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Strategic Trade Policy, Competition and Welfare: The Case of Voluntary Export Restraints between Britain and Japan (1971–2002)

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Abstract
We evaluate the voluntary export restraint (VER) placed on Japanese automobile exports from 1977 to 1999 by the UK. We show that the policy failed to assist the British domestic car industry. Instead, UK-based US multinationals and Japanese manufacturers were the primary beneficiaries, at a substantial cost to UK consumers. While there are a number of caveats, the policy was on balance damaging to the UK economy in welfare terms.

JEL Classifications
F13, F15, F59

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1 Introduction

The 'new trade protectionism' is commonly seen as arising from the constrained ability of governments to use traditional tariff barriers under the General Agreement on Tariffs and Trade (GATT). Evaluating specific 'quantity constraints', and other forms of non-tariff barriers, can be difficult because they have qualitative effects that differ from tariff barriers, making them hard to characterize theoretically. The theoretical literature highlights that the effects of 'quantity constraints' are contingent, for example, on firms' interactions and on other elements that require particular trade interventions to be examined individually.[1] Such policies are also difficult to tease out empirically, particularly when markets are imperfect and traded goods are differentiated. For example, voluntary agreements, while constraining trade, were synonymous with quality upgrades of product attribute types, as constrained industries and firms looked to shift their product mix to higher quality products to generate greater potential unit profits.[2] Britain had used non-voluntary forms of import quota extensively during the interwar and the post-war reconstruction periods (Kitson and Solomou, 1990; Milward and Brennan, 1996). However, voluntary export restraints (VERs) were first introduced to protect the UK and US textile industries and later formed the basis of the Multi-Fibre Agreement (Silberston, 1989).

The most studied VER was that between the US and Japan on autos between 1981 and 1990 (Feenstra, 1988; Berry *et al*., 1999). However, the US bilateral VER on autos was pre-dated by the UK VER that was announced in 1975, and implemented in 1977, and although they were initially negotiated for a five-year period, they were to remain in place until December 1999. While Italy was the first to use non-tariff barriers in 1956, the UK was the first to utilize the VER policy in automobile markets. It was followed by a number of other European nations, starting with France announcing that it would implement a VER in 1977.

The call for restraints to be enforced reflected the rise in international markets of new, productive, Japanese automobile manufacturers who posed a major threat to the incumbents across the world. The ability of Japanese automobile manufacturers to expand market share created serious doubts about the economic sustainability of an industry mostly dominated, until the 1970s, by European and North American multinationals. In Britain's case, the effects of multilateral trade liberalization were accelerated by its accession into the European Economic Community (EEC) in 1973. Integration with the EEC led to a sharp rise in import penetration in

[1] Irwin, (1996, p.207–16) provides an insightful contextualization of the theoretical development in strategic trade policy

[2] Falvey (1979) provides early examples of the literature analysing VERs. See also Krishna (1989) and Das and Donnenfield (1987).

the UK car market by other European producers, from 21.6% in 1971 to 34.1% by 1980. In addition to the expanding share of European car manufacturers in the market, there was a sharp rise in Japanese imports, mirroring a global expansionary export trend by Japanese manufacturers. The Japanese competition was considered a threat to Britain's domestic car industry, which was already struggling under increased competition within its core domestic market. The government's interest in the fate of the ailing motor industry received a new impetus in 1975 when Britain's last mass car manufacturer, British Leyland (BL), was nationalized. While the UK government could do little to stem the inflow of fellow EEC members' cars, it was capable of influencing Japanese car imports. Japanese industry representatives advocated a voluntary reduction in exports to the UK under VERs, with negotiations commencing in 1975.

To evaluate a quantity-based restriction in a highly differentiated product market we need to utilize a rich data source. Ideally, studies should include the population of goods and their characteristics over the period of analysis. However, examinations of VERs have failed to do this. Specifically, products have been typically defined in terms of a few 'baseline' models, even though, particularly in the case of firms that market consumer goods, products are marketed in differing forms or model versions. Furthermore, the characteristics space has been limited to a few observable versions. By contrast, the data-set employed in this study incorporates a complete sample of new registrations, list car prices, and over 120 matching attributes for the complete set of car model versions marketed in the UK between 1971 and 2002. A critical aspect of VERs (which was appreciated by contemporary analysts across a wide variety of industries affected by restraints and who influenced theoretical research in the area) is that VERs are synonymous with quality upgrading.

Methodologically, we develop a structural model following recent work by Grigolon and Verboven (2013) in the context of the version level data source. Grigolon and Verboven (2013) explicitly incorporated segmentation into the random-effect Berry *et al*. (1995, 1999) framework in estimating a random coefficients model. We utilize Grigolon and Verboven's (2013) approach as they found strong support for their method when applied to car markets.

The result of the application of the refined BLP method to the rich version level data source is that we are able to provide precise estimates that enable us to identify the policy as being binding for 16 of the 22 years it was imposed. Also, in comparison with the only other study of welfare effects using a structural framework (Berry *et al*., 1999), we are able to reach more concrete conclusions with respect to the welfare impacts of the policy. Also of great import, we show that the omission of observable attributes and of unobservable model fixed-effects has

lead to considerable bias of the coefficients on the key policy variables. Specifically, the VER dummies were found to be significant and perversely signed in one year where the full set of observable attributes and unobservables model specific fixed-effects were not included. Furthermore, the coefficients relating to the years when the VERs were binding were almost 30% lower when the full set of controls were applied.

Specifically, we find that: the policy's primary objective of assisting Britain's last remaining mass car producer, BL, was not achieved, with UK-based multinationals and European and Japanese manufacturers being the primary beneficiaries and that VERs met their secondary objectives of promoting Japanese direct investment in UK plants and employment creation, but did so at a substantial cost to UK consumers. The findings suggest that the policy brought welfare loses to the UK economy, but cautions that the omission of either an assessment of direct job creation effects in Japanese plants or the benefits to the UK components industry would over estimate the extent of that loss.

2 Theoretical and empirical debates over voluntary export restraints

Beyond automobiles, VERs were applied across a range of industries and across countries. VERs were to form the basis of the Multi-Fibre Agreement (Silberston, 1989), but were also applied on other goods such as steel in the US (on three occasions), footwear from Taiwan and Korea to the UK (Greenaway and Hindley, 1985), and videocassette recorders (Hindley, 1986). Unravelling the extent to which VERs were used, and even if they were used at all, is difficult because the agreements would have been between industries and so their existence would not have had to be notified to any international body (Greenaway and Hinley, p.3-4).

A considerable and controversial theoretical literature concerning the effects of quantitative restraints in particular, and strategic trade policy in general, developed from the late 1970s. The theoretical arguments explaining the quality change induced by quantitative trade barriers were originally provided under a specification of preferences where quality and quantity are perfect substitutes. Falvey (1979) provides an early example of the literature analysing VERs. Their work points to differential impacts upon prices of differing quality and indicates that, in perfectly competitive markets, quality upgrading is an unambiguous result. Conversely, Das and Donnenfield (1987) show that when the foreign exporter acts as a monopolist on the domestic market, the sign of quality effects depends on demand and cost conditions.

