welfare accruing from the merger) would likely be understated. We discuss the merger's effect in Section 6.1, and then turn to alternative merger scenarios in Section 6.2.

6.1 Effects of the H-K Merger

To assess the economic impacts of the merger, we compare the post-merger outcomes (as shown in the data) with the outcomes of a no-merger scenario. The no-merger outcome is simulated by investigating the likely development of the Korean car market in the absence of the H-K merger. We assume that Kia did not go bankrupt in the absence of the merger and treat post-1999 Hyundai and Kia as separate business entities, which are assumed to independently set their own domestic prices and export volumes for each car model.

In the simulation exercise, we replace the $platform_{jt}$ variable in Eq. (8) with counterfactual levels that may have arisen in the absence of the merger; we also change the ownership of products $\mathcal{F}_f$ such that Hyundai and Kia sold their brands independently after 1999. However, we leave long-run strategies, such as car characteristics, constant. We use the estimates of the demand (2-3) and marginal cost models (4-4), shown in Tables 2 and 4, along with the estimated foreign market marginal revenue (obtained in Section 5.3) to compute equilibrium sales volumes and domestic prices by model for each period t of the study period. The estimated values are then used as the model errors, ξ_{jt} for demand and η_{jt} for marginal costs, on the right-hand sides of Eqs. (5) and (8).

Figure 4 shows the merger's effects on market outcomes for both the merged and non-merged parties. The figure contains four panels: domestic prices (4-a), domestic sales (4-b), export volumes (4-c), and the social surplus (4-d). The solid line in panel (4-a) indicates the ratio of the simulated outcome following the merger to that in the absence of the merger. Thus a ratio greater (less) than one indicates that the merger had a positive (negative) effect on domestic prices. In each of the other three panels, the solid line indicates the difference between the simulated outcomes in the two scenarios. A positive (negative) difference indicates a positive (negative) effect on the relevant economic outcome. Thus, the difference points to zero for the pre-merger period (before 1999).

The upper left-hand panel of Figure 4 indicates that the merger led to an average increase in domestic prices of 19 percent for H-K models but a mere 2 percent for other firms' models. Indeed, H-K reduced its domestic sales by an average of 25 percent from the no-merger level. The merger's minor effect on other firms may have been reflected in our finding of small cross-price elasticities (reported in Table 3). In comparison with the values of the own-price values, the estimated cross-price elasticities are small, particularly for the elasticities of demand of non-merged parties' cars with respect to the prices posted by either Hyundai or Kia.

