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The Consequences of Trade Liberalisation on the Australian Passenger Motor Vehicle Industry

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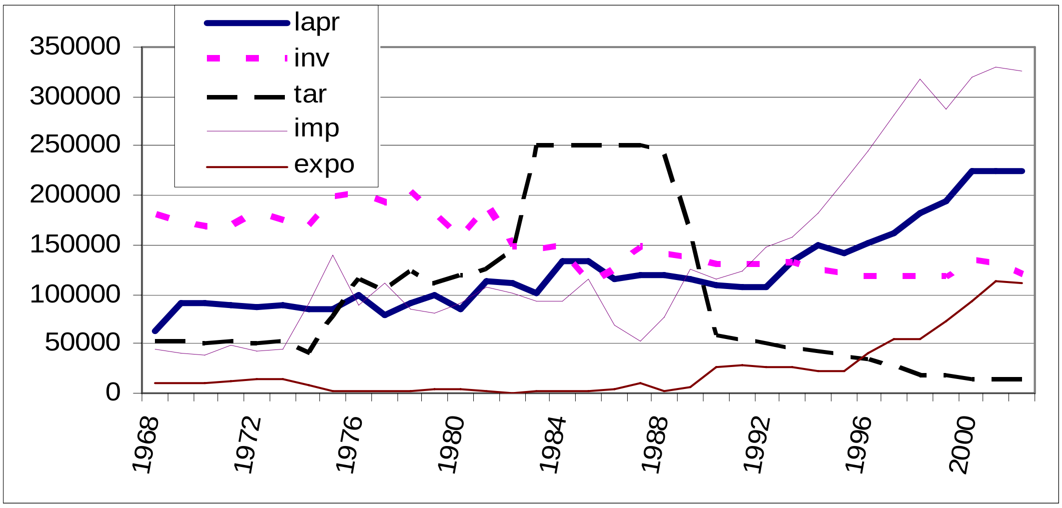
Abstract

This paper is an appraisal of the impact of Australian trade liberalization measures on imports, exports, productivity, and internal demand of the passenger motor vehicle industry. There is clear evidence that this liberalization has increased the volume of trade, imports, exports, and productivity, but reduced the locally produced cars for internal consumption. Various models are constructed and applied. Thus, this paper is an application of the bounds testing procedure based on the ARDL approach to cointegration and the comparison of the latter with the OLS and Johansen's cointegration methods in the contexts of small samples.

1 Introduction

The Australian Passenger Motor Vehicle[1] (PMV) industry has traditionally received special treatment from the government and hence it has been heavily affected by the policies of the latter. The visual inspection[2] of Figure 1 indicates substantial acceleration in imports, exports and labour productivity in the 1990s unambiguously. The inventories to sales ratio has also been decreasing noticeably in the same period. To put it into more technical terms, a structural break seems to have taken place around the end of the 1980s and the beginning of the 1990s.[3] Given this background we intend to explore the impact of reduction in tariffs (a way to liberalize trade) on the automobile vehicle industry in Australia.

Figure 1 The coevolution of automobile key variables in Australia



Note: The tariff (tar), labour productivity (lapr), and the inventories to sales ratio (inv) are adjusted to fit the scale of the series of imports (imp) and exports (exxp).

This exploration will be substantiated with econometric evidence. Given the small sample available (35 years of observations) we faced a dilemma in the first place: shall we simply opt for the OLS method and discard more 'complicated' methods such as the Johansen procedure? Or use both? But, we know that OLS can produce spurious results if its variables are integrated of order 1 [I(1)] and they are expressed in level terms; on the other hand the Johansen procedure needs a large sample. The answer came from the econometric rescuer of the bounds testing procedure through ARDL estimations (as proposed more synthetically by Pesaran, et al., 2001). So we decided to extensively use this procedure in this paper, but without ignoring the other two methods (the reasons will become apparent as we advance in the details of this article). Consequently the salient features of this paper include an extensive application of the ARDL model and bounds test procedure. This paper further includes a comparison with the other two methods (OLS and Johansen's). By using the above analysis we have tested a hypothesis that trade liberalisation on the Australian PMV industry have had a positive impact on its performance in terms of exports imports, and productivity.

The next section will summarize the protection policies regarding this industry in the last 40 years or so. The third section will present a proposed model of the mechanism of the tariff reductions on imports, exports, productivity, prices, and consumption of Australian produced automobile vehicles in Australia. The fourth section will summarize the background for our quantitative analysis by referring to the data, structural breaks, and econometric theory issues. The fifth section will attempt to quantitatively assess the proposed model by using three techniques for the determination of the long term or equilibrium relationships: primarily ARDL cointegration with bounds testing complemented by Johansen's cointegration, and OLS. The final section will summarize conclusions, limitations, and policy recommendations.

2. Trade Policy and Passenger Vehicle in Australia

For most of the period from 1968 to 1985, automobile industry received massive support from government in the form of tariff and non-tariff barriers (Table 1). Import quota restricted the import share of PMVs to 20 per cent; there was also the restriction of the 85 per cent local content usage.[4] Tariff rates for the PMV industry increased to a peak of 57.5 per cent in 1978 and remained at that rate until 1987. The Export Facilitation Scheme (EFS) became functional in 1982. This scheme allowed PMV producers to reduce the level of local content in their vehicles below 85 per cent, conditional on their export performance. The additional duty free entitlements (export credit) could then be used to import components free of duty, or sold to other vehicle producers. It is well known that there was a continuous rise in both nominal and effective protection rates for the whole automobile sector between 1968 and 1985 and for the PMV sector between 1968 and 1989. The effective rate of protection for PMVs increased to the peak of more than 250 per cent by 1988.

The attempt to reduce the level and complexity of assistance to the PMV industry started in 1985. However, the effects of these reforms were materialised in 1988 by reducing the effective rate of protection to 233 per cent (see Table 1). There has been a consistent fall in nominal and effective protection rates for the PMVs since 1989 and effective protection rates fell to 19 per cent by 2000. In 1985, the Button Car Plan was initiated to reduce the import quota. The Button Plan addressed the incentive issues by broadening the EFS to allow firms to accumulate 'export credits' and use them to offset import duties and to promote minimum volume output restrictions. The Button Plan generated rationalisation by promoting a minimum viable scale of operation, productivity, quality, exports and lower real prices in PMVs (Owens, 1995; Conlon and Perkins, 1995).

The quantitative import restrictions and increased level of tariffs and subsidies were mainly put in place to protect the PMV industry from import competition. The quotas built-up over time remained until 1988. Higher tariffs and continuing support by the EFS scheme were the other factors that influenced the PMV industry between 1985 and 1988. The complexity of these policy measures has led this industry to remain highly protective until 1988.

By the end of 1988, import quotas were abolished and the tariff rate on PMV was reduced from 57.5 per cent to 45 per cent and scheduled to diminish by 2.5 per cent per year until 1992. In 1989 the local content scheme was abolished. Removal of quotas and phased tariff reductions increased the exposure of the PMV industry to the forces of global competition and required them to restructure in order to be competitive. However, due to lobbying by industrialists further reductions in tariffs have been postponed (see for example Anderson and

Findlay, 1995). In 1997[5], it was decided to hold nominal tariffs constant at 15 per cent from 2000 to 2004. Tariffs would then be reduced to 10 per cent in 2005 and to 5 per cent in 2010.

Table 1 Estimated Rates of assistance (in %): 1966 to 2003

Year	Passenger Motor Vehicle			Automobile industry		Non-tariff reforms
	Tariff*	NRA *	ERA*	NRA*	ERA*	
1966-72	45	na+	na	34-35	49-50	Local content level 85%
1974-77	45	na	na	26-34	38-73	Imposed import quota on PMVs in 1975 and 1977
1978-84	57.5	na	na	42-51	81-135	Introduced EFS in 1979
1985	57.5	85	>250	49	143	Button car plan to increase import competition, improve volumes and implement lean production techniques.[6]
1986	57.5	69	>250	40	125	
1987	57.5	49	>250	28	92	
1988	45	38	233	27	88	Import quota were abolished.
1989	42.5	36	137	26	72	Local content scheme was abolished. Motor Vehicle Standard Act (1989)
1990	40	34	127	28	52	
1991	37.5	32	117	26	48	EFS was expanded by removing the ceilings. Linked the export credit to the value of the duty free saving.
1992	35	30	108	24	45	
1993	32.5	28	na	22	41	
1994	30	26	na	20	38	
1995	27.5	23	31	19	35	
1996	25	21	na	17	31	A voluntary code of practice for reducing the fuel consumption of new PMVs
1997	22.5	19	na	15	28	
2000	15	15	19	10	19	
2003	15	15	11	na	11	EFS replaced by Automotive Competitiveness and Investment Scheme (ACIS).

Note: * Tariff (*tarn*) is a tax on imported PMVs at the customs point. NRA (*tari*) is the nominal rate of assistance and represents the ratio of the domestic price to the world price for a comparable commodity; ERA is effective rate of assistance represents the ratio of domestic price value added to world price value added.; + not available.
Source: Industry Commission 1997, Productivity Commission 2002-03.

The EFS was made more flexible and market oriented and remained in force until 2001. In 2001, the EFS was replaced by the Automotive Competitiveness and Investment Scheme (ACIS) which provides duty credits on the basis of production, investment and research and development. Penalties for low volume production continued until 1996.[7] As a result, by 2003, the estimate of average effective rate of assistance for PMV had fallen to 10.8 per cent compared to 4.5 per cent for all manufacturing. The Australian car industry currently comprises four (see ABS, 2005) foreign owned producers of Passenger Motor Vehicles

(PMV) - Ford Motor Company of Australia Ltd., General Motors-Holden's Automotive Ltd., Toyota Motor Corporation Australia and Mitsubishi Motors Australia Ltd.- and about 200 firms supplying components. All four assemblers of PMVs are subsidiaries and dependent on their parent companies located outside Australia for strategic direction. Holden and Toyota's plants achieve the minimum viable scale of operation by producing more than 100,000 vehicles per year (Riemens, 2002: p.107).

3 A proposed model of the impact of reduced tariffs

There are several questions that need some answers in order to subsequently proceed to formal econometric evidence. Has the continuous tariff reduction and overall liberalization of trade made an immediate impact on key variables such as imports, exports, productivity and perhaps internal demand? Or has that reduction introduced some lags as to the reaction time between these variables? For example, it is rather more logical to assume that imports have been initially and more directly or immediately affected, whereas productivity took some time before it manifested itself in various ways, and so on. Another question is for example: if exports follow a general increase in productivity, then what are the factors that determine them? A literature review on these questions has revealed a relative void in pertinent research.[8] Consequently, in this paper some propositions will be made as to what we expect to find in our quantitative analysis.