As with the strategic trade policy literature in general, the use of VERs provides the possibility for nations to potentially benefit from policies. However, whether this occurs is far from clear, being contingent on the nature of competition, and the timing of interaction (Harris, 1985; Krishna, 1989; Okawa, 2004). Some researchers indicate that VERs could lead to a welfare improvement depending on the modelling method employed (Harris, 1985; Krishna, 1989). The EU took over the VER in 1992, while nations' policies towards foreign direct investment (FDI) by Japanese firms remained under national jurisdiction. Flam (1994) argues VER benefits producing countries and hurts non-producing countries. FDI reverses these effects. The combination of a VER and FDI is an equilibrium outcome between conflicting countries, and results from uncoordinated European commission (EC) policies and the strength of producing countries in EC decision-making. It can be second best for both camps, but third best for the EC as a whole, inferior to both a prohibitive VER and free trade. Ultimately however, while there may be some potential for welfare enhancement, as Flam (1994, p.130) highlights, 'such coordination is infeasible and… a customs union therefore risks unexpected and undesired effects. Thus, the analysis should be seen as adding to the many reasons given by Helpman and Krugman (1989) for why strategic trade policies may fail.'

Empirical analysis on VERs falls under three methodological headings. The first is a series of hedonic studies and includes work on two European markets (De Melo and Messerlin, 1988), and the US market (Dinopoulos and Kreinin, 1988; Feenstra, 1988). In all cases VERs were shown to have been binding: in France in 1984 and 1985, but not in Germany (De Melo and Messerlin, 1988); in the US, by influencing European import prices to US consumers (Dinopoulos and Kreinin, 1988) and by raising the price of Japanese autos from 1980 to 1984 (Feenstra, 1988). A second body of quasi-empirical research has been based on the parameterized simulation of simple theoretical models. There are a number of examples of research that uses this methodological approach to examine European car markets, including Laussel *et al*. (1988) and Turrini (1999). However, the plausibility of such studies is undermined by both the large possible set of theoretical possibilities, leading simulation models to use a number of assumptions that are not appealing in examining the car industry, where they clearly do not hold (such as symmetric firms producing a single good where there is a constant elasticity of demand between products), and the tendency to employ parameters that are estimated elsewhere, so that even if those inputs are well-estimated, the simulated outputs often have large standard errors, making appraisal ambiguous (Levinsohn, 1994).

Since the mid-1990s, mirroring developments in the empirical industrial organization literature, researchers have argued in favour of the use of structural modelling, adopting discrete choice

methodologies. Specifically, Goldberg (1995) estimated a structural oligopoly model for the US car market, applying a nested logit model to consumer data, while Berry *et al*. (1999) use a random effects model to quantify both their impacts and their effects on the firms, consumers and foregone tariff revenues associated to the US–Japanese VER between 1986 and 1990. Both papers found that VERs were binding in the US and had substantive impacts, albeit in different years. Furthermore, both papers examined the effects of a counterfactual tariff and on firm profits.

The work of Berry *et al*. (1999) is unique in that the authors also calculate consumer welfare effects directly. From a policy perspective, they found that the substantive losses to US consumers were of the same order as the implied losses in tariff revenue. Estimated effects on firms' profits were insufficiently defined to make any concrete statement about the strategic importance of VERs to domestic and Japanese players. In the European context, work examining five markets (Belgium, France, Italy, Germany and the UK) in 1990 found evidence of binding constraints for France and Italy, but not in the Germany or the UK (Verboven, 1996). Further work found binding constraints applied to France, Italy and the UK (Goldberg and Verboven, 2001). However, the emphasis of both these studies was on price differentials in five European markets and not on trade policy *per se*, and they make no attempt to analyse the policy effects of VERs.

3 VERs between the UK and Japan

In the mid-1970s the global car industry came under considerable pressure from Japanese exports, against a trend of reduced demand for cars in the wake of the 1973 oil crisis. In response to the Japanese expansion, allegations of dumping and subsequent representations were made in attempts to persuade Japanese manufacturers to voluntarily limit their export volumes to a number of European countries, including Britain (Dunnet, 1980). Formal discussions between the industries had begun that year, with the UK manufacturers being represented by the Society of Motor Manufacturers and Traders (SMMT), while the Japanese Automobile Manufacturers' Association (JAMA) acted on behalf of the Japanese industry. The industry agreement limited Japanese new car registrations to a 9–11% range of total registrations for five years.[3]

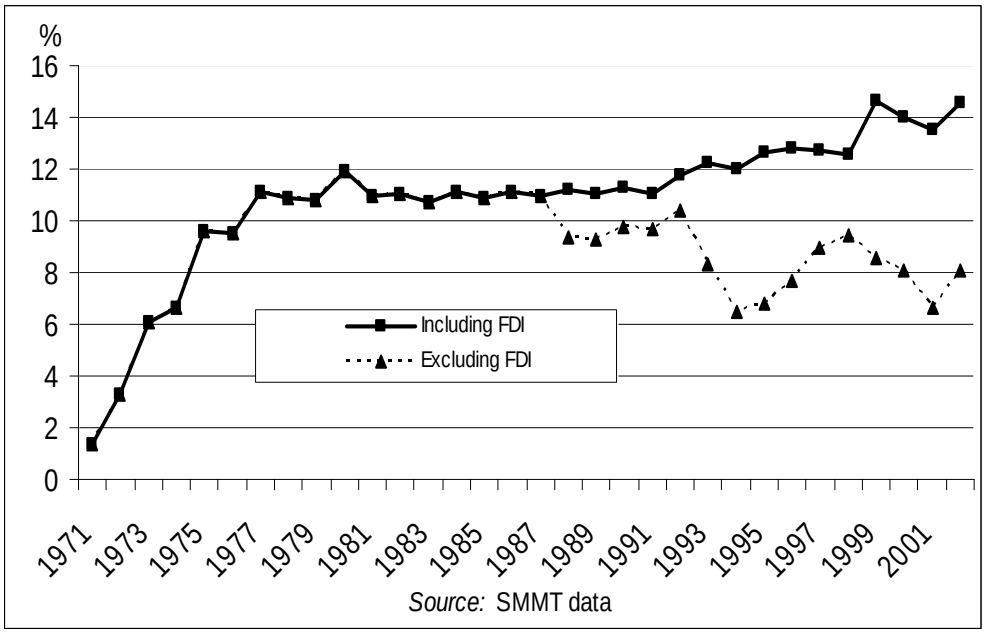
This *status quo* remained until the signing of the EC–Japan understandings and subsequent agreements, the so-called Elements of Consensus (EOC), in July 1991. The EOC provided an on-going means of partially insulating the industry over a transitional period, using country specific

[3] The European Commission's involvement in coordinating quantitative restrictions extended to industries outside the motor industry including video recorder restrictions (Greenaway and Hindley, 1985).

levels of VERs. The EOC gave block exemptions to autos, thus acting in clear violation of the Treaty of Rome and the single market programme (SMP), but its adoption provided a carrot for countries with constrained car markets to sign up to the Single Market Programme in 1992. The VER phase out represented a pragmatic means to meet the EC's objective of insulating the European industry, so that it could restructure itself to be competitive with Japanese manufacturers, while providing a clear date for VERs to cease. In keeping with the EOC, the phase out of VERs was finally completed in December 1999.