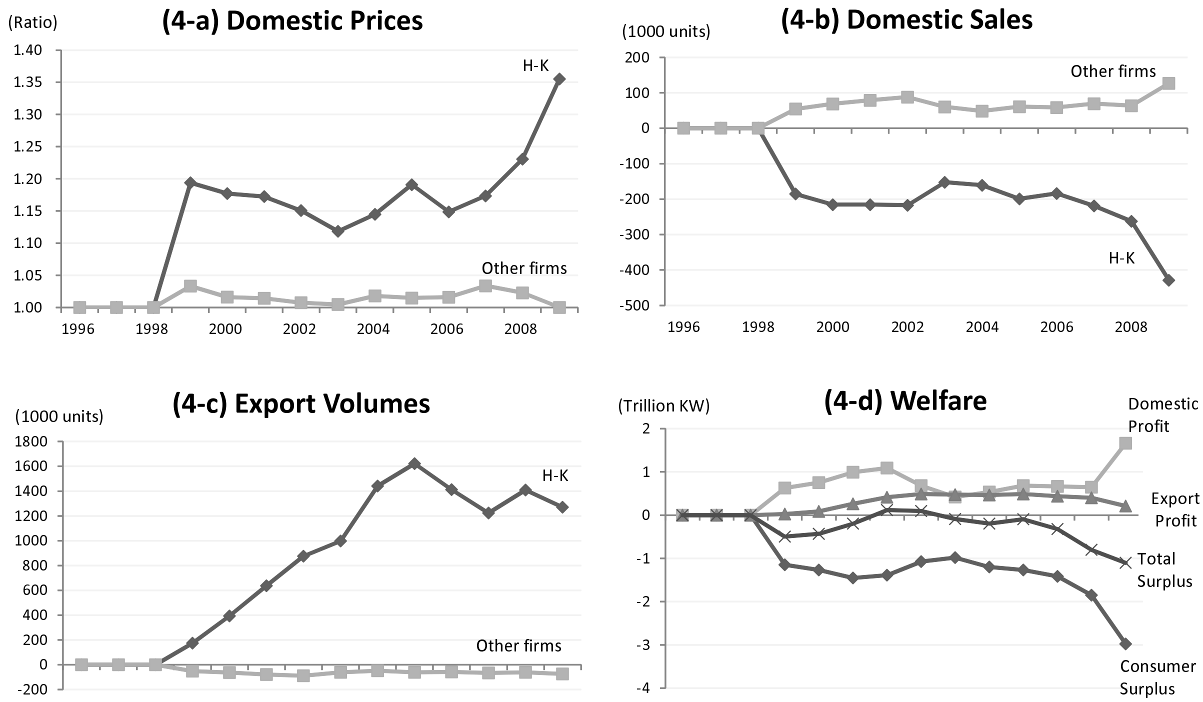
In contrast to domestic sales, panel (4-c) illustrates that the merger substantially improved H-K's export performance: the volume of H-K cars exported nearly quadrupled as a result. Of the 26 models rolled out by H-K, an average of 24 were exported; the corresponding number would have been just 11 in the absence of the merger. To examine how these effects differ depending on engine size, we decompose the merger's effects into three engine-size categories, as shown in Figure 5 for domestic prices (5-a) and export volumes (5-b). The latter panel shows that export volumes expanded far more for medium-sized cars than for small or larger cars. This is because H-K integrated platforms primarily for medium-sized cars.

As illustrated in Figure 3, the efficiency gains from platform integration would not have had much influence on domestic prices of cars that were already being exported in the absence of the merger. Our simulation exercise shows that 79 percent of exported small-sized cars would still have been exported even if the merger had not taken place; the export proportions would have been 31 percent and 28 percent lower for medium-sized and large cars, respectively. The findings for export status by engine size are simply that the average domestic price for small cars would have been impacted less by the efficiency gains from the merger than prices for medium-sized and large cars. This is clearly illustrated in panel (5-a), showing that domestic prices for small cars increased by 31 percent on average, compared to 20 percent for medium-sized and 12 percent for large cars.

We noted earlier that the estimate of q_{jt}^E in model (6-2) did not allow us to reject the hypothesis that Korea is a small country, facing a competitive overseas market. Nevertheless, Table 8 reports the results of a robustness check using the alternative assumption that Korea is a large country. We construct the 99-percent confidence interval for the estimates of q_{jt}^E, and use the lower bound of -0.009 to simulate the model. As the panels show, relaxing the small-country assumption results in few changes to the quantitative results discussed above.