Proponents of free trade have emphasized that free trade entails greater industrial efficiency, boosts competition, and increases the volume of trade (Jayanthakumaran, 2004; Weiss, 1999). When barriers to international trade have been in force for a long period of time, we are compelled to propose a mechanism according to which free trade restoration entails changes towards greater industrial efficiency, boosted competition and increased trade volume. This mechanism must first clarify the relative delays in the reaction of variables. Consequently we propose the following schema of reactions: imports react first, then productivity, then exports. Internal demand for the product (in our case PMVs) is a consequence of these three factors.

Imports are the fastest reacting variable to the reduction in trade barriers, as lower protection will immediately make it possible to determine how much of the internal demand will be replaced and at the same time increased by the new possibilities of importing existing or new models of cars. The only major direct delay that could be caused by the reduction in tariffs would be the delay of new orders from abroad (foreign exporters of cars to Australia might need a few months before they can satisfy the new demand due to the reduction in tariffs). However, an indirect delay is very important here. It is due to the actual determination of this new demand. Car dealers gather information from customers, experiment with various models and then order considerable (economical) quantities of the models that would be potentially in demand in Australia. This brief analysis suggest that the demand for imports of foreign automobiles this year is a function of tariffs of this year and of tariffs prevalent in the previous one or two years.

If we also add the traditional price and income factors on this demand, we propose the following model:

$$imp_t = f_1(\sum_{i=1}^{n} imp_{t-i}, \sum_{i=0}^{n} tarn_{t-i}, \sum_{i=0}^{n} imppr_{t-i}, \sum_{i=0}^{n} gdp_{t-i}, \sum_{i=0}^{n} excy_{t-i}, \sum_{i=0}^{n} excd_{t-i}) \qquad (1)$$

where *gdp* is a proxy for income and the business cycle, *imppr* is the price of imports before tariffs, and *imp* is the quantity of imported vehicles demanded. The tariff variable (*tarn*) is the nominal tariff rates that should be the most appropriate, although effective tariffs and nominal tariffs for the whole automobile industry cannot be completely excluded (see Table 1 for definition details). Two extra variables which are crucial and are added in our model, the exchange rates of the Australian dollar in relation to the Japanese Yen (*excy*) and in relation to the American dollar (*excd*). For all these variables lags up to *n* previous years are considered *a priori* but it is difficult to specify these lags on theoretical grounds. Hence the empirical work that follows below will determine the precise lag structure as well the significance or not of all these variables. In our model tariff, GDP and exchange rate are exogenous and imports and import prices are endogenous. However, this is also an empirical issue as we will demonstrate later further below.

Imports are expected to substantially increase together with the gradual and continuous reduction in tariffs. Once the local car producers realize that their production risks to be substantially decreased due to foreign competition (more imports), they will have to either eventually close down their operations in Australia or become more efficient to be able to compete more and more against this foreign competition. If they choose to stay in Australia, they must find ways to become more efficient and to consequently increase their productivity. There is evidence in several studies that productivity increases when protection lessens (Kirkpatrick and Maharaj, 1992; Chand, 1999; Bloch and McDonald, 2002; Mahadevan, 2002; Jayanthakumaran, 2004). Furthermore there is evidence that falling protection in Australian car industry improved the performance in terms of productivity and exports (for example, Fleischmann and Prentice, 2001; Dixon and Rimmer, 2004).

In our paper we propose that productivity is expected to rise mainly because of four reasons. First, it is due to a general rationalization process (Riemens, 2002, pp.107-110) in the existing car producers that involve closing down of some car plants, (Deans, 1992; Truett and Truett, 1997: 24-25). Second, it is due to an effort to reduce all costs in order to reduce car prices. Both these two types of productivity gains can be represented or approximated by two proxy variables: imports (*imp*) and production prices (*propr*). A third type of productivity gain is due to a reorganization of existing plants and companies. Sanidas (2004b, 2005 forthcoming) has given ample evidence that a good proxy for this reorganization is the inventories to sales ratio (*inv*), which takes into account important organizational innovations[9] such as the just-in-time cum quality control process. A fourth reason for productivity increases could be the implementation of technical innovations (e.g. a new tool) in the production of cars in Australia. However, these innovations are also implemented in several other countries because the car manufacturers in Australia are giant multinationals that usually have the same policy about technical innovations in all countries they operate. In other words we assume that these multinationals did not wait for reduction in tariffs in order to implement their technical innovations (which are already present in their mother countries). Hence this fourth type of productivity gain is not included in our proposition. Overall we then suggest the following model for explaining productivity gains in the PMV industry in Australia.

$$lapr_t = f_2\left(\sum_{i=1}^{n} lapr_{t-i}, \sum_{i=0}^{n} propr_{t-i}, \sum_{i=0}^{n} inv_{t-i}, \sum_{i=0}^{n} imp_{t-i}\right) \qquad (2)$$

where *lapr* stands for labour productivity. Again the optimum structure of lags in equation (2) will be determined empirically (n is the maximum value of lags). *A priori*, we would expect that lags are important in determining productivity. In our model inventory and import are exogenous and labour productivity and producer prices are endogenous. However, this is also an empirical issue as we will demonstrate later further below.

Improvement in productivity of car manufacturers in Australia will have a positive impact on several other factors. First, prices of Australian produced cars will feel a downward pressure or at least will be competitive with prices of foreign produced cars. Second, the quality of Australian produced cars will be improved and their reputation in the international commercial arena will also be improved. Third, and as a consequence of the first two points, exports of Australian produced cars are expected to rise substantially, especially as the Australian manufacturers are giant multinational companies. In addition, improvements in productivity in Australian car factories will be supplemented by a better use of resources due to decreases in protection. Effectively, the demand for Australian produced cars by foreign countries will depend also directly on the process of liberalization of trade in Australia[10] since lower tariffs in particular on car parts will enhance the competitiveness of these cars. Consequently we suggest the following model for the demand of Australian exports of PMVs.

$$exxp_t = f_3\left(\sum_{i=1}^{n} exxp_{t-i}, \sum_{i=0}^{n} exxppr_{t-i}, \sum_{i=0}^{n} tari_{t-i}, \sum_{i=0}^{n} lapr_{t-i}, \sum_{i=0}^{n} imp_{t-i}\right) \qquad (3)$$

where *tari* is the tariff structure of the industry[11], and *exxppr* is the export prices of Australian made cars. Again the remarks on the number *n* of the structure of lags made for the previous equations are also valid for this equation. In addition, we should add that exports can also depend on two extra factors. First, they would depend on the elasticity of income of importers of Australian cars. However, we can expect this elasticity to be very small as the export market is huge; hence we propose to exclude this factor in equation (3). Second, exports would also depend on the protection measures of the countries that would import Australian cars. The United States of America and New Zealand were the major markets for Australian cars in the 1990s. In the USA, the light cars (saloon cars and station wagons) attracted an import duty of 2.5 per cent during the 1990s (Dieter 2003). Import prices have remained relatively constant from Australia to New Zealand due to duty-free import status under the CER agreement (Motor International 2000, p. 136).[12] Considering the above facts we ignore protection measures of the importing countries in our analysis.

There is a third part of total demand for vehicles in Australia, namely that of internal demand for Australian produced vehicles. We must note from the outset that this internal demand becomes more and more specialized, in that Australians seem to prefer smaller and luxury cars that are imported from overseas (Motor Business International 2000, p.121).[13] Given this background, we think that this type of demand (demand for local production) *dlp* is primarily a function of two broad categories of factors. First, it becomes evident that the higher the imports, the lower this demand becomes as Australians face overall a larger international market with more choice, variety and source of cars imported. For example, more European cars are now imported in Australia.[14] Second, given the choices available from overseas countries, *dlp* will also depend on the improved quality, price and variety of Australian produced cars, hence the following two proxies are proposed to capture this second broad category of factors: production price (*propr*) and organizational improvements (*inv*). Consequently the following model is proposed:

$$dlp_t = f_4\left(\sum_{i=1}^{n} dlp_{t-i}, \sum_{i=0}^{n} propr_{t-i}, \sum_{i=0}^{n} inv_{t-i}, \sum_{i=0}^{n} imp_{t-i}\right) \tag{4}$$

There is a final point we must now discuss. Are equations (1), (2), (3), and (4) simultaneously determined? We cannot say one way or another on *a priori* theoretical grounds. It all depends on the lag structure inherent in these equations. There are two contradictory forces here. First, we expect that the structure of lags in these equations will be such that we will have a step by step determination of these key variables. Hence, imports will set the pace for changes as explained above; then, the productivity of the car industry will gradually improve because of the continuous reduction in protection as explained above. Exports will be the consequence of the first two changes in imports and productivity. Finally, the internal demand for Australian produced vehicles is also dependent on imports. Second, the existence of contemporaneous lags might suggest some sort of simultaneity. Consequently this point will be taken up again in the final section where we discuss and synthesize the relevant issues, and where we introduce the seemingly unrelated regression equations (SURE) model. A final remark will close this section. The signs of the coefficients attached to each variable in each equation will be discussed in the following section.

4 Background for our quantitative evidence

4.1 Data

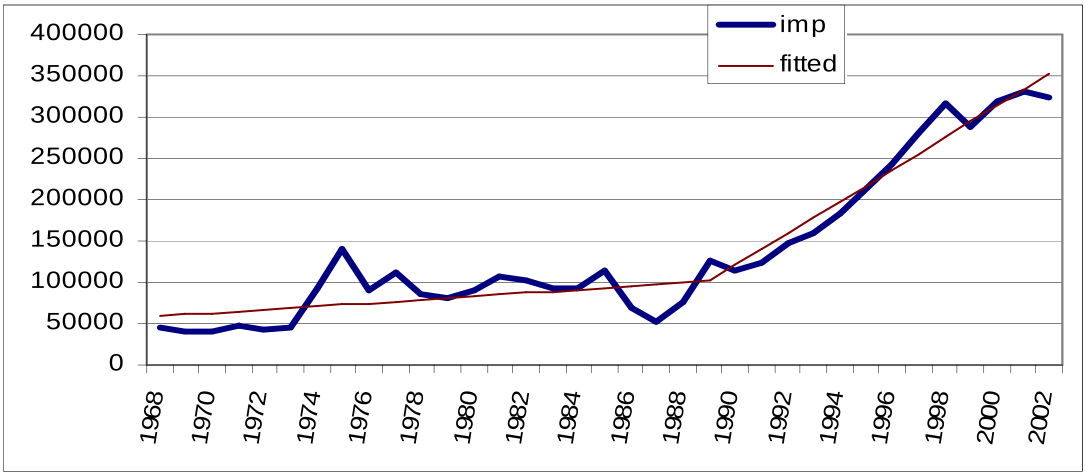
The period used for our econometric results is between 1968 and 2002. We left the year 2003 for forecasting purposes. Data relating to production, sales and number of workers for the PMV industry have been obtained from the Australian Automotive Intelligence, 2002. This series have been crosschecked with Australian Bureau of Statistics (ABS) data and Industry Science Resources (1986 to 2003). Inventories were obtained from ABS on request. The estimates of effective and nominal protection rates and tariff rates are available from the Industry Commission (1995) and Productivity Commission (2002/03). Exports and imports are available from Automotive Key Statistics, ABS (prior to 1984) and the Industry Science Resources (1986 to 2003).[15] Exchange rates, GDP and deflators are available from the Bulletin of the, Reserve Bank of Australia (various issues). ABS is the primary source for most of the secondary sources mentioned above. Note that there is no consistent classification of the sub-sectors of the automobile industry in Australia from 1968 to 2003. To maintain consistency in the relevant series we have estimated the data in a few cases only. For example, for the years 2001 and 2002 and for the series of labour productivity we estimated the employment figures in order to be consistent with the previous years.