Figure 1 shows that when Japanese cars produced in the UK are accounted for, Japanese (import) market penetration drops below the threshold 9% in the two years following the commencement of UK production by Nissan in 1986, and similarly drops further in the two years following Toyota's entry into UK-based production. As previous researchers have argued (Mason, 1995; Turrini, 1999) transplants were included in the quota, however it was the case that these UK produced Japanese cars were sold on the continental market thus reducing the degree of direct competition on the domestic champion British Leyland in the UK market.[4]

Figure 1 Market share of Japanese manufacturers in the UK (1971–2002)



[4] Representatives of the Commission are sincerely thanked for frankly confirming this information, and corroborating the interpretation of the EOC taken in this paper.

4 Data and descriptives

Ideally, studies should include the population of goods and their valued characteristics over the period of analysis. However, examinations of voluntary export restraints have failed to do this. Specifically, products have been typically defined in terms of a few baseline models, even though, particularly in the case of firms that market consumer goods, products are marketed in differing forms or model versions. Furthermore, the characteristics space has been limited to few observable versions.

By contrast, the data-set employed in this study incorporates a complete sample of new registrations, list car prices, and over 120 matching attributes for the complete set of car model versions marketed in the UK between 1971 and 2002. The SMMT originally compiled the quantity data. List prices were taken from two price guides: *Parkers* (1993–2002) and *Motorists' Guide* (1971–93), while the vast array of product attributes at the variant level were obtained from AugurTech Ltd.[5] The two key novelties of the data-set are that it uses the model version as the unit of analysis and that it includes an exceptionally rich array of explanatory variables. The incorporation of a complete set of about 120 product attributes is of particular importance in evaluating VERs. A critical aspect of VERs (which was appreciated by contemporary analysts across a wide variety of industries affected by restraints that influenced theoretical research in the area) is that VERs are synonymous with quality upgrading. That voluntary agreements led to quality upgrading was appreciated in the earlier applications of VERs to the textile and steel industries. In addition, the findings of prior studies, which used data-sets that include only a spartan set of (typically) performance-based product attributes, indicate that upgrading effects are empirically important (Feenstra, 1988). Reasonably capturing the multiple dimensions of quality upgrading for a product as complex as a car is a challenging undertaking. The data-set includes a similar list of performance-based product characteristics to those commonly employed in earlier work comprising of: fuel consumption (miles per pence)[6]; power (brake horsepower divided by weight); and size (length multiplied by width). However, in contrast to previous research, which has typically attempted to capture embodied attribute upgrading (if at all) through crude counts of luxury features, the data-set contains a far richer set of observable characteristics.

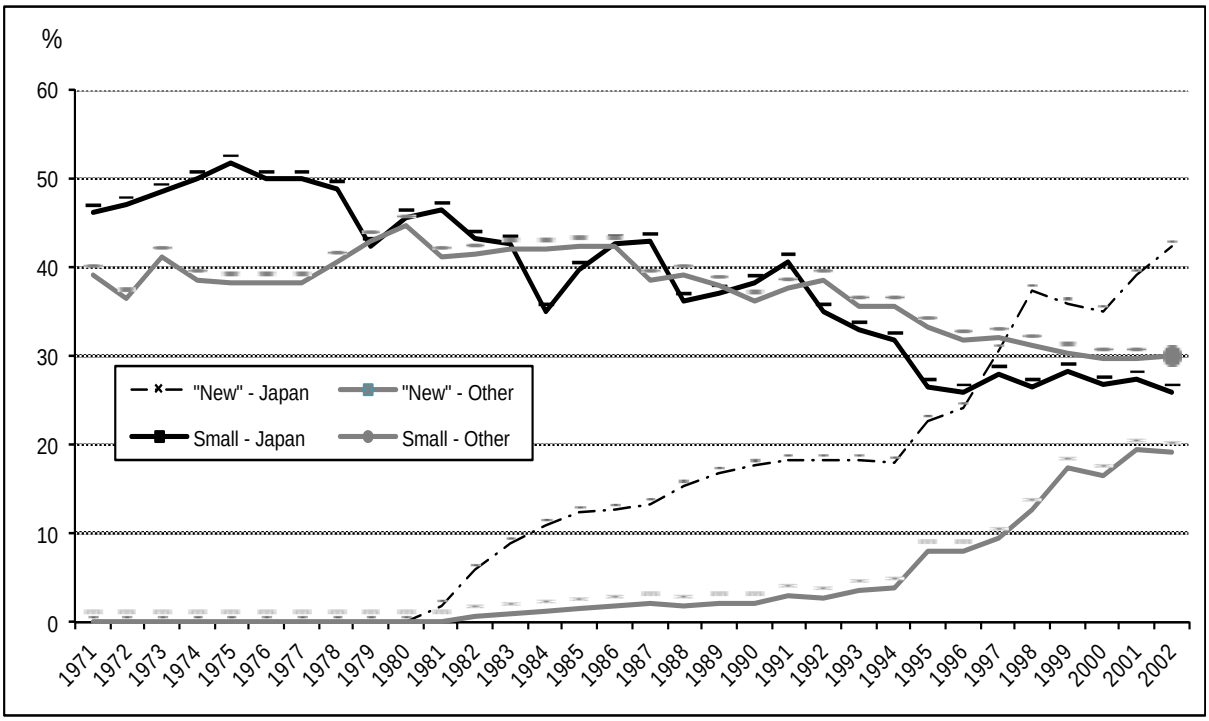
[5] AugurTech Ltd is an internet design consultancy for the motor industry whose data is provided directly from all automobile manufacturers operating in the UK. Information from two trade publications, *Parkers* Guide (1993–2002) and *Motorists Guide* (1971–93), was used to complete the data-set where there were any gaps.

[6] Miles per pound in real 2002 prices was obtained from the Department of Trade and Industry, while fuel type and grade comes from *Parkers* and the *Motorists' Guide*.

To examine the extent to which quality upgrading occurred in Japanese cars, two dimensions of the upgrading process are examined in turn, namely via: (i) adjustments to the product-mix;[7] (ii) technology upgrading of car models via the embodiment of new technologies.