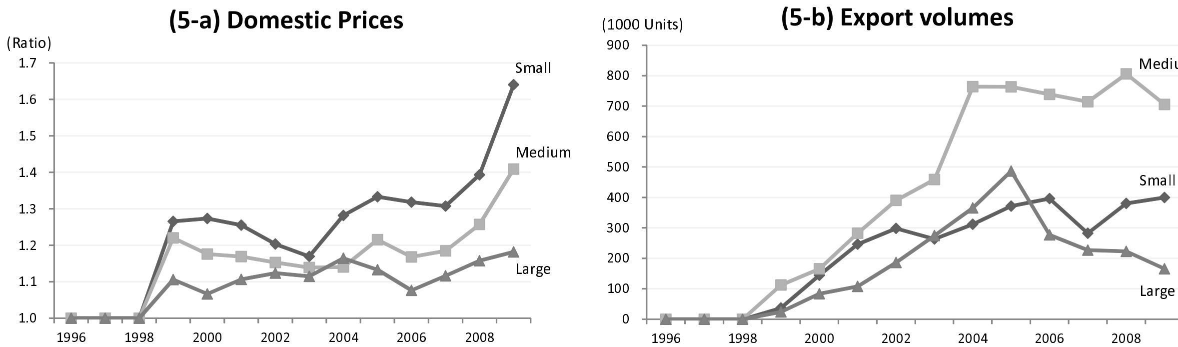
Finally, we consider the merger's welfare implications. As presented in panel (5-d), domestic consumers' welfare (i.e., the consumer surplus) decreased, as domestic prices increased (see panel (5-a)). Meanwhile, the producer surplus increased, with roughly 30 percent of this arising due to the increased export profits shown in our simulation. However, the enhanced producer surplus would not have fully counterbalanced the lost consumer surplus: there was thus a 1.6-percent decrease in social welfare (i.e., a deadweight loss) for the studied period.

Figure 4: Merger Effects at Firm Level



Notes: Each line in (4-a) shows the ratio of the domestic prices under the merger to those in the absence of the merger. In other panels, each line shows the difference between the outcome with merger and that in the absence of the merger.

Figure 5: Effects of the H-K Merger by Engine Displacement



Notes: Each line in (5-a) shows the ratio of the domestic prices under the merger to those in the absence of the merger. Each line in (6-b) shows the difference between the export volumes under the merger and those in the absence of the merger. In the figure, "small" represents car size whose the engine displacement size less than 1,500 cc; "medium" is in the range between 1,500 and 2,000 cc; and "large" is over 2,000cc.

Table 8: Comparison in Effects of H-K Merger under Small- and Large-country Assumptions

			Small-country Assumption		Large-country Assumption	
		With merger	No merger	Annual Average Change (%)	No merger	Annual Average Change (%)
Domestic Prices (1000 KW)	Small	6833	5259	31.3%	5254	31.3%
	Medium	12027	9954	20.3%	9954	20.3%
	Large	21949	19485	12.3%	19504	12.1%
Domestic Sales (1000 units)	Small	1326	1894	-31.9%	1888	-31.6%
	Medium	3332	4490	-25.1%	4479	-24.9%
	Large	2722	3434	-20.7%	3412	-20.2%
Export Volumes (1000 units)	Small	6180	3048	163.2%	3305	123.5%
	Medium	7107	1205	1238.4%	1419	781.6%
	Large	3117	696	1607.3%	859	482.7%

Note: Domestic prices are the sales-weighted averages after the H-K merger . Domestic sales and export volumes are the respective sum of those during the period from 1999 to 2009. We set the coefficient of q_j^E in Eq. (11) equal to zero under the assumption of small country, whereas the coefficient under the large country is set at the lower bound of the 99 percent confidence interval of the estimated coefficient of q_j^E in Table 6

6.2 Alternative Merger Scenarios

As mentioned in Section 2, Hyundai outbid Daewoo in the third round of the tender, while Ford and Samsung were disqualified because their bids were below the reserve price. We thus consider here what would have happened to economic welfare had another company acquired Kia. We consider two alternative mergers: one with Daewoo as the acquirer and the other with Samsung.[20]