4.2 Evidence of structural breaks

The existence of structural breaks is important for two reasons. First, it is in a way the purpose of this paper to provide evidence for this existence. However, econometric time series evidence will not be the main tool but a preliminary result to make the reader more aware of the situation at hand. The following section (5) will extensively provide such evidence indirectly through regression techniques (see next sub-section). Second, the existence of structural breaks makes the decision as to whether the variables are I(1) or I(0) more difficult. This is another reason why the ARDL method is used in this paper. In this sub-section, four time series techniques are used to support our suspicion for the existence of structural breaks. The detailed test results are not reported here for space limitations.

As was mentioned in previous sections, the structural break took place around the end of the 1980s and the beginning of the 1990s and it is associated with tariff reductions on the PMV industry. A simple OLS regression with two variables was used as the fitted line, namely a trend (1, 2, 3, …,35) and a dummy variable that has the value zero from 1968 to 1989 and the values (1,2,3,…) from 1990[16] to 2002. The slopes of the two independent variables are very significant (the results are not shown here). From this regression it becomes more evident that after liberalization imports have been accelerating. The above conclusions are confirmed by the rolling regressions technique (tried with several windows): the slope of the linear trend increases substantially and the intercept diminishes substantially after 1993 to 1995 (depending on the window used, 11 to 15 years; results not shown here). In addition, the CUSUM, CUSUMSQ (the regression used was a simple constant) and Chow tests further confirm the structural break. Figure 2 shows the original data for imports and the fitted line as per text.

Figure 2 Imports and structural break



A similar to imports procedure is followed for labour productivity, exports and the internal demand for Australian produced PMVs (see Figures 3, 4, and 5).

Figure 3 Labour productivity and structural break

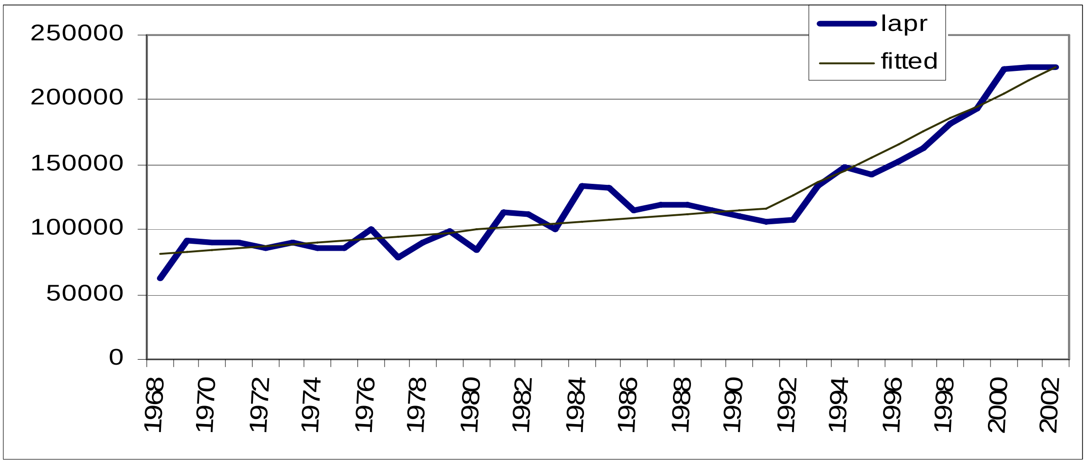


Figure 4 Exports and structural break

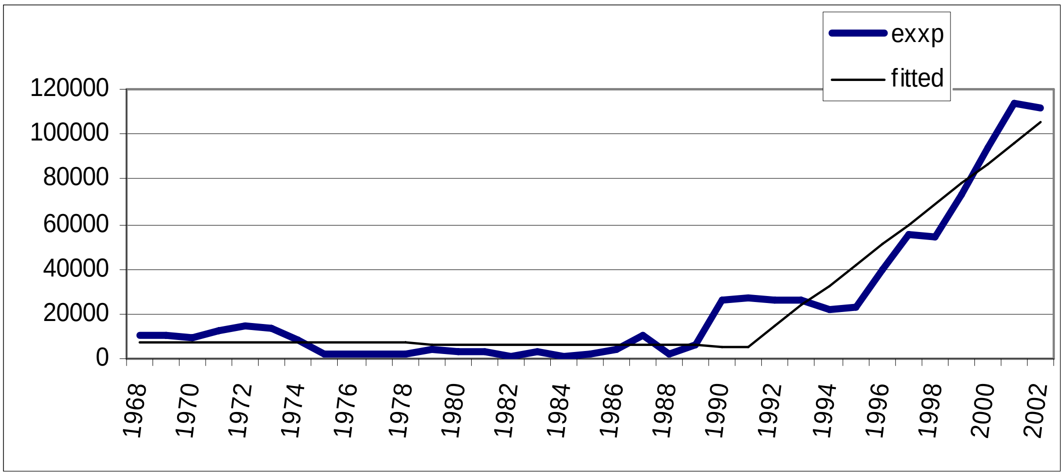
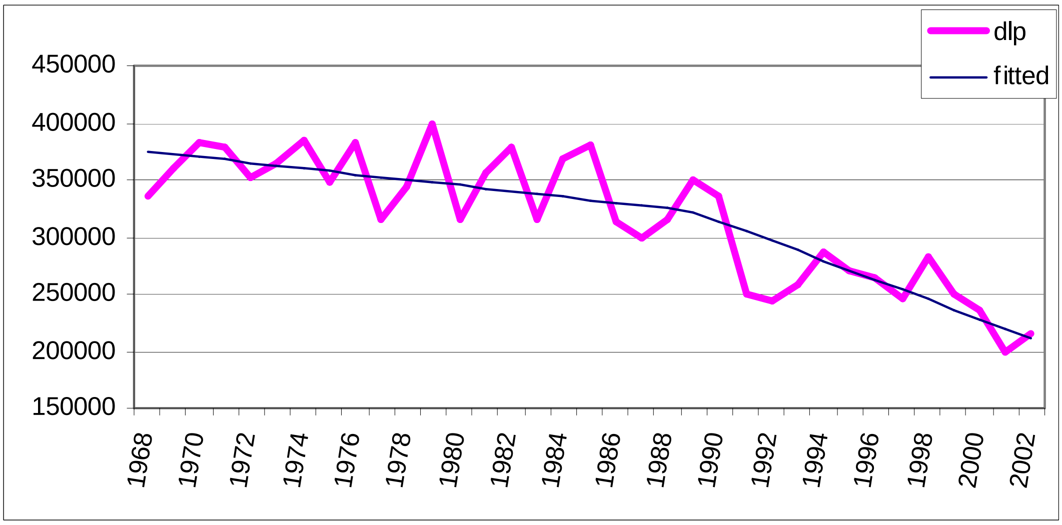


Figure 5 Internal demand for Australian produced cars and structural break



4.3 Evidence of long-run relationships: econometric background

The relatively small sample size of available data is the main constraint which delimits the available techniques to be used to only a couple of them that potentially would provide more valuable results: the ARDL model (see for example, Caporale and Chui, 1999, p. 258; Boyd et al, 2001, p 188;) and the bootstraps technique (a combination of bootstraps on cointegration is provided by Fachin, 2000). In this paper, the latter will not be included due to space limitations. A series of recent publications by Pesaran and Pesaran (1997), Pesaran and Shin

(1999), and Pesaran et al (2001) have formally introduced the ARDL model of cointegration and its two stage procedure for determining long term equilibrium relationships. Several other publications applied this procedure to specific problems: (Narayan and Narayan, 2004; Anari and Kolari, 2002; Vita and Abbott, 2004; Bahmani-Oskooee and Kara, 2003).

There are four main advantages of the two stage procedure of ARDL estimation: first, there is no need to determine whether or not the examined variables are integrated of order 1, I (1), or zero, I(0) in order to establish a cointegrating vector for them (Pesaran et al, 2001). This element is very important in our case because we suspect there is a structural break in each PMV related series, hence it makes it more difficult to establish the exact integration order. Second, with the bounds testing process of cointegration, it becomes more statistically significant to cointegrate small sample I(0) or I(1) variables (see Ghatak and Siddiki, 2001, who used N=30 observations; Payne, 2003, p. 1724; Fatai et al, 2003, who used N=40 and found that forecasting performance of the ARDL model was the best). Third, it becomes possible to be more flexible in terms of the structure of lags of the lagged variables in the determination of the ARDL model (Pesaran et al., 2001). Fourth, it becomes possible to check which variable is the dependent one and which variables are the independent ones or the 'long-run forcing' variables (Pesaran and Pesaran, 1997, p. 306).

In order to complement or supplement the ARDL model estimation, two more econometric techniques will be used: Johansen's cointegration method and the always readily available OLS method. The first is notorious for its asymptotic or large sample affinities, although small sample corrections have been suggested (see Ahlgren and Antell, 2002; Fatai et al, 2003; Richards, 1995) and the second is known for its risks of 'spurious' results when level variables are analysed. However, these two techniques will be briefly used in order to check the results overall (a similar lie of thinking is found in Fatai et al, 2003, p. 83). In addition the importance of *a priori* economic reasoning to lessen the small sample uncertainties has been stressed by other researchers (Richards, 1995, p. 652; Greenslade et al, 2002). Consequently, in our paper we also provide ample background of this *a priori* economic reasoning mainly in the first three sections. As it will be further emphasized below the results of all three techniques are in some ways similar which is encouraging for the validity argument. It must also be stressed that the purpose of this paper is not to determine accurate coefficients (this might be too demanding given the small samples) but to get some overall statistically significant results that confirm the proposed model of section 3 and the authors' expectations.