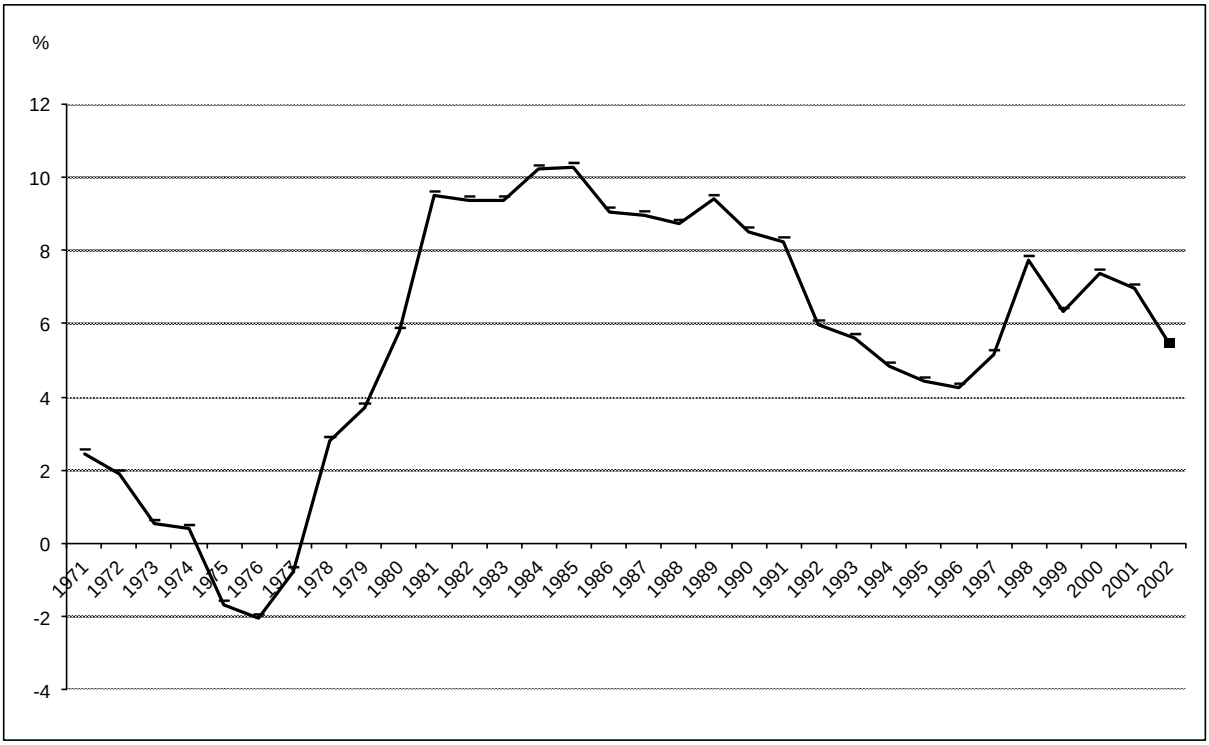
An important aspect of quality upgrading was the adjustment of the product-mix of Japanese cars. The allocations of new registrations between market segments over the period, for both Japanese and non-Japanese firms, are summarized in Panel A of Figure 2. Trade publications identify eight market segments. In order to simplify the graphic, the two key segments where shares occurred are shown: small (mini and small family), and 'new' (multi-purpose vehicles and four-by-fours).

Figure 2 Quality upgrading in Japanese cars.



Panel A Market shares in key segment groups (%)

[7] Indeed, Goldberg (1995) defines upgrading as a movement toward market segments that include more expensive cars.



Panel B Relative difference between mean average embodiment of new attributes between Japanese and other manufacturers (%)

Panel B of Figure 2 depicts the difference between the mean proportions of binary features of Japanese cars relative to non-Japanese manufacturers (calculated as the sum of the [sales weighted] mean embodiment of binary features of Japanese manufacturers as a ratio of the mean incorporation of those same attributes by non-Japanese producers). Panel B dramatically emphasizes the rapid embodiment of features by Japanese manufacturers relative to non-Japanese manufacturers in the wake of the VER agreement enforcement in 1977, relative to the 1973 and 1976 period when they had been less well equipped. The policy had a profound effect on the nature and perception of Japanese cars. It was not until the 1990s that the market converged on the level of feature embodiment found in Japanese manufacturers' products. Nevertheless, on average, Japanese products were still better equipped by the end of the period examined.

A number of noteworthy shifts in segment market shares are captured in Figure 2, Panel A. First, between the late 1970s and the mid-1980s there was a shift towards small cars, reflecting the effects of the oil crises of the 1970s. Subsequently, the proportion of small cars fell. The falling share of small cars coincided with a second, and more dramatic, shift from the mid-1980s following the development of the 'new' segments that went from accounting for 1% of new registrations in 1983 to about 18% of non-Japanese manufacturers' sales in 2002. The shifting

product-mix of Japanese manufactured vehicles was markedly different. Following the implementation of VERs in 1977 there is a discernible shift away from small cars. After 1981 the ratio fell back as Japanese manufacturers concentrated their sales in the 'new' segments, with the initial expansion occurring in the four-by-four segment that was monopolized by the Land Rover until arrival of the Toyota Land Cruiser in 1981 and Suzuki's SJ410 in 1982. Japanese producers were then to dominate the multi-purpose vehicle (MPV) segment. A previous analysis on new goods and people carriers (PCs) showed that such products provide manufacturers with higher mark-ups (Petrin, 2002). It was therefore quite natural that constrained Japanese manufacturers concentrated their energies on developing their products for these market segments. Indeed, Japanese manufacturers have dominated early sales of PCs and by 2002 their product-mix included over twice as many 'new' segment sales then the mean product-mix of other producers.

5 Estimating the effects of VERs on sales, market shares and welfare

The UK car market is modelled as an oligopolistic market in which *N* multi-product firms compete in prices. The methodology adopted is similar to that developed by Berry *et al*. (1995) (BLP), while additional generality in the structure of the demand is possible via random coefficient modelling.

We utilize a random coefficients model that incorporates the nested logit and the random coefficients logit as special cases. There are *j* model versions that are marketed in period *t*. There are *i* potential consumers who may choose either from an outside good 0 or one of the *J* differentiated goods, $j = 0,.....,J$. Consumer i's conditional indirect utility for the outside goods is $u_{i0t} = \overline{\varepsilon_{i0t}}$. For products $j = 0,.....,J$ we have

$$u_{ijt} = x_{jt}\beta_i + \xi_{jt} + \overline{\varepsilon_{ijt}}, \qquad (1)$$

where x_{jt} is a $1 \times K$ vector of observed product characteristics (including price which is assumed to vary with income), β_i is a $K \times 1$vector of random coefficients capturing the individual specific

valuations of the product characteristics, while ξ_{jt} are characteristics that are unobserved by the econometrician.[8] $\overline{\varepsilon_{ijt}}$ is remaining individual specific valuation of the product, *j*.