One major challenge in evaluating alternative mergers is how to account for efficiency gains under such a counterfactual scenario. We do this through the construction of a platform variable for each counterfactual merger. To identify which models would have likely constituted a shared platform between Daewoo (or Samsung) and Kia, we use the Mahalanobis measure: $(X_{it} - X_{jt})' \, S_t^{-1} \, (X_{it} - X_{jt})$, in which X_{kt} captures the characteristics of model k in year t, as introduced in Section 2, and S_t is the covariance matrix of the characteristics. We minimize the Mahalanobis measure to find a Daewoo model with the characteristics most similar to a Hyundai. We then replace the given Hyundai model with a Daewoo for each platform observed in the data, assuming that the number of platforms remained the same as that observed following the H-K merger. We follow the same process to construct the counterfactual platform variable for Samsung. This approach suggests that 74.4 percent of Daewoo models and 94.4 percent of Samsung models would have shared platforms with Kia models in the respective counterfactual merger scenarios. We use the data for the $platform$ variable in Eq. (8) to simulate the effects of the counterfactual mergers using the same procedure as in Section 6.1.

To obtain a sense of how similar models are to one another, we present the distribution of one characteristic, engine displacement size, by make in Figure 6. Each circle represents a model, with its size indicating the domestic sales volume for that model. The figure shows that Hyundai models are generally more similar than other makes to Kia models. This corroborates our finding

[20] While Ford was also a serious contender in the race for Kia, we do not consider this foreign manufacturer as a counterfactual acquirer. This is because, as mentioned in Section 5.1, imported and Kia models were poorly matched substitutes in terms of both characteristics and estimated demand from Korean consumers. We thus therefore do not expect that a merger between a foreign automaker and Kia would lead to a considerable increase in market power or prospects for improved production efficiency. Moreover, our assumption of exogenous import prices does not allow us to simulate the optimization problem for a foreign firm such as Ford.

that cross-price elasticities of demand between Hyundai and Kia are larger than those between any other company and Kia. It may also imply that the anticompetitive effect on domestic prices was larger for the H-K merger than would have been the case for these counterfactual mergers, as we will confirm below.

Table 9 shows simulated effects of alternative mergers involving Daewoo and Samsung, respectively, on five important outcomes: marginal costs, domestic prices, consumer surplus, producer surplus (comprised of domestic and export profits), and social surplus. To facilitate comparison with reality, we include in the table the effects of the H-K merger, as taken from Figures 4 and 5.

A merger with Daewoo or Samsung would have had a smaller effect on domestic prices than the H-K merger did. The annual increase in domestic prices would have been at most 2 percent for either the Daewoo or Samsung merger but was nearly 14 percent for the H-K merger. We also find that these price changes arise largely due to demand-side effects: the estimates show that the H-K merger achieved a larger reduction in average marginal costs (6.3 percent) than would have happened under either counterfactual merger (5.6 percent for Daewoo and 3.8 percent for Samsung). Thus domestic profits (and the producer surplus) would have been largest under the H-K merger, followed by the Daewoo-Kia merger. This result is consistent with the fact that Hyundai won the tender over the runner-up Daewoo. In the end, KFTC approved the H-K merger, even though it was the most deleterious to the consumer and social surpluses. Although the alternative mergers would have increased the social surplus, they would have been unable to meet the demands of Kia's creditors. This observation is consistent with the view that KFTC's merger decision was made with an eye to industrial policy, as opposed to competition policy, which weighs consumer benefits.

Figure 6: Distribution of engine displacement by make (as of 2004)