It is now important to briefly describe some of the main points of the ARDL bounds test model. More details about it can be found in Pesaran et al (2001), Pesaran and Pesaran, (1997), Heij *et al*, (2004) and Patterson, (2000)[17]. The difference model associated with an ARDL (p, q_1, q_2, q_3) model can be expressed as in the following equation[18]:

$$\begin{aligned}\Delta y_t &= \alpha + \sum_{i=1}^{p}\beta_i \Delta y_{t-i} + \sum_{i=0}^{q_1}\gamma_i \Delta x_{t-i} + \sum_{i=0}^{q_2}\delta_i \Delta z_{t-i} + \sum_{i=0}^{q_3}\varepsilon_i \Delta w_{t-i} + \sum_{j=1}^{2}\lambda_j (\Delta g_j) \\ &+ \sum_{j=1}^{2}\eta_j (g_j)_{t-1} + \eta_3 x_{t-1} + \eta_4 z_{t-1} + \eta_5 w_{t-1} + \eta_6 y_{t-1} + u_t\end{aligned} \tag{5}$$

where y, x, z, and w are endogenous variables, g_i are exogenous or deterministic variables (for example a variable with a fixed lag, or a trend), the Greek small letters indicating coefficients, p and the $q_i\,(i=1,2,3)$ are the optimum lags, and u is the usual error term $(u_t[o,\sigma^2])$. The optimum lags are determined by estimating $(4+1)^{3+1}$= 625 different ARDL models, if the maximum lag for p or $q_i\,(i=1,2,3)$ in the estimation procedure is 4 and given that in this example the endogenous variables are 3+1=4. The usual Akaike AIC) or Schwartz (SBC) information criteria for selecting the optimum distribution of lags p and $q_i\,(i=1,2,3)$ are used here. The part of equation (5) that has $\eta_j\,(i=1,2,....6)$ as coefficients[19] is the error correction equation, and these coefficients constitute the cointegrating vector or long term or equilibrium vector for all the variables (exogenous and endogenous).

There are at least two ways to estimate the cointegrating vector (coefficients η_j). The first one is based on the just described ARDL associated EC model. More precisely, in a first stage equation (5) without the EC part is estimated. Then the EC part is added on the already estimated part of (5) and an F test is conducted to check the null hypothesis that all coefficients η_j are jointly equal to zero. If the calculated F statistic is higher than the critical value of the upper bound computed in Pesaran and Pesaran (1997, p. 478) or in Pesaran et al (2001) then the null hypothesis of no long-run relationship is rejected, that is some of the coefficients η_j or all of them are not equal to zero. The higher bound just mentioned corresponds to the case of the endogenous variables being I(1), whereas the lower bound is the case of the endogenous variables being I(0). If the calculated F statistic is lower than the lower bound then we have no cointegrating vector, and if the F statistic is between the critical lower and higher bounds then the answer is not clear as to the existence of a long-run relationship (in this case, the exact integration order is needed to be known).

The second way to calculate the coefficients of the cointegrating vector is Johansen's method which is a system approach (instead of a single equation approach as the ARDL model is) and which uses the maximum likelihood technique to the underlying VAR model. The optimum lag (the same for all variables[20]) is determined according to the usual Akaike or Schwartz criteria. In addition, in Johansen's method it is important to know the degree of integration of all variables involved, whether they are I(0), or I(1), and so on. A joint issue with the degree of integration is whether or not there are structural breaks in the series since the existence of these breaks will influence the ADF tests for the order of integration[21]. Also, it is usually mentioned in the literature (see Maddala and In-Moo Kim, 1998) that Johansen's method is applicable when the sample size is very large. Finally, it is possible to have more than 1 cointegrating vectors (and hence more than one ECMs) since this method is a system of VAR equations.

It is now necessary to stress an important point. The small sample we have in our disposition to carry out the quantitative results should make us cautious as to which extent we are ready to quickly dismiss some of these results if the appropriate tests suggest so. In other words we should try to minimize the risk of rejecting hypotheses which are in reality true. To be more technical, due to the small sample restriction the type I error would have the tendency to be high in our research. If we want to minimize this error we risk increasing the type II error (the probability of accepting the false hypothesis). To resolve this problem in a reasonable way we have put more emphasis on our *a priori* economic expectations without neglecting a rigorous econometric procedure. We also put more emphasis on the comparative results of the three econometric methods used here. We will at times refer to this point as the ‘error compromise’ point henceforth, during the discussion of our econometric results.

5 Determination of long-run relationships: econometric results

5.1 Imports

We turn now to the existence and the determination of a long-run relationship between the involved variables. As a pilot preliminary estimation the multiple OLS regression is used based on the proposed equation 1 of section 3 and is recorded in Table 4 (column 1). In this model all the coefficients have the right sign and are very significant (except the constant). The diagnostic tests are good as well[22]. Also in Table 4(column 2) the same equation estimated in terms of natural logs is shown for comparison if we accept the hypothesis of constant elasticities. We do not think such elasticities are prevailing in reality mainly because of the presence of a structural break. However, the readers might want to appreciate the results of this alternative in their own way; hence we include them in here. For example, constant elasticities could be equivalent to some average elasticities over the whole period examined.

The OLS results are encouraging to pursue the research with the ARDL model. For this purpose and following Pesaran *et al* (2001), we must from the outset determine the optimum lag structure for the bounds test and at the same time make sure that we do not face the problem of serial correlation of residuals in the conditional ECM. (ibid, p. 311). An OLS was run on this ECM, see equation 6, and the appropriate tests were conducted as Table 2 shows.

$$\Delta imp_t = \alpha + \sum_{i=1}^{1} \beta_i \Delta imp_{t-i} + \sum_{i=0}^{1} \gamma_i \Delta imppr_{t-i} + \lambda_1 \Delta tarn_{t-1} + \lambda_2 \Delta gdp_t + \eta_1 imp_{t-1} + \eta_2 imppr_{t-1} + \eta_3 tarn_{t-1} + \eta_4 gdp_{t-1} + u_t \quad (6)$$

Table 2 Test statistics for selecting the lag order of the imports equation

p	AIC	SBC	$\chi^2(1)$	$\chi^2(2)$	$\chi^2(3)$	$\chi^2(4)$	$\chi^2(5)$
1	-376	-383	2.3 (0.13)	7.0 (0.03)*	7.1 (0.07)	7.5 (0.11)	8.9 (0.11)
2	-362	-371	2.2 (0.14)	2.3 (0.32)	2.7 (0.43)	4.7 (0.32)	9.5 (0.09)
3	-352	-362	0.16 (0.69)	0.58 (0.75)	1.8 (0.61)	6.2 (0.18)	10.8 (0.055)
4	-342	-354	0.06 (0.80)	4.0 (0.13)	4.3 (0.23)	19.3 (0.00)*	19.4 (0.00)*
5	-332	-345	0.30 (0.58)	3.1 (0.21)	4.1 (0.25)	11.3 (0.024)*	11.3 (0.045)*

Notes: The LM test is calculated for up to order 5 years. * means significance, at a level less than 5%.

Some comments are necessary for the results of Table 2. First, the more we increase the value of ‘p’ (the order of lags in equation 6) the fewer the degrees of freedom available in the OLS equation, given the small sample, and hence perhaps the more unreliable the results are (due to multicollinearities, and so on). Perhaps this is the reason for the continuous increase in the values of the AIC and SBC criteria (the more variables we add to the OLS equation, the higher the equation log-likelihood becomes on which these criteria are based on, given the sharp decrease in the degrees of freedom). Second, serial correlation of residuals seems to be absent for p equal to 2 and 3, but not for p equal 1, 4, and 5. Of course, the higher the p becomes the more unreliable the results are and hence serial correlation for p equal to 4 and 5 is doubtful but not for p equal to 1. For this uncertainty, the bounds test is calculated for three values of p that is for 2, 3, and 4 and the F-statistic are 6.06, 5.94, and 4.36 respectively, all of them confirming the existence of a long-run relationship between all the variables involved (at the 5% and with 3 regressors[23]). A consequence of this almost universal significance of this relationship is that we are able to compute several ARDL models with various lag structures. The following Table 3 shows the results. It is hard to choose the right model, as they are all significant but probably the best is the one that conforms more to our economic reasoning, which would suggest a conservative lag structure (importers are influenced by factors that affect them in the last two years or so). Also given our small sample, we should opt for a model that has the shortest lag structure. From Table 3, we can also see that the lower the lag structure of the two endogenous variables *imp* and *imppr* the higher the impact of the tariff variable, the lower the impact of the import prices variable, and the slower the speed of adjustment as shown by the coefficient of the ECM. This result again suggests that we should opt for a lower lag structure mainly because we expect a high tariff impact (given the presence of a structural break). Now that we have determined the maximum lag (two years), we will carry out the remaining of the analysis regarding the determination of ARDL models and the bounds testing.

Table 3 Long term coefficients of the imports equation as per ARDL models

	ARDL (2, 4)	ARDL (3, 1)	ARDL (0,1)
Criterion	Akaike	Akaike	Schwarz
Maximum lag	5	3	5
Imppr	-22.1 (-11.5)	-17.6 (-6.3)	-14.0 (-5.2)
tarn(-2)	-1331.4 (-4.8)	-1928.9 (-4.4)	-1870.8 (-3.9)
gdp	3.5 (18.6)	3.3 (11.3)	2.95 (9.3)
Const	55047 (2.8)	68492 (2.2)	62709.6 (1.8)
ecm (-1)	-1.8 (-5.4)	-0.939 (-5.5)	-1 (none)

Notes: The ecm(-1) speed of adjustment is greater than one for the ARDL(2,4) model, which is not a desirable result.

First, a pilot search indicated once more that the exchange rate variables are not significant variables to include in the final model (as the OLS has already indicated). Second, the ARDL model that has imports as dependent variable, imports and price of imports as endogenous variables, and nominal tariff lagged one year and GDP as exogenous variables was subjected to the criteria for finding the optimum lag structure (the results are shown in column 3 of Table 4). Both the Schwarz[24] and Akaike criteria provided the optimum (1, 0) lag structure for imports and import prices (a maximum lag of two was the initial input into the algorithm). Third, the following model was estimated as seen in equation 7.

$$\Delta imp_t = \Delta imp_{t-1} + \sum_{i=0}^{1} \Delta imppr_{t-i} + \Delta tarn_{t-1} + \Delta gdp_t + const \qquad (7)$$

The F statistic was then calculated with the inclusion of the one year lagged variables. This F statistic (shown in column 4 of Table 4) is greater than the upper bound provided by Pesaran and Pesaran (1997) and Pesaran et al (2001): 4.94 > 4.38 (at 5% and 3 regressors). Hence a long-term relationship exists between the variables of the ARDL model[25] (irrespectively of whether or not these variables are I(0) or I(1)).