The random coefficient vector, β_i can be specified as follows. β is a $K \times 1$ vector of mean valuation of characteristics, σ is a $K \times 1$ vector with standard deviation of the valuations, and v_i is a $K \times 1$ vector with standard normal random variables. We then specify

$$\beta_i = \beta + \sum v_i \,, \tag{2}$$

where $\sum$ is a $K \times K$ diagonal matrix with standard deviations σ on the diagonal. The individual valuations for the products *j*, $\overline{\varepsilon_{ijt}}$, may be modelled as i.i.d. random variables with an extreme value of logit distribution as in BLP. Following Berry (1994) we assign each product *j* to a group *g*, where groups, $g = 0,.....,G$ are mutually exclusive and collectively exhaustive, with group 0 being the outside good. Hence:

$$\overline{\varepsilon_{ijt}} = \varsigma_{igt} + (1-\rho)\varepsilon_{ijt} \,, \tag{3}$$

where ε_{ijt} is an i.i.d. extreme value and ς_{igt} has the unique distribution such that $\overline{\varepsilon_{ijt}}$ is extreme value. The parameter ρ is the nesting parameter $0 \le \rho \le 1$, and can be interpreted as a random coefficient proxying for the degree of preference correlation between products of the same group. As ρ tends to zero, the within-group correlation tends to zero and the model reduces to a simple logit. Using (2) and (3) and defining the mean utility of the product *j*, $\delta_{jt} = x_{jt}\beta + \xi_{jt}$, allows consumer *i*'s indirect utility to be

$$u_{ijt} = \delta_{jt} + x_{jt}\sum v_i + \varsigma_{igt} + (1-\rho)\varepsilon_{ijt} \,, \tag{4}$$

Indirect utility comprises three terms: a mean utility term common to all consumers, δ_{jt}; an individual specific term, $x_{jt}\sum v_i$, relating to continuous product characteristics, x_{jt}; and an individual specific term, $\varsigma_{igt} + (1-\rho)\varepsilon_{ijt}$, relating to the products' discrete characteristics, the groups. Hence if $\sigma_k = 0$ for all elements of σ (or in Σ), then we obtain the nested logit.

[8] As in Berry *et al*. (1995), price is assumed to vary with income and is assumed to be a lognormal approximation of UK households each year. Household data was derived from the Family Expenditure Survey.

However, if $\rho = 0$ the model equates to the BLP random coefficient model. Where $\sigma_k = \rho = 0$, we then obtain the simple logit results.

Each consumer *i* at time *t* chooses the product *j* that maximizes their utility. The aggregate market share of product *j* is the probability that product *j* yields the highest utility across all products including the outside good. The predicted market share of product $j = 0,.....,J$ as a function of the mean utility vector δ_j and the parameter $\theta = (\beta, \sigma, \rho)$, is the integral of the nested logit expression over the standard normal variable vector v_i

$$s_j(\delta, \theta) = \int_v \frac{\exp((\delta_j + x_{jt}\Sigma v)/(1-\rho))}{\exp(I_g/(1-\rho))} \frac{\exp I_g}{\exp I} \phi(v) dv \quad , \tag{5.1}$$

where I_g and I are "inclusive values" (McFadden, 1978) and are defined by $I_g = (1-\rho)\ln \sum_{k=1}^{Jg} \exp((\delta_k + x_{kt}\Sigma v)/(1-\rho))$ and $I = \left(1 + \sum_{g=1}^{G} \exp I_g\right)$, where J_g is the number of products in segment *g* such that $\sum_{g=1}^{G} J_g = J$. If $\rho = 0$, we obtain BLP's (1995) random coefficient logit model

$$s_j(\delta_t, \theta) = \int_v \frac{\exp(\delta_{jt} + x_{jt}\Sigma v)}{1 + \sum_{k=1}^{J} \exp(\delta_{kt} + x_{kt}\Sigma v)} \phi(v) dv \quad . \tag{5.2}$$

We approximate the integral over v_i in (4) by simulating *R* draws over the density of *v*, hence

$$s_j(\delta_t, \theta) = \frac{1}{R} \sum_{i=1}^{R} \frac{\exp((\delta_{jt} + x_{jt}\Sigma v_i)/(1-\rho))}{\exp(I_g/(1-\rho))} \frac{\exp I_g}{\exp I} \tag{6}$$

To estimate the demand parameters θ, we follow BLP and the subsequent literature. The observed market shares vector (i.e. unit sales per product divided by the number of potential consumers, M_t) to predict the market share vector, $s_t = s_t(\delta_t, \theta)$.

In modelling the supply side we follow Berry *et al*. (1999). While the European market is the world's largest, the UK car market is relatively small in global terms, implying that marginal costs can be assumed as constant (Goldberg and Verboven, 2001). There is compelling evidence that the UK car market is oligopolistic (Geroski and Murfin, 1991). Direct evidence of oligopolistic behaviour is found in an on-going series of investigations by UK government agencies involved with anti-competitive practices. In particular, two separate studies by the Monopolies and

Mergers Commission investigated whether collusive behaviour occurred in the market and found that this was the case (Monopolies and Mergers Commission, 1984), with a further investigation leading to Volvo's admission of price fixing (Monopolies and Mergers Commission, 1992). How such oligopolistic pricing should be modelled is an issue that is less clear. We follow Berry *et al*.'s (1995) approach and industry wisdom, by assuming competition follows Bertrand (Nash in prices, i.e. that at equilibrium each firm is setting each of its product prices to maximize total firm profits conditional on the prices charged by other firms and the characteristics of all the car markets) rather than Cournot (Nash in quantities). Marginal costs are calculated as

$$\log(mc_{j,t}) = w_{j,t} + \upsilon_{j,t} + \lambda VER_{j,t}, \quad (7)$$

where w_j is a vector of observable cost shifters (in this case wages and exchange rates) and v_j is a vector of unknown parameters.[9] VERs are modelled on the cost side as a specific tariff that, where binding, raises prices by an amount exceeding cost plus mark-up. Note that the time subscripts are suppressed to simplify the expression, with VERs being captured via location and year-specific dummies for each of the years that the restraints were applied.

6 Simulating the effects of the UK–Japanese VERs: estimation and results

Our estimation procedure follows BLP. The GMM objective function includes a weighting matrix to account for heteroskedasticity. We can proceed with GMM by interacting the error term with a vector of instrumental variables, z_{jt}, that is uncorrelated with the error term. Following common practice, the vector of instrumental variables, z_{jt}, includes: a vector of product characteristics of competing firms; the sum of characteristics of competing firms and the sum of characteristics of other products of the same firm. Furthermore, we also incorporate cost shifters on the supply side. Intuitively, cost shifters affect product prices, but are uncorrelated with product *j*'s unobserved quality. The key identifying assumption is that product attributes x_{-j} are not correlated with the error term. This is arguably a questionable assumption, but the validity of these instruments in the estimation can be tested. Standard errors are computed using the standard GMM formulas for asymptotic standard errors.

[9] Exchange rates, defined as destination market currency per unit of the exporter's currency divided by the destination's CPI and multiplied by each respective source country's CPI. *Sources: International Financial Statistics* (various issues), Washington DC; *International Monetary Fund* (various issues), Washington DC. Manufacturing wage per worked hour (*OECD Statistical Compendium*).

Several recent papers have studied a variety of problems relating to BLP's numerical performance (Dubé *et al*., 2012; Knittel and Metaxoglou, 2014). In addition, recent work by Grigolon and Verboven (2013) comparing random effects models and the method utilized here using European automobile markets, has found that the methods employed in this paper were well able to capture competition policy. We adopt their method of approximating the integral (4) using the simulator (5), applying the Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm to solve the non-linear optimisation problems (Nocedal and Wright, 2006). We also use Halton draws over the density $N(1,0)$, by taking a stricter tolerance in inverting market shares, using Berry et al. (1995) contraction mapping with differing starting values and stringent convergence criteria.[10]

Table 1 provides estimates from the structural model. We employ three differing specifications to examine the extent that of the inclusion of a more realistic (in the sense that we capture non-performance features and other features that are valued by the consumer) set of observable attributes. The attribute variables are positively signed, illustrating that attributes (other than the high fuel costs associated with higher fuel consumption per mile) provide additional utility to the buyer. The first estimation includes only the attributes mentioned in the text and does not incorporate some 118 other product characteristics. The coefficients are well signed and the vast majority of t-statistics are significant at the 1% level.