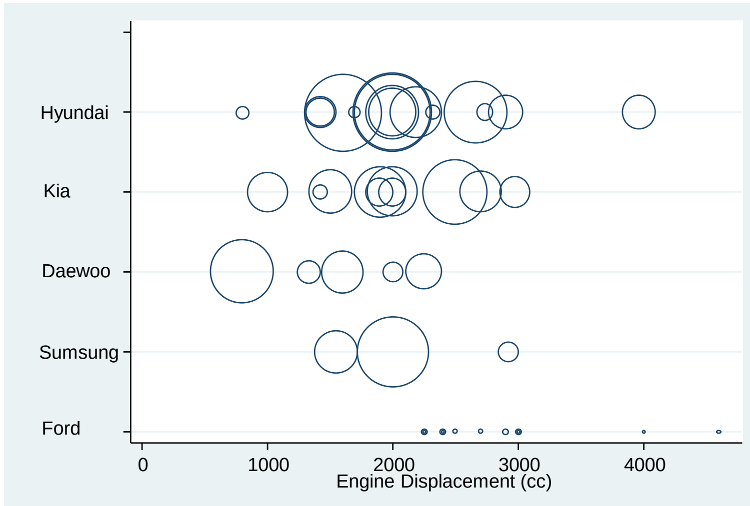


Table 9: Effects of Alternative Mergers

		Hyundai (Actual)	Daewoo	Samsung
Decrease in marginal cost (Average change in percentage)		6.3%	5.6%	3.8%
Domestic Price (Annual average change in percentage)		14.2%	2.0%	2.1%
Welfare impact (Annual average change in trillion KW)	Consumer surplus	-1.46	-0.07	-0.16
	Domestic profit	0.80	0.17	0.14
	Export profit	0.34	0.64	0.36
	Total surplus	-0.32	0.74	0.35

7 Conclusion

This paper presented an estimation model to examine the effects of domestic mergers on exports. The model indicated that the merger effects differ by product according to the product's pre-merger export status; efficiency gains from a merger increase export volumes of products that are already exported prior to the merger, and offset domestic market power for those that are not exported even after the merger. The paper applied the model to the case study of the 1998 horizontal merger between Hyundai and Kia Motors in South Korea. Consistent with the fact that Hyundai and Kia were both export-oriented prior to the merger, the paper found that the H-K merger would have expanded export volumes and at the same time boosted the domestic prices, leading to a decrease in the total surplus averaged over the ten years after the merger.

We conclude by discussing the linkages between antitrust policies, as discussed here, and trade policy. It has been shown that trade liberalization is a complement to antitrust policy because it increases competition in the domestic market and lowers the margins when firms compete in an oligopolistic fashion. As noted above, auto imports accounted for a mere two percent of the Korean market amid strict import restrictions. Indeed, ad-valorem tariff rates of 8 to 10 percent were imposed, and imports were severely regulated, especially for Japanese cars. Partly in return for the IMF bailout accepted at the time of Asian Financial Crisis, Korea agreed to liberalize international trade — for example, by eliminating the regulation on Japanese cars. While this move toward trade liberalization was hoped to weaken the market power amassed through the H-K merger, we found here that this did not happen. In contrast, the H-K merger increased prices by 14.2 percent, and imports' share in the domestic market remained at a mere 5.1 percent even after ten years after the merger. This aligns to the fact that cross-price elasticities of demand between imported and Korean autos were estimated as very tiny.

In approving the H-K merger, KFTC significantly weighted the cost efficiencies created by the merger and its subsequent effect on exports. Among the candidates for acquiring Kia, Hyundai was the least beneficial to consumers and the most profitable for the industry. KFTC, appearing to favor industrial policy, thus approved the H-K merger to create a national champion. After the 1998 H-K merger decision, a series of subsequent mergers took place, likely due to the perception that KFTC would be lenient when reviewing mergers.

A Data Appendix

We constructed a dataset for passenger cars sold in Korea during the study period (1996 to 2009), including both domestically manufactured and imported models. The annual dataset contains a total of 113 domestic models manufactured by five firms and 108 imported models supplied by 17 foreign firms. Price data were obtained from CARLiFE (1997-2009) and crosschecked against online information. Data on prices in 1996 were not available from CARLiFE, so we used that from the Korean Automobile Manufacturer Association (1996). The prices used in the paper are list prices, adjusted to constant 1996 KW using the CPI. Approximately 30 percent of prices were missing from the above sources; we thus imputed them via using hedonic regressions. The estimates are presented in Table 10.

Domestic sales and export volume data were available from the Korean Automobile Manufacturer Association (1996, 1998-2000, 2002-2010). The information on car characteristics came from several sources; Korean Automobile Manufacturer Association (1996, 1998-2000, 2002-2009), Auto Morning (2001-2003, 2005), and Motorbuch Verlag (1998-2003).