Fourth, the long-run coefficients (the cointegrating vector) of this long term relationship are estimated according to the proposed ARDL model and its ECM representation is also estimated in a fifth stage (shown in column 4 of Table 4). A similar procedure is followed for the variables in terms of logs, and the results are shown in Table 4, columns 2, 5, and 6. Sixth, the Johansen procedure is applied to the established relationship suggested by all the stages so far, initially by verifying that the variables involved are I(1). An ADF test was conducted which showed that all these variables are effectively integrated of order one[26]. Seventh a VAR(1) model is chosen according to the tests suggested by Johansen's method and also according to the expected signs and approximate magnitudes of the coefficients of the cointegrating vector as per results of the previous two methods. Eighth, the small sample adjustment is also mentioned so that an idea as to how significant Johansen's cointegrating vector is for our small sample. This adjustment or correction of Johansen's statistics of maximum eigenvalue and trace are based on a formula (see Table 4) as applied for example by Richards (1995) and Fatai *et al* (2003). According to this correction, Johansen's method confirms our OLS and ARDL results.

Ninth, it is expected that the bounds test be applied to the other (endogenous) variables of the main equation for imports (see Pesaran and Pesaran, 1997). However this is not necessarily a desirable and automatic application as it depends on whether the other endogenous variables depend on the same variables as the main variable does. So this point will be dealt with each time separately according to the situation. For imports as the main dependent variable the bounds test supports the existence of a long-run relationship as seen in Table 4; the imports equation is: $imp = f(imppr, tarn, gdp)$. Do we expect for the other endogenous variable import prices, that the equation having the latter as dependent variable will also constitute a long-run relationship: $imppr = f(imp, tarn, gdp)$? On *a priori* grounds does GDP constitute a long-run forcing variable that explains import prices? In some ways, the answer is yes: the higher the income in Australia the higher the pressure on import prices to go higher. Also, the lower the nominal tariffs become the higher the import prices (*ceteris paribus*) because of the possibility of higher profits. Finally, the higher the imports the lower the import prices according to the law of demand. If this is not convincing, let us see what the bounds test has decided. The following equation (equation 8) in first differences was first estimated via OLS:

$$\Delta imppr_t = \Delta imppr_{t-1} + \sum_{i=0}^{1} \Delta imp_{t-i} + \sum_{i=0}^{1} \Delta tarn_{t-i} + \sum_{i=0}^{1} \Delta gdp_{t-i} + const \qquad (8)$$

Then through the addition of all involved variables lagged one year we have the F-statistic equal to 8.54 which[27] is much larger than the upper bound of 4.38 (with three regressors and at 5%). Hence we should be now more convinced[28] that there is a long-run relationship between all variables involved as follows (t-statistics are shown below the coefficient):

$$\underset{(-7.9)}{imppr_t} = \underset{(-2.1)}{-0.042} * imp_t - \underset{(14.2)}{43.07} * tarn_{t-2} + \underset{(1.2)}{0.159} * gdp_t + 1411.8 \qquad (9)$$

Table 4 **The quantitative results for imports**

	OLS **Levels** (1)	OLS logs (2)	ARDL (1, 0) **levels** (3)	Long-run η_j **levels** (4)	ARDL (0, 1) logs (5)	Long-run η_j logs (6)	Joh/en's Coin/on VAR(1) **Levels** (7)	Joh/en's Coin/on VAR(1) logs (8)
Dependent v.	imp	imp	imp	imp	imp	imp	imp	imp
imp(-1)			0.37 (2.7)					
imppr	-12.3 (-5.4)	-1.04 (-4.8)	-8.10 (-2.7)	-12.95 (-3.4)	-0.78 (-3.4)	-1.31 (-5.6)	-16.4 (-4.1)	-1.54 (-6.22)
imppr(-1)					-0.53 (-2.2)			
tarn (-1)			-1206.3 (-2.7)	-1927.9 (2.7)			-1682.8 (-2.7)	
tarn(-2)	-1941.6 (-4.8)	-0.36 (-2.6)			-0.29 (-2.2)	-0.295 (-2.2)		-0.23 (-1.86)
gdp	2.87 (11.5)	2.22 (8.9)	1.83 (3.6)	2.93 (6.6)	2.46 (9.6)	2.46 (9.6)	3.3 (7.73)	2.62 (10.4)
const	56886.1 (1.9)	-2.996 (-1.3)	37977.3 (1.2)	60692.5 (1.1)	-3.46 (-1.61)	-3.46 (-1.6)	57018.1 (1.3)	-3.3 (-1.61)
R^2	0.96	0.91	0.96		0.92		0.31	0.25
Serial correlation	0.49	0.93	0.10		0.48		0.51	0.12
Functional form	0.17	0.005	0.47		0.004		0.054	0.49
Normality	0.07	0.95	0.70		0.92		0.71	0.57
Heterosc/icity	0.997	0.076	0.84		0.103		0.92	0.67
ecm (-1)				-0.626 (-4.5)		-1.0 (none)	-0.572 (-4.5)	-0.578 (-3.7)
F-stat (bounds testing)				4.94 > 4.38		4.08 < 4.38		
Johansen's max eig/value							25.0>21.9 25.0>19.7	31.1>21.9 31.1>19.7
Small sample correction							22.1>21.9 22.1>19.7	27.4>21.9 27.4>19.7
Johansen's trace statistic							33.9>30.5 33.9>27.6	38.3>30.5 38.3>27.6
Small sample correction							29.9<30.5 29.9>27.6	33.8>30.5 33.8>27.6

Notes: (a) The F-statistic for bounds testing is included in column for the long-run coefficients η_j, although it was calculated within a different context as described in this sub-subsection.
(b) The t-statistics are indicated under the coefficients.
(c) The coefficients η_j correspond to the long-run coefficients of equation 5 in section 4.3, and are relevant to the ARDL model in the Table.
(d) For Johansen's cointegrating vector (restricted intercepts and no trends) the exogenous variables are *tarn* and *gdp*. The diagnostic tests are related to the underlying ECM.
(e) For Johansen's cointegrating vector (restricted intercepts and no trends) the maximum eigenvalue and the trace statistics are compared with the critical values at the 5% and 10% levels. The small sample corrections are calculated by multiplying Johansen's statistics with the ratio (N-vp)/N, where N is the number of observations (34 in this case), v is the number of variables in the VAR system (4 in this case), and p is the order of the VAR system (1 in this case).
(f) The diagnostic tests show that we have overall good models.

Some extra comments are now due for the results obtained in the way just described. First, for the additive model, the coefficients of the long-run relationship between the involved variables according to the ARDL method are similar to those obtained by the OLS estimation. The demand for imports (*imp*) significantly depends on import prices (*imppr*) and local income (*gdp*) as expected but also on lagged (one to two years) nominal tariffs (as described in Table 1). Thus the lower the tariffs the higher the imports, the average elasticity as per the multiplicative model being about -30%, a result quite reasonable. Second, a significant long-run relationship when variables are expressed in log terms is also established (with the diagnostic test for the correct functional form indicating that probably the multiplicative model is not the right one). Third, Johansen's cointegrating vector and the corresponding ECM yield satisfactory results and they are reconfirming the results of the previous two models (OLS and ARDL). Overall, the expected behaviour of imports in the context of reduced tariffs is well represented by all the undertaken quantitative analysis. In particular the variable of tariffs (in this case especially the nominal tariffs) is a key variable in explaining the changes that took place in the 1990s and beyond.

5.2 Labour productivity

Regarding the existence of a long-run relationship between labour productivity (*lapr*) and the other variables as suggested in section 3, the results are again very encouraging (see Table 5). *Lapr* is responding to the factor of imports with a lag of two years (definitely significant in all models considered) and to the proxy of organizational innovations (*inv*) also with lags up to two years. This justifies our theoretical expectations that the Australian vehicle industry reacted to the increased international competition to become more efficient and competitive. This reaction is not instantaneous but is propelled by what happens to imports and reorganization of factories first (hence the appearance of lags).[29] *Lapr* is also related in the long-run with production prices in an inverse way (see the negative sign of *propr*).

In the same way as for the imports variable we must first determine the lag order of the conditional ECM and the likelihood of serial correlation of its residuals. With *lapr, propr* and *inv* as endogenous variables, the AIC and SBC increased with the lag order p increasing from 1 to 5, thus again making the decision difficult as the choice of lag order on pure statistical criteria (we believe that is due again to the small sample and the limiting degrees of freedom with conditional ECMs that have three endogenous variables and an increasing number of lags). However, the more important issue of checking for the presence of residuals serial correlation forced us to run many more regressions to elucidate the case. When *lapr, propr* and *inv* are the endogenous variables we found that only the conditional ECM with lag one (hence up to two years lags are possible in terms of levels) have no serial correlation (up to order 4 years). When *lapr, imp* and *inv* are the endogenous variables we found that again only with lag of one there is no serial correlation (up to order 4 again). In order to clarify this 'peculiar' behaviour (that is only with p equal to one in the conditional ECM) we do not get serial correlation, we added another exogenous variable, namely GDP, to take into account the business cycle but once more only the p equal 1 case seems to strongly suggest no serial correlation.

Given the above analysis, the F-statistic of the bounds test as calculated by the addition of all variables involved lagged one year on the equation 10 below is high enough (3.99>3.8 at 10% with 3 regressors) to confirm the dependent variable *lapr* as being driven by *propr*, *inv*, and *imp* in the long run (out of which *imp* is the exogenous variable).

$$\Delta lapr_t = \Delta lapr_{t-1} + \sum_{i=0}^{1} \Delta propr_{t-i} + \sum_{i=0}^{1} \Delta inv_{t-i} + \Delta imp_{t-1} + const \tag{10}$$

Furthermore, equation 10 assumes that we have three endogenous variables (*lapr*, *propr*, and *inv*). If we assume that only *lapr* and *propr* are endogenous[30], then equation 10 was re-estimated as in equation 11 and in this case the calculated F-statistic became 6.0>4.38 (at 5% and 3 regressors).

$$\Delta lapr_t = \Delta lapr_{t-1} + \sum_{i=0}^{1} \Delta propr_{t-i} + \Delta inv_{t-1} + \Delta imp_{t-1} + const \tag{11}$$

This foregoing debate about the application of the bounds test shows us that in applied econometrics, flexibility of experimentation within the plausible limits of sound economics is a useful tool in order to eliminate types one and two errors: discard results as insignificant while they are significant and *vice-versa* according to the error compromise mentioned earlier. Also there is an interaction between the checking of serial correlation, lag order and the interplay between endogenous and exogenous variables. This checking might help us to decide about which variables should be exogenous and so on.