Qualitatively speaking, these findings broadly carry over to the second estimation that utilizes the full set of product attributes. Given the substantial number of attributes, only a sub-set of those attribute variables are presented. The attribute variables are consistently positively signed and are largely significant (74 of the 118 in Specification 2 and 61 in Specification 3). What is noteworthy is that there is a marked drop in the value of coefficients as greater observable and then unobservable characteristics are added. There is an average 32% fall in the value of the 11 initial variables when the full set of attributes are added and 40% reduction when the model-specific fixed effects are included. That the inclusion of more characteristics did influence the estimates is inconsistent with Berry *et al*. (2004). However, Berry *et al*. (2004) do not have the vast list of attributes at their disposal and do not capture model fixed effects. We provide bilateral tests of the models. Perhaps not surprisingly the diagnostics support the model with both observable and unobservable attributes.

Of central interest, the key results relating to the VER variables in the pricing equation are positive and statistically significant for 16 of the 22 years that the policy was in place. There are

[10] The tolerance level being $1e^{-12}$ and the convergence criteria $1e^{-6}$.

two exceptions. First it appears that during the first few years after the policy was introduced it did not have a binding impact on Japanese manufacturers. Also, during the market downturn in 1991 the VERs do not appear to have been binding. Since VERs enter the cost equation in the form of a specific tariff, the positive coefficient indicates the level of tax that would generate equilibrium prices that equate to those observed under the restraints in the years where the VERs bind.[11] From a qualitative perspective the findings are quite similar. There is a significant negative impact of the policy in 1979 in Specification 1. While the inclusion of the full set of observable characteristics are incorporated into Specification 2, and where unobservables are included in Specification 3 does not reverse the sign, the findings are insignificant in the later specifications. Of critical importance from a policy evaluation perspective, the coefficients on the VER dummies are lowered by 16% when observable characteristics are included. And the inclusion of *both* the full set of observable characteristics and the model fixed-effect in the pricing equation is some 28%, which implies that the net gains would be considerably overstated were they not included.

[11] The results are estimated under the Bertrand assumption; however, analysis employing Cournot and Collusion assumptions provided qualitatively equivalent outcomes. Given the length of our data period we have also estimated using shorter time periods and found the central finds remain well determined.

Table 1 Estimated parameters from the demand and pricing equations (selected coefficients: 14,401)

		Without Full Set of Observable Attributes				With Full Set of Observable Attributes				With Observable & Unobservable Attributes			
		Demand Equation		Pricing Equation		Demand Equation		Pricing Equation		Demand Equation		Pricing Equation	
		Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
attributes	power	0.20	(15.81)	0.03	(16.88)	0.14	(12.92)	0.021	(11.56)	0.112	(9.88)	0.016	(7.40)
	size	2.70	(4.09)	1.13	(7.30)	1.89	(6.39)	0.791	(3.46)	1.350	(2.27)	0.904	(3.01)
	economy	-1.20	(7.65)	-0.5	(5.06)	-0.84	(6.21)	-0.35	(3.83)	-0.607	(4.78)	-0.400	(2.40)
	injection	1.22	(3.93)	0.51	(3.62)	0.854	(2.62)	0.357	(2.27)	0.610	(2.62)	0.408	(1.98)
	non-diesel turbo	1.70	(2.41)	0.53	(1.40)	0.51	(1.28)	0.1696	(0.53)	0.170	(0.72)	0.0265	(1.16)
	diesel w/o turbo	2.98	(3.64)	1.24	(3.06)	2.086	(3.31)	0.868	(2.78)	1.490	(3.31)	0.992	(1.92)
	diesel w/ turbo	4.01	(4.40)	1.67	(3.53)	2.807	(4.89)	1.169	(3.92)	2.005	(4.89)	1.336	(3.24)
	aircon	0.87	(3.59)	0.36	(3.42)	0.609	(3.97)	0.252	(2.63)	0.435	(2.11)	0.288	(2.01)
	ABS	1.34	(1.48)	0.56	(1.39)	0.536	(1.48)	0.392	(0.99)	0.670	(0.87)	0.448	(0.34)
	PAS	3.45	(5.62)	1.44	(2.86)	2.415	(4.68)	1.008	(2.38)	1.725	(4.68)	1.152	(2.53)
	airbag	2.07	(4.24)	0.86	(2.62)	1.449	(3.53)	0.602	(2.18)	1.035	(3.53)	0.688	(2.37)
	wage			0.432	(4.72)			0.348	(3.99)			0.310	(4.21)
	exchange rate			0.370	(2.26)			0.385	(2.10)			0.335	(1.99)
	Price/income	-3.65	(8.26)			-2.98	(4.53)			-2.12	(5.09)		
VER	1977			-0.176	(1.14)			-0.147	(0.56)			-0.214	(0.98)
	1978			0.232	(1.46)			0.194	(0.18)			0.185	(0.39)
	1979			-0.307	(1.98)			-0.256	(1.54)			-0.267	(1.21)
	1980			0.170	(1.11)			0.142	(0.94)			0.131	(0.45)
	1981			0.720	(0.98)			0.600	(0.42)			0.492	(0.60)
	1982			1.111	(1.29)			0.926	(0.22)			0.759	(0.08)
	1983			1.530	(3.09)			1.275	(2.71)			1.046	(2.99)
	1984			1.325	(4.27)			1.104	(3.99)			0.984	(3.27)
	1985			1.717	(4.41)			1.431	(3.78)			1.107	(5.41)
	1986			3.132	(5.08)			2.610	(7.43)			2.132	(4.86)
	1987			2.679	(6.27)			2.233	(5.90)			1.948	(4.92)
	1988			1.615	(3.80)			1.794	(3.64)			1.527	(3.80)
	1989			2.541	(4.29)			2.117	(3.68)			1.847	(3.93)
	1990			1.920	(4.07)			1.600	(3.75)			1.312	(3.21)
	1991			0.683	(1.48)			0.569	(1.69)			0.554	(1.53)
	1992			1.530	(3.81)			1.275	(2.98)			1.046	(3.03)
	1993			2.670	(4.79)			2.225	(4.96)			1.825	(4.14)
	1994			3.210	(6.68)			2.675	(6.89)			2.194	(5.83)
	1995			2.790	(5.92)			2.325	(5.02)			1.907	(6.30)
	1996			2.670	(6.13)			2.225	(4.98)			1.825	(5.12)
	1997			2.550	(5.04)			2.125	(4.20)			1.743	(4.75)
	1998			2.370	(4.29)			1.975	(3.87)			1.620	(4.06)
	1999			2.210	(6.98)			1.842	(4.01)			2.075	(4.27)
	Constant	-8.902	(6.41)			-10.113	(5.20)			-9.329	(5.06)		
	With Segmentation	YES				YES				YES			
	Full set of attributes	NO				YES				YES			
	Model Fixed Effects	NO				NO				YES			
	Random Coefficients	YES				YES				YES			
	Parameters ρ	2.68	(18.67)			3.01	(15.78)			2.47	(14.88)		
	(both equations) p/y	-3.65	(8.26)			2.98	(4.53)			-2.12	(5.09)		
	χ^2					1,342	(29.78)			855	(21.89)		

Source: Data sources provided in text. Information identifying when attributes were first incorporated into products, provided below, was enumerated by the authors from trade publications.