Data on imports were obtained from the Korean Automobile Importers and Distributors Association, supplemented by Wards Communications (1997-2009). They were available only for the period from 1997 to 2009. While we have no data for 1996, we know that imports accounted for a mere 0.7 percent of the market. There are no quantitative changes to our demand estimates if we replace the 1996 data with import data from 1997 instead. The original sources list import data at the sub-model level, such as by different types or grades for a given model. To make these figures compatible with the data on domestic cars, we aggregated them to construct data on prices and characteristics by taking the median values for a given car model; we construct the data on imported sales by taking the sum. The information on integrated platforms was primarily obtained from Industry Research and Consulting (2011) and supplemented by news articles obtained from Lexus Nexis and the website automobile-catalog.com.

Data on the number of households were obtained from Euromonitor International (1996-2008) and used to calculate market size in the demand estimation. Since the data were unavailable only in 2009, we imputed the values for this year via linear interpolation. The average length for which an owner holds on to a given car, which we used to define the purchasing entity in the demand estimation, was provided by Yonhap News (2011). The household income distribution was available from Korean Statistics Bureau (1996-2009). We used monthly household income and expenditures per household by income segment (urban, more than 2 members). The data classify seven income brackets; for each of these, the number of households is identified. We converted real annual income to constant 1996 KW using the CPI.

Finally, the FOB prices for cars were obtained from Korean Customs. Export values and quantity data were available at 6-digit and 10-digit levels of HS code 8703 ("Motor cars & other motor vehicles principally designed for the transport of persons, including station wagons and racing cars").

Table 10: Hedonic Price Estimates

	1996-1998		1999-2001		2002-2004		2005-2007		2008-2009	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Size	14.300	4.700 ***	11.200	3.540 ***	18.900	4.330 ***	13.700	2.190 ***	5.910	3.210 *
Horsepower	10.100	3.050 ***	8.180	3.330 **	1.640	3.620	12.400	2.830 ***	7.360	2.020 ***
Fuel efficiency	-5.800	2.230 ***	-7.810	1.730 ***	-9.350	2.780 ***	-6.000	1.720 ***	-11.400	2.220 ***
Model age	-1.980	1.560	0.429	1.690	0.116	1.760	0.334	1.010	-0.920	1.080
RV dummy	0.295	0.195	0.181	0.180	-0.322	0.148 **	-0.012	0.108	0.038	0.113
Make Dummies										
Hyundai	0.299	0.374	0.369	0.373	0.024	0.168	-0.049	0.095	0.017	0.102
Kia	0.300	0.375	0.236	0.376	0.016	0.179	0.062	0.103	-0.148	0.103
Daewoo	0.345	0.381	0.329	0.387	-0.045	0.194	0.026	0.108	-0.011	0.096
Ssangyong	0.272	0.402	0.358	0.400	-0.106	0.218	0.055	0.122	0.044	0.102
Year Dummies										
1997	-0.014	0.112								
1998	-0.110	0.103								
2000			-0.005	0.093						
2001			0.103	0.128						
2003					-0.109	0.132				
2004					-0.250	0.097 **				
2006							0.114	0.055 **		
2007							0.051	0.079		
2009									-0.017	0.057
Constant	7.270	0.954 ***	7.915	0.752 ***	8.246	1.002 ***	7.126	0.508 ***	9.509	0.693 ***
R-squared	0.74		0.77		0.85		0.86		0.91	
Number of observations	75		75		53		88		58	

Notes: The superscripts, ***, **, * indicate significance at the 99-, 95-, and 90-percent confidence levels, respectively. The variable of horsepower is normalized by per weight, and divided by 1e+3. The variables of size and fuel efficiency are divided by 1e+2. RV dummy takes 1 if car model is either SUV or minivan. Heteroskedasticity-robust standard errors are used in the table.

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