Although all models in Table 5 seem to provide significant and meaningful results, the coefficients are not similar and hence it is not easy to decide as to which one the cointegrating vector exactly is. However, this is not a problem as we have presented models with significant differences in lag structures, endogeneity of variables and so on. In addition we should note that again the multiplicative model does not seem to generate as good results as the additive model (for example the bounds test for the long-run relationship is negative, and the small sample correction suggests that Johansen's cointegrating vector does not exist).

It remains to see whether more long-run relationships exist. When the other two endogenous variables *propr* and *inv* are tested for such relationships between the same variables involved, it was not possible to find an F-statistic high enough to confirm their existence. This is not surprising since both these dependent variables depend on other variables not considered in this paper. For example the inventories to sales ratio depends on management strategic decisions, diffusion of new concepts in society and so on. To properly establish long-run relationships with these two dependent variables is of course out of the scope of this study.

Table 5 The quantitative results for labour productivity

	OLS levels	OLS logs	ARDL (1,1,2) levels	Long-run η_j levels	ARDL (1, 0, 2) logs	Long-run η_j logs	Joh/en's Coin/on VAR(2) levels	Joh/en's Coin/on VAR(1) logs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent var	lapr`	lapr	lapr	lapr	lapr	lapr	lapr	lapr
lapr(-1)	0.536 (5.1)	0.644 (6.0)	0.626 (5.7)		0.64 (5.3)			
propr	-2.49 (-4.0)	-0.487 (-3.9)	-3.86 (-5.3)	-4.3 (-2.1)	-0.56 (-3.8)	-1.55 (-2.4)	-3.97 (-2.1)	-2.43 (-1.4)
propr(-1)			2.26 (2.9)					
inv			-0.006 (-0.056)	-0.90 (-3.4)	0.059 (0.34)	-1.9 (-3.4)		
inv (-1)			-0.107 (-0.97)		-0.26 (-1.4)			
inv(-2)	-0.432 (-5.0)	-0.604 (-4.7)	-0.223 (-2.2)		-0.486 (-3.1)		-0.876 (-3.9)	-2.54 (-2.0)
imp(-2)	0.241 (5.3)	0.17 (4.0)	0.195 (4.0)	0.52 (7.2)	0.178 (4.0)	0.19 (4.0)	0.485 (8.6)	0.49 (2.4)
const	145993 (5.8)	14.2 (5.3)	108871 (3.0)	291207 (3.9)	15.9 (4.2)	44 (3.8)	-282343 (4.3)	60.4 (2.0)
R^2	0.96	0.94	0.98		0.94		0.39	-0.029
Serial correlation	0.87	0.75	0.93		0.52		0.56	0.14
Functional form	0.31	0.20	0.78		0.12		0.39	0.81
Normality	0.34	0.04	0.81		0.04		0.56	0.97
Heterosc/icity	0.49	0.46	0.75		0.71		0.996	0.01
ecm (-1)				-0.37 (-3.4)		-0.36 (-3.0)	-0.41 (-3.9)	-0.087 (-1.4)
F-stat (bounds testing)				6.0 > 4.38		3.61 < 4.38		
Johansen's max eig/value							31.4>25.5 31.4>23.0	27.7>25.5 27.7>23.0
Small sample correction							23.8<25.5 23.8>23.0	21.0<25.5 21.0>23.0
Johansen's trace statistic							44.2>42.4 44.2>39.1	50.7>42.4 50.7>39.1
Small sample correction							33.5<42.4 33.5<39.1	38.4<42.4 38.4<39.1

Notes: (a) See also notes (a) to (f) of Table 4.

5.3 Exports

The establishment of an explanation of the series of exports involves more variables than the other key dependent variables examined so far. Despite the reduction in degrees of freedom, the results are satisfactory (the additive model performs much better than the multiplicative model). Demand for exports is significantly dependent on export prices but most importantly is dependent on all the other three variables that represent increases in efficiency and productivity, namely lagged one year tariffs for the industry (*tari*), labour productivity (*lapr*), and lagged one year imports (*imp*). In addition, exports of Australian produced vehicles also significantly depend on the exchange rate (*excd*) of the Australian dollar in terms of the American dollar (for most of the period of the 1990s this exchange rate has been depreciating). From the econometric point of view, once more the ARDL estimation of a long run relationship between all the variables involved seems to support the OLS results (for the additive model only).

However, the testing procedure proved to be more difficult this time mainly due to a sharp decrease in the degrees of freedom when we apply lags longer than order two. Thus, a conditional ECM (according to equation 3) that had either the variables *exxp, lapr, imp,* and *exxppr* as endogenous variables, or *exxp, lapr,* and *exxppr* as endogenous, or only *exxp* and *lapr* as endogenous, and lags up to order two indicated the presence of serial correlation (see the imports subsection for more details about the procedure). This in a way is an expected result because we could have omitted some important variables related to the economies of the importing of Australian cars countries such as their respective GDPs, or other income approximating variables. However, given our small sample it would be catastrophic to include extra variables. Consequently, according to our error compromise proposition, we will follow the overall procedure despite the presence of serial correlation at this stage[31]. In addition, we also have the results of OLS and Jorgensen's cointegration that effectively support our ARDL results[32]. Furthermore as it will be seen in the last section, the SURE model will overall confirm these outcomes.

We must also see the possibilities of long-run relationships when the other two endogenous variables of the *exxp* equation 3 are considered as dependent variables. First the following equation was used to calculate the F-statistic for the bounds test when exports is the dependent variable:

$$\Delta exxp_t = \Delta exxp_{t-1} + \sum_{i=0}^{1} \Delta exxppr_{t-i} + \sum_{i=0}^{1} \Delta lapr_{t-i} + \Delta tari_t + \Delta imp_t + \Delta excd_t + const \tag{12}$$

The F-statistic is 5.17 which is greater than the critical value of 3.81 (at 5% for 5 regressors). The same equation was then used with export prices (*exxppr*) as the dependent variable; the calculated F-statistic is 2.3 which is lower than the critical value and hence there is no long-run relationship between the variables involved when *exxppr* is the dependent variable. On *a priori* economic reasoning *exxppr* needs much more to be explained than this equation offers. When the variable labour productivity (*lapr*) is used as the dependent variable in the above equation the calculated F-statistic (4.86) is higher than its critical value thus indicating the existence of a long-run relationship also in this case. However, on *a priori* economic reasoning this relationship cannot hold in reality: how can *lapr* depend on exchange rate, or export prices? In addition the sign of the tariff variable is wrong in the underlying long-run relationship (confirmed by ARDL models). Hence overall we can safely exclude the significance of such relationship even though the F-statistic indicates the contrary. Once more we stress that we believe that economic reasoning must be able to support statistical and econometric results.

Table 6 The quantitative results for exports

	OLS levels	OLS logs	ARDL (1,0,0) levels	Long-run η_j levels	ARDL (0, 0, 0) logs	Long-run η_j logs	Joh/en's Coin/on VAR(1) levels	Joh/en's Coin/on VAR(1) logs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent var	exxp	exxp	exxp	exxp	exxp	exxp	exxp	exxp
exxp(-1)	0.51 (4.5)	0.29 (1.5)	0.502 (4.3)		-0.39 (-0.54)	-0.39 (-0.54)		
exppr	-2.2 (-3.8)	-0.63 (-0.9)	-2.3 (-3.8)	-4.59 (-4.1)			-4.45 (-5.8)	2.07 (0.7)
exppr(-1)								
tari(-1)	-185.1 (-3.9)	-1.34 (-3.1)	-192.5 (-3.9)	-386.4 (-5.5)	-1.9 (-9.0)	-1.9 (-9.0)	-316.0 (-8.9)	-1.64 (-4.5)
lapr	0.183 (2.1)	-0.72 (-0.8)	0.189 (2.2)	0.38 (2.7)	-0.27 (-0.31)	-0.27 (-0.31)	0.48 (3.7)	6.6 (1.2)
lapr(-1)								
lapr(-2)								
imp(-1)	0.071 (2.3)	-0.05 (-0.2)	0.068 (2.2)	0.137 (2.1)	-0.26 (-0.83)	-0.26 (-0.83)	0.12 (2.0)	-2.1 (-1.1)
excd	-20916 (-2.7)	-2.44 (-3.2)	-21564 (-2.8)	-43273 (-2.6)	-2.49 (-3.2)	-2.49 (-3.2)	-28598 (-2.3)	2.94 (0.6)
const	41655 (2.5)	26.5 (2.4)	43837 (2.5)	87967 (2.4)	26.4 (2.3)	26.4 (2.3)	56158 (1.97)	-57.6 (-0.8))
R^2	0.978	0.89	0.978		0.876	0.876	0.48	0.016
Serial correlation	0.65	0.81	0.61		0.12		0.55	0.56
Functional form	0.12	0.008	0.12		0.003		0.033	0.10
Normality	0.81	0.04	0.77		0.13		0.78	0.15
Heterosc/icity	0.02	0.96	0.02		0.49		0.015	0.23
ecm (-1)				-0.50 (-4.3)		-1.0 (none)	-0.64 (-6.3)	-0.10 (-0.97)
F-stat (bounds testing) (5%)				5.17 > 3.81		1.69 < 3.81		
Johansen's max eig/value							43.3>316 43.3>28.8	27.9<31.6 27.9<28.8
Small sample correction							35.7>316 35.7>28.8	
Johansen's trace statistic							80.0>56.3 80.0>52.7	55.0<56.3 55.0>52.7
Small sample correction							65.9>56.3 65.9>52.7	45.3<52.7

Notes:

(a) See also (a) to (f) of Table 4.

(b) Also models with *lapr* and/or with *lapr(-2)* were found satisfactory.

(b) Instead of *exppr*, *propr* was used successfully

5.4 Internal demand for Australian produced vehicles (dlp)

The econometric results for the explanation of *dlp* (defined as total local production minus exports) and establishment of its long-run relationships are shown in Table 7. We will start with the additive levels model. The pilot OLS regressions (column 1 in Table 7) confirm our expectations that lagged imports (up to two years) have a significant negative impact on demand for Australian produced cars, whereas the price of local production *propr* and the proxy for organizational improvement *inv* have a significant positive impact on this demand as expected. Before the ARDL method is applied to the data we carried out the usual procedure for serial correlation with the lag order p equal up to 5 and the LM tests up to 5 lags. Once more like for the imports and the other variables the AIC and SBC criteria kept increasing with p, thus making the choice of the optimum model difficult from this point of view. The LM tests almost consistently showed that there is no concern for serial correlation (except when p equals 1 and lag order equals 4, and when p equals 4 or 5 and the lag order is 5 for the LM test). The overall conclusion out of this procedure is that we should estimate ARDL models with a maximum lag order up to 5, and see what the results are (the bounds test would follow in this case). When imports with a lag of 2 years was used as the exogenous variable, consistently both the AIC and the SBC suggested the (0, 0) optimum lag structure (0 for *dlp* and 0 for *propr*) with the maximum lag equal to 1, 2, 3, or 4. When imports with a lag of 1 year was used as the exogenous variable the SBC suggested consistently the (0, 0) lag structure again and the AIC suggested the (1, 0) lag structure for the cases when the maximum lag was 1, 2, or 3, but suggested the lag structure of (0, 0) in the remaining case. We therefore concluded that very probably we should go ahead with the structure (1, 0) suggested by the AIC if the bounds test suggests so as the next paragraph will tell us.