Before 1945 Centre Arm Rest Front, Centre Arm Rest Rear, Chrome Trim, Chrome Grille, Cigarette Lighter, Cloth Trim, Drivers seat Lumbar Support, Exterior Side Mouldings, Front Fog Lamps Fitted, Front Head Rest, Front Spoiler, Height Adjustable Drivers Seat, Height Adjustable Seat Belts, Independent Suspension, Leather Upholstery, Leather Coated Steering Wheel, Limited Slip Differential, Rear Seat Belts, Rear Spoiler, Rev Counter, Sports Front Seats, Sunroof, Trip Counter, Time Clock, Vinyl Trim, Walnut Trim; **-1945** Diff Lock, Full Time 4 Wheel Drive, 2 Speed Transfer Box; **1950s** Air Conditioning, Power Assisted Steering, Electric Windows (front), Electric Windows (front & rear), Fuel Injection; **1960s** Pop-up Headlights, Radio fitted, Adjustable Steering Column, Disc Brake (front), Disc Brakes (front & rear), Front Door Bins, Intermittent Wash Wipe, Radio Cassette, Heated Rear Window, Halogen Head Lights; **1970** Adjustable

Mirrors, Central Locking, Velour trim, Tinted Windows; **1971** Locking Wheel Nuts, Headlamp Wash, Child locks; **1972** Electric Aerial, Rear Sun Blind Fitted, Head Rests (front & rear), Alloy Wheels; **1973** Split rear seats, Heated Mirrors, Height Adjustable Headlight Aim, Colour Coded Bumpers, Colour Coded Mirrors, Diesel Engine; **1974** Rear Wash Wipe; 1975 Digital Odometer, Sunroof (electric), Headlamp Wash Wipe, 4 Wheel Steering; 1976 Cruise Control, Electric Mirrors; **1977** Removable Hard Top, Remote Boot Release, Remote Petrol Cap Release; **1978** Turbo, Electric Height Adjusting Drivers Seat, Heated Front Seats, Part Time 4 Wheel Drive, Sunroof (Factory Fitted), Rear Load Cover, Deadlocks, Removable Soft Top, T-Bar Roof, Roof Rails; **1980** Pre-tensioned Seat Belts (front), Antilock Braking System, Trip Computer; **1981** On Board Computer, Electric Memory Seats, Rear Sun Blind (electric), Radio Cass (remote); **1983** Half Leather Trim, Side Impact Protection, Free Wheel Front Hubs, Cup holders, Twin Sun Roofs; **1984** Automatic Stability Control; **1985** Three Rear 3 Point Seat Belts, Alarm, High level brake Light, External Temperature Gauge, Heated Front Windscreen; **1986** Electric Power Hood, **1987** Pollen Filter, Rear Reading Lights; **1988** Drivers Airbag, Active Suspension, Catalytic Converter, Remote Central Locking, Side Steps Fitted; **1989** Voice Synthesizer, Radio CD Player, Multi-play CD, Child Seat, Front Twin Airbags, Engine Immobiliser; **1990** Compact Disc Player, Electro Chromatic Rear Mirror, Traction Control; **1991** Visible Identification Number; **1992** Electric Front Seat Belts, Front Side Air Bags, GSM Mobile, Xenon Headlights; **1994** Electric Operated Soft Top; **1995** Courtesy Light Delay, Electric Folding Mirrors, Revolving Front Seats; **1996** Traffic Navigation System; **1997** Climate Control, 12 V Accessory Power Point.

7 Simulating the effects of the UK–Japanese VERs

To analyse the implications of the trade policy on profits and consumer welfare in the UK car market it is necessary to provide a plausible counterfactual against which to juxtapose the results. The logical candidate is that a free trade regime occurred rather than one where VERs were not implemented, i.e. an equilibrium where the coefficient on the implicit tax, λ, is set to zero. The effects of the policy impacted producers by affecting the profit margins of firms and affected consumers by raising the prices of Japanese and other manufacturers' products, and by stimulating employment. Welfare effects are calculated for the years studied in which the export restraints were binding.

7.1 Profit shifting

The effects of the export restraint on prices and profits of key manufacturers, as implied by the model simulations, are summarized in the upper panel of Table 2 in real 2002 pounds. The decline in imports associated with VERs did not, however, enable all producers to raise prices substantially. Of the four producer groups, Japanese firms had the highest price differences (£2,523) followed by the UK-based MNEs – Ford UK and GM Vauxhall – (£848), continental European manufacturers (£445) and the domestic 'champion' (£98). These findings differ from the only other paper to provide a comparable welfare analysis of a VER – Berry *et al*. (1999); they were unable to provide well-defined effects on profits, while the findings of this paper are more precisely determined.

The domestically owned BL saw a relatively small profit gain, while US multinationals achieved substantive windfall profits. Those MNEs did not expand sales substantively however, with their gains merely reflecting increased mark-ups earned. Manufacturers from continental European countries also exacted considerable gains. This effect reflects the substitution from Japanese to European manufacturers, as has been highlighted in earlier work (Dinopoulos and Kreinin, 1988; Goldberg, 1995). In particular, Goldberg (1995) found that only 54% of the sales gains derived from the VER were captured by US firms, while Dinopoulos and Kreinin (1988) found that European firms were able to expand their prices by about one third. Gains to European manufacturers were greater in the UK than in the US, in part due to the weakness of BL, but also because European manufacturers had a larger combined market share.

Table 2 VER effects on welfare (1983–99 in £ m)

VER Effects on Total Profits of Strategic Groups (£ mns)			
	With VER	No VER	Difference
Japanese	3,400	3,326	75
UK (BL)	225	194	31
UK (MNEs)	7,922	7,130	792
European	2,526	2,274	252

Consumer Welfare, Domestic Profits, and Forgone Tariffs (£ mns)			
Compensating Variation	Change in domestic profits	Foregone Tariff Equivalent	Welfare loss (equivalent tariff)
1,458	1,150	1,148	- 1,456

Notes: 1. Average prices are sales weighted. 2. UK MNEs include Ford and GM products. 3. 'European' includes cars manufactured by manufacturers in the UK with the exception of BL products during the period of BMW's ownership. 4. All resulting estimates are precisely determined (at the 5% or better).

Japanese firms increased their prices significantly under the export restraint and did not witness a fall in profits. Their ability to maintain profits reflected relatively inelastic demand for Japanese products and revenue gains associated with VERs (as opposed to tariff policies). The success of Japanese manufacturers also reflected the change in their product-mix towards higher-end models, with the most dramatic example being Toyota's development of the Lexus. But the more common result was that those manufacturers concentrated on selling ‘new’ rather than small family and mini cars.