The ARDL approach to cointegration (column 3 in Table 7) confirms the pilot regression and it suggests that a lagged demand is also important. The cointegrating vector (column 4 in Table 7) has coefficients that are similar to the OLS regression. The F-statistic of the bounds test (in column 4 in Table 7) is high and confirms the existence of a long-run relationship between the variables involved. This F-statistic is 4.91 (greater than the critical value of 4.38 and 3 regressors) as derived from equation 13.

$$\Delta dlp_t = \Delta dlp_{t-1} + \sum_{i=0}^{1} \Delta propr_t + \Delta inv_t + \Delta imp_{t-1} + const \qquad (13)$$

Also note that when the other endogenous variable *propr* becomes the dependent variable it was not possible to find an F-statistic high enough for the bounds test to validate a long-run relationship in this case. This result is not surprising as there are other factors that affect the determination of production prices *propr* than those contained in equation 4. The cointegration results according to Johansen's method (column 7 in Table 7) are confirming the results of the previous two methods only to the extent of the *propr* and *imp* variables (the coefficients for these latter variables of Johansen's cointegrating vector are rather different in magnitude but have the right sign). In addition, the small sample correction reconfirms the conclusion.

For the multiplicative levels model (variables expressed in natural logs), satisfactory results are obtained for the OLS and ARDL models but not for the Johansen's cointegration model (indeed very bad results for the latter). The constant elasticities seem to be reasonable. It is worth noting that the functional form test indicates once more that the multiplicative model might not be the right one to use. In addition, the bounds test appeases us as to the existence of a long-run relationship even in the multiplicative case.

Table 7 The quantitative results for internal demand for Australian produced cars

	OLS levels	OLS logs	ARDL (1,0) levels	Long-run η_j levels	ARDL (1, 0) logs	Long-run η_j logs	Joh/en's Coin/on VAR(1) levels	Joh/en's Coin/on VAR(1) logs
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent var	dlp	dlp	dlp	dlp	dlp	dlp	dlp	dlp
dlp(-1)		0.29 (2.7)	0.146 (1.3)		0.29 (2.7)			
propr	-11.6 (-7.3)	-0.685 (-5.7)	-11.5 (-6.9)	-13.5 (-5.9)	-0.685 (-5.7)	-0.97 (-4.7)	-7.6 (-2.3)	-1.9 (-1.3)
inv	-0.446 (-2.3)	-0.265 (-2.4)	-0.48 (-2.4)	-0.56 (-2.2)	-0.265 (-2.4)	-0.37 (-2.2)	0.19 (0.6)	-0.74 (-0.8)
imp(-1)			-0.175 (-2.6)	-0.21 (-3.1)			-0.238 (-3.0)	0.007 (0.14)
imp(-2)	-0.264 (-4.7)	-0.074 (-2.2)			-0.074 (-2.2)	-0.10 (-2.5)		
const	648541 (11.8)	19.7 (7.0)	595180 (8.1)	696836 (9.3)	19.7 (7.0)	27.9 (7.6)	470839 (4.4)	40.1 (1.65)
R^2	0.89	0.88	0.89		0.88		0.45	-0.009
Serial correlation	0.51	0.08	0.31		0.08		0.09	0.09
Functional form	0.83	0.004	0.79		0.004		0.12	0.91
Normality	0.77	0.93	0.65		0.93		0.71	0.37
Heterosc/icity	0.42	0.23	0.28		0.23		0.50	0.50
ecm (-1)				-0.85 (-7.8)		-0.71 (-6.5)	-0.99 (-5.3)	-.03 (-0.3)
F-stat (bounds testing) (5%)				4.91 > 4.38		2.54< 4.38		
Johansen's max eig/value							24.4>21.9 24.4>19.7	21<21.9 21>19.7
Small sample correction							21.5<21.9 21.5>19.7	18.5<21.9 18.5<19.7
Johansen's trace statistic							38.7>30.5 38.7>27.6	38.0>30.5 38.0>27.6
Small sample correction							34.1>30.5 34.1>27.6	33.5>30.5 33.5>27.6

Notes:

(a) See also (a) to (f) of Table 4.

(b) The ARDL levels model with *imp*(-1) yielded similar results to that with *imp*(-2) but with slightly lower R^2, although the lag structure of the latter model did not suggest a lagged *dlp* variable.

(c) For the ARDL levels model, the Schwarz criterion chose an (0,0) lag structure, hence same to the OLS model.

6 Synthesis, discussion, and conclusions

We will begin this final section with a synthesis of the obtained results by considering the possibility that errors of each equation (1) to (4) estimated separately in the previous section are contemporaneously correlated. In this case the SURE model can be used although once more this model is more valid for large samples. However, we propose that if the estimated equations through SURE yield similar results to those already obtained we will present them here in a Table as the synthetic results providing that the SURE model can be used. Effectively, once we calculated each one of the four equations under the SURE model, we found that the appropriate χ^2 calculated statistic 14.48 is larger than the critical value of 12.59 (at 5% with 4(4-1)/2 = 6 degrees of freedom) (see Pesaran and Pesaran, 1997). Hence we can use SURE which provides us with the following synthesized results in Table 8.

Table 8 Results of the SURE model for the additive case

Dependent	imp	lapr	exxp	dlp
imp(-1)			0.09 (3.3)	
imp(-2)		0.21 (4.7)		-0.22 (-4.1)
lapr(-1)		0.59 (5.7)	0.33 (4.1)	
exxp(-1)			0.29 (2.8)	
imppr	-12.2 (-5.6)			
propr		-2.2 (-3.7)		-12.0 (-8.2)
exxppr			-2.3 (-4.4)	
tarn(-2)	-1878 (-4.8)			
tari(-1)			-216.1 (-5.0)	
inv				-0.40 (-2.3)
inv(-2)		-0.42 (-5.2)		
gdp	2.9 (12.1)			
excd			-13764 (-1.8)	
const	51379 (1.8)	136410 (5.8)	23698 (1.4)	643602 (13.0)
R^2	0.96	0.96	0.97	0.89

Notes: (a) In the exxp equation *lapr* of the model in table 5 is replaced with *lapr* (-1) so that the SURE estimation is possible.
(b) In the exxp equation a Wald test shows that the coefficient of *excd* can be significant even with a value of -28800 (instead of -13764) thus confirming the previous results.
(c) For the multiplicative case, the results are not shown here but overall they look similar to those obtained in the previous section.

There is a sequence of mechanisms that took place in the 1990s as a response to trade liberalization measures as understood by the above equations (and the previous ones). The reduction in tariffs is the path setter or the leader of that sequence. Then the boost in imports comes to increase competition, which in turn boosts productivity and exports. Internal demand for Australian produced cars is also led by what happens on the imports front. This procedure seems to work. As extra evidence, it is important to note that through our models we were able to predict quite accurately the outcomes for 2003[33]. The following Table 9 summarizes the prediction for 2003 based on two models: the long run cointegrating coefficients as shown in column 4 of each one of the Tables 4, 5, 6, and 7 (called model 1 in Table 9), and the coefficients of the SURE estimates as shown in Table 8 (called model 2).

Table 9 Forecast errors for 2003 (in %)

Dependent	imp	lapr	exxp	dlp
Model 1	9.8	0.9	0.9	12.8
Model 2	-0.3	0.07	-4.1	11.1

Notes: (a) the long run cointegrating coefficients as shown in column 4 of each one of the Tables 4, 5, 6, and 7 represent model 1.
(b) The coefficients of the SURE estimates as shown in Table 8 represent model 2.

The foregoing analysis can be enriched in some other ways. For example, in order to check that imports do not depend on exports (although the other way is true) an ARDL model[34] with imports as the dependent variable, and exports and import prices as the independent endogenous variables, and nominal tariffs lagged two years and GDP as the independent exogenous variables has provided similar results as to those mentioned in this paper. However, exports are not significant in entering the long-run relationship between all the involved variables as seen in equation 14 (the t-statistics are under the coefficients).

$$imp_t = -0.196 * exxp_t - 14.58 * imppr_t - 1981.8 * tarn_{t-1} + 3.16 * gdp + const \qquad (14)$$

(-0.71)(-5.87) (-3.78) (10.51) (1.90)

The bounds test also confirms this conclusion: the equation 15.

$$\Delta imp_t = \Delta imp_{t-1} + \sum_{i=0}^{1} \Delta exxp_{t-i} + \sum_{i=0}^{1} \Delta imppr_{t-i} + \sum_{i=0}^{1} \Delta tarn_{t-i} + \sum_{i=0}^{1} \Delta gdp_{t-i} + const \qquad (15)$$

was first estimated through OLS and then the addition of all involved variables lagged one year (e.g. imp_{t-1}) were added to the previous equation and the F-statistic was calculated; its value 4.93 is larger than the upper bound of the bounds test (4.05 for 4 regressors) and hence there is a significant long-run relationship of all the variables involved considered together. However, as already mentioned, the endogenous regressor of exports is not significant within that long-run equation. The overall conclusion out of this discussion is that when exports is the dependent variable (see Table 4) imports are a significant variable to explain exports in the long run. However when imports is the dependent variable, exports is not a significant long-run variable to explain imports as the present analysis has just shown[35].

From the economic point of view we are confident that we have established a meaningful mechanism that explains the behaviour of imports, exports, internal demand for locally produced cars, and labour productivity. This mechanism is supported by the econometric analysis of these variables. However, economists and econometricians have learnt in their training to be sceptical about evidence provided by models and methods that incorporate quantitative evidence mainly because models and methods can be based on many assumptions which are very often unrealistic. If we suppose that our economic models are correct (see section 3), we still have to use convincing econometric methods to validate these models. We knew that the method of OLS when used in data expressed in levels can provide spurious results and hence be at the mercy of much criticism. We also knew that the Johansen procedure of cointegration can also be easily criticised if the estimated sample is small.