7.2 Consumer welfare

Consumers are the unambiguous losers under the policy. The measure of the welfare change is the difference between the VER and the non-VER equilibrium using the predicted prices from the simulation exercise.[12] The lower panel of Table 2 shows that consumers paid a heavy burden for the policies, amounting to about £1.46 bn. Losses in consumer welfare also follow a cyclical pattern, reasonably suggesting that the ability of firms to extract surplus from consumers fell during downturns in demand. This amount is equivalent to about 50% of the burden paid by US consumers,[13] despite the UK economy being about one-seventh the size of that of the US, reflecting the considerably longer period that the restrictions were in place in the UK.

7.3 Tariff revenue

The foregone revenue with a VER is sometimes referred to as the bribe paid to induce Japan to agree to the policy in the first place (Berry, *et al.* 1999). Suppose the UK had instead opted for the tariff that would have resulted in the same industry equilibrium observed under the VER. In this case we calculate the forgone tariff to equate to £1.148 bn. In effect this represents 80% of the welfare loss of the policy.

8 Concluding discussion

The advent of Japan–UK VERs and FDI impact in the UK car market is analysed from their implementation in 1977 until they were removed in December 1999. To do so we use an exhaustive version level data-set that covers the period from 1971 to 2002, incorporating over 120 observable product attributes. Given that the extent of the data provides limits on empirical techniques, and given recent research suggesting both that there are issues with the random effects framework and that the more straightforward nested logit model provides quite reasonable outcomes in the context of European automobile markets, we opt for this approach.

[12] We compute the compensating variation following Berry *et al*. (1999). First take a draw from the estimated distribution of tastes and take the distribution of income from the Family Expenditure Survey. This draw can be thought of as a simulated household. Next, compute which product gives the highest utility at the VER (i.e. the actual) prices and the resulting utility. Now find the income, which generates the same level of utility at the non-VER prices (i.e. the prices we obtained when we solved for the industry equilibrium in the absence of the VER). The change between this income and the initial draw on the household's income is the compensating variation. To estimate the expected compensating variation for a randomly chosen household, we do this a large number of times and take the average. Multiplying this expectation by the number of households in the economy gives the total compensating variation. The estimates in Table 2 use 10,000 draws but are robust to greater numbers of draws. We note that later work by Berry and Pakes (2007) compares the method used here with a number of alternative methods and find that all the methods "do very well" (p.1222).

[13] Comparing findings from this paper with Berry *et al.* (1999).

Determining the success of any policy depends on the extent to which it met the objectives it was designed to achieve. VERs had two objectives that mirrored Britain's changing political climate over the period. The initial and primary policy role was as a means to protect nationalized domestic industry in the form of Britain's last remaining mass-producing company, BL, which had been nationalized in 1975. The shift from nationalization to privatization under the Thatcher regime signalled a move away from government protection of domestic industry more generally. But this was not the case in the car industry, which received special status due to its size and its symbolic role. While protection of domestic industry remained the key objective, under the Thatcher regime VERs were actively conceived as a means to encourage efficient Japanese manufacturers to set up production in the UK to provide jobs. Overall the results concerning the effects of VERs on affected groups, over the period where VERs were binding, allow an evaluation of the overarching impacts of the policy and of how different stakeholders were affected. The main welfare losses associated with the VER were felt by British consumers, amounting to £1.46 bn. Against this, automobile firms were able to bolster profits, however the impacts were far from symmetrical. Despite the generally acknowledged role of trade policy as a means to protect the domestic industrial champion, BL, the adoption of VERs had relatively little impact on BL, who obtained £31 m in profits from the policy. In contrast, UK-based US multinationals obtained substantial windfalls from the policy, with Ford and General Motors gaining an additional £792 m over the period. Japanese firms gained at three levels, benefiting from: (i) enhanced profits net of the cost of upgrading the products (£75 m); (ii) subsidized plants (approximately £430 m); (iii) selling transplants within the EU (not measurable with only UK data). Thus, results show that the policy had mixed success in meeting its objectives. VERs demonstrably failed to provide any significant protection for the domestically owned BL. BL was simply not sufficiently competitive to acquire the share of the market left by constrained Japanese manufacturers and gained only a minor windfall in profits. The principal gains of the policy were obtained by unintended beneficiaries who were third parties to the arrangements – US-owned UK-based MNEs and European manufacturers (the UK-based MNEs being the happier of the two groups obtaining windfall profits of about £800 m) – more than 25 times larger than BL could achieve. European manufacturers gained a smaller profit of about £252 m – still more than eight times that of BL.

In order not to undermine the primary objective of protecting UK industry, at the expense of various forms of investment assistance, the UK was able to entice Japanese investment while continuing to constrain Japanese firms' sales in the UK but *not* in other constrained European markets. By 2002 Japanese manufacturers accounted for over 40% of UK production, with Japanese firms continuing to expand their production base in the UK and being the key

contributors to a doubling of UK production from its trough of 887,000 units in 1982 to 1.63 m units in 2002, despite Ford UK withdrawing from production of its Ford-badged autos that same year. The precision of the findings for both consumers and firms suggests that the policy had negative welfare outcomes.

The second objective of job creation associated with Japanese FDI in the UK was at least achieved, with the UK playing key host to Japanese investment in Europe. The policy led to the direct creation of about 7,000 jobs in Honda, Nissan and Toyota UK plants, which can be viewed as a successful policy outcome. Indeed these direct job creation effects are likely to have provided a substantial windfall to the UK economy although the precise extent of these gains is outside the scope of this study.

However it is worth noting that direct job creation effects have not been estimated, the outcome excludes also the indirect benefits to UK component suppliers. While quantifying this benefit is not possible within this study it is certainly the case that the industry was a large one when the policy was instigated and this is still the case.

In comparing the policy to a tariff as BLP we found that the welfare effects outweighed the tariff, although the magnitudes were not very different. Where the analysis here differs is that we are able to precisely point to profit benefits for producers in the UK and we also highlight the job creation effects of the policy. The finding does not imply that the use of such policies will, as a rule, be negative. Indeed the theoretical literature is far from clear as is highlighted by the debate that strategic trade policy sparked off with the economic profession. There are also, of course, methodological caveats. In particular we utilize a methodology that is an extension of Berry *et al*.'s (1995) seminal work but that suffers from the same methodological caveats associated with the model not being a dynamic one and therefore not accounting for any endogenous shifts in products or their characteristics, nor accounting for the myriad other aspects of dynamics of automobile purchases, such as financing, expectations of depreciation, and resale value.

It is worth putting the results in the context of the wider objective of the VER as a means to restructure European car-makers under the gamut of the EC's EOC. The restructuring process appears to have been largely successful, with major European conglomerates on the whole being competitive with Japanese manufacturers. Such success is reflected in the ending of VERs not

leading to a substantial Japanese expansion in the UK or elsewhere, Japanese manufacturers capturing 11.5% of the Western European market in 1999 and 14.3% in 2009.[14]

[14] 2009 is used as the reference date as there was a substantial fall in Japanese manufactures in general, and Toyota sales in particular, following the series of recalls from November 2009, culminating with the recall of 1.8 million cars in Europe following an accelerator problem in January 2010 (BBC News, 2010).

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