In any case we knew that small samples always can be an easy target for disbelief of econometric results since the overwhelming majority of methods developed by statisticians and theoretical econometricians is based on the properties of large samples (e.g based on Monte Carlo experiments). However, the method of a bounds test based on a single ARDL equation developed by Pesaran et al (2001)[36] has provided us with a more comfortable research environment whereby we can use smaller samples with confidence and establish long-run relationships which do not need as many assumptions as the other methods do[37]. Consequently, we feel confident that the results presented in this paper can be considered as worth quoting despite some shortcomings as already mentioned and as the next points will reinforce.

Our preferred methodology to examine three *a priori* different types of methods, compare their respective results and conclude accordingly has at least two advantages and one disadvantage. First, the three methods are 'helping' each other in the sense that one supports or denies the other. Thus, the OLS is the precursor and pilot, the ARDL procedure is the bulk of evidence and the Johansen procedure is a back up. In other words there is an econometric 'debate' between the three methods. Second, through this debate we can be more confident about the quantitative support of our economic models. Third, we have a range of results that if they are similar we feel even more confident but if they are dissimilar, then the problem to choose the long-run coefficients becomes more complicated. Fortunately for the purpose of our paper we do not need a precise estimation of these coefficients as our aim was to establish the existence of these particular relationships with the involved variables to be significant and to have the right sign.

In addition, in the present paper our aim was not to compare econometrically the three methods mentioned above but to use them in a logical way in order to support our economic models. An econometric comparison *per se* could be the agenda for another paper in the future, although some brief comments are worth making here. First, the Johansen method by itself presented some problems and yielded a mixture of good and poor results, hence it could be judged inadequate if used by itself. The OLS method used by itself could easily be criticised despite some good results.[38] However, the ARDL and its bounds testing could survive by its own merits according to our understanding. This is even more valid in our case because we wanted a method that examines each equation step by step in the first place given the step by step mechanism that prevails in an economy when protection is gradually reduced (as elaborated in section 3, imports seem to set the pace for changes followed by changes in productivity, and exports). In general terms our result is consistent with Truett and Truett (1997), Riemens, (2002) Tcha and Kuriyama (2003) and Dixon and Rimmer (2004). The above studies linked Australian government policies and performance of the automotive industry (for example productivity, structural changes, welfare effects and balance of trade) and revealed positive performance. Our study is different by directly linking the trade reform and the PMV industry's performances in terms of import, productivity, exports and domestic demand for Australian made PMVs and setting a step by step mechanism that prevails in an economy when protection is gradually reduced. Here in our paper the determination of lags is crucial.

Finally, it is worth to close this paper with two extra remarks. First, we believe that from the beginning of our investigations we had an 'obvious' case of the role of liberalization on promoting imports, exports, labour productivity and rather subduing local production. The graphs also showed an 'obvious' story when we noticed the significant breaks that took place in the four variables around the end of the 1980s and the beginning of the 1990s. However we risked not to provide any quantitative analysis to support the 'obvious' events because econometrically we stopped at the main disadvantages of the OLS and Johansen procedures as explained already. Fortunately, we saw that the bounds testing procedure might be able to rescue our research endeavours and we hope that this rescue has been real and significant.

Second, given the background of our foregoing analysis we might be able to predict that a complete liberalization of trade in Australia for the PMV industry could slow down the demand for Australian made cars even though the Australian car producers are gaining in efficiency and accessing export markets.[39] The world car industry is dominated by an oligopoly of a few multinationals which will always plant their factories where the future is best. This future at least in the foreseeable time does not look bright given the small market of

Australia and the intense competition of so many neighbouring Asian countries. However, our exports analysis provides us with another story: if Australia becomes a strongly export oriented vehicles country, then this country's local vehicle industry can be saved and prosper. Thus, this is possible given the recent strong upward trends in Australian vehicle exports and labour productivity.

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[1] PMV covers passenger cars, station wagons, panel vans and pick-ups, which are assembled or manufactured in Australia (Industry Science Resources, 1996, p.101). In 1990s, PMVs represented about 77 percent of total vehicles registered.
[2] The individual series will be shown again in other graphs below.
[3] A 'structural break' is defined here for the purpose of this paper as a break in the slope of the trend of the series that can be explained by appropriate variables as will shown in subsequent sections.
[4] By fulfilling the minimum level of local content requirement producers have the right to import the allowable level of imported components duty free. In 1965, local content requirement were established at the 95% level. This was reduced to 85% level during 1968-85. The local content requirement was abolished in 1989.
[5] Garnaut (1997) argued that further liberalisation was urgent and important for the automobile industry.
[6] See below about organizational innovations and the inventories to sales ratio. The lean production system reduces this ratio over time because of increases in organizational efficiencies generated by this system (see Sanidas, 2004b; Sanidas, 2005, forthcoming).

[7] Producers who produce models which did not achieve production volumes of at least 30,000 units a year from 1989, are subject to penalty. This production volume is commonly known as the sanction volume rules. The penalty involved the withdrawal of eligibility for the 15% duty free imports.
[8] Empirical works in this regard reveal the general relationship among the above variables without adequately addressing the lag effects. We intend to determine the lag effects by using various econometric models in this study.
[9] See Sanidas (2004a) for a crucial distinction between technical (e.g. a machine) and organizational innovations.
[10] Santos-Paulino and Thirlwall (2004) used panel data and time series/cross section analysis to estimate the effect of trade liberalisation on export and import growth for a sample of 22 developing countries since the mid-1970s. This paper concludes that liberalisation stimulated not only imports but also export growth.
[11] The EFS would have made Australian PMVs more competitive by reducing export prices. We expect that our $exxppr_{t-i}$ and $tari_{t-i}$ reflect the effects of EFS on exports.
[12] See Eagles and James (1988, p. 76) for a historical evidence of closer economic relations (CER) trade agreement between Australia and New Zealand.
[13] Australian made cars are Avalon, Camry, Commodore, Magna and Falcon. Camry is considered as a medium-size vehicle. The rest are upper-medium size family cars with V6 engines (Riemens, 2002, p.107)
[14] Despite Ford's leadership of the Australian car market, the best selling car in 1996 was the GM/Holden Commodore. Europeans hold a relatively small but increasing share of the market, with BMW being the leader. Mercedes-Benz and Volkswagen are also showing signs of strong growth (Motor Business International 2000, p.74).
[15] The Industry Science Resources covered the following tariff classifications 8703.21.10, 8703.22.10, 8703.23.10, 8703.24.10, 8703.31.10, 8703.32.10, 8703.33.10 and 8703.90.10 from 1985. The Industry Science Resources provide consistent exports and imports data. Previous data were obtained from the ABS catalogue number 5416.
[16] For the series of labour productivity and exports the 'breaking' year was chosen to be 1992 for reasons that become apparent in subsequent sections. Nonetheless the exact year of break is not important in our analysis.
[17] Johansen's cointegration and OLS are much better known techniques and have been already extensively used by many researchers (contrary to the more recent ARDL bounds testing procedure).

[18] This is equivalent to equation (18.181) in Pesaran and Pesaran (1997, p. 394).
[19] The coefficient of the dependent variable 'y' in the ECM is usually standardised to one and hence the other coefficients of the ECM should have a negative sign.
[20] This is another difference between the ARDL bounds test approach and the Johansen procedure. The lag structure in the latter is rigid in the sense that it does not allow different lags for the different variables of the model.
[21] As the sub-section 4.2 has already suggested, there are structural breaks in all main variables examined and hence the order of cointegration becomes uncertain. Also, given the change in the slope of the trend in these series (structural breaks) in the econometric analysis that follows we excluded the trend from the underlying VAR, EC and other models so that the explanatory variables (exogenous and endogenous) can do the job of explaining the dependent varaiables.
[22] More comments on the obtained results will follow at the end of this described procedure.
[23] The last one, 4.36 is just short of the 4.378 critical value.
[24] Given that we have a small sample, it is logical to be inclined for the most parsimonious information criterion which is the Schwarz one (Pesaran and Pesaran, 1997). However, we might follow a different path in some cases.
[25] As it is the lag structure for the bounds test is not as flexible as the one for the determination of the ARDL model: if the maximum lag adopted in the estimation of an equation such as 7 is three then all involved endogenous variables should be lagged up to three units (see Pesaran and Pesaran, 1997, etc). It is worth noting that Pesaran *et al.* (2001, p. 310 and notes of Table II on p. 312) in their application of the bounds test seem to have eliminated all lagged changes of one of the endogenous variables. If it were possible to have a flexible lag structure for the bounds tests, then ideally we should have an algorithm that finds the optimum lag structure of the equation used for the bounds test, that is the one that yields the highest F-statistic.

[26] It is well known that series with structural breaks might be leading to the wrong decision, that is, a variable might not be I(1) and yet the ADF test shows it is. (See for example Zivot and Andrews, 1992; Perron, 1989)
[27] The 'symmetric' relationship with imports as the dependent variable has also produced a significant F-statistic (5.25) as expected (the model in Table 4 has a different lag structure than the present one).
[28] We are still not convinced that this relationship is very significant as there are perhaps some other variables that could be added for a better explanation. But we offer the present results here for the sake of econometric discussion.
[29] Nissan has terminated its Melbourne car plant in 4 February 1992. The remaining Toyota Motors Australia, Ford Australia, General Motors Holden and Mitsubishi Motors Australia "face the uncomfortable fact that a thinning of the auto-industry ranks was an intended consequence of government policy." (Deans 1992: p.42)
[30] Also if, as for the detection of serial correlation, *lapr*, *imp*, and inv become the endogenous variables, and hence *propr* becomes the exogenous variable, the F-statistic is 4.61, thus once more confirming the long-run relationship between all the variables involved.
[31] More research in the future might confirm or not confirm our results regarding the exports variable.
[32] In this paper we mainly use ARDL cointegration through the bounds testing to support our OLS and Johansen's cointegration. In this case of exports it is the other way around. In general the three methods can and support each other.
[33] The purpose of this paper is not to forecast, or to generally compare forecasts and methods.
[34] The most parsimonious information criterion Schwarz indicates an optimum lag of (0, 0, 1) for the three endogenous variables.
[35] Once more, there is no symmetry in the two equations for imports and exports because the variables explaining these two dependent variables in the long run are different in the two equations.

[36] And other similar references leading to that seminal article as mentioned in this paper.

[37] Although we mentioned this earlier, we can summarize again the advantages of the bounds test: the existence of the cointegrating vector can embrace both I(1) and I(0) variables; the optimum structure of the ARDL model and its corresponding bound tests will not limit the significance of such tests; and small samples can be used with more confidence.

[38] The meaning of 'good' results here refers to our expectations in terms of *a priori* economic theory and practice.

[39] Imports over total local sales (Australian PMV production + imports – exports) have been increased from 19% in 1988 to 55% in 2003. Exports over total local sales have been increased from 0.2% in 1988 to 19% in 2003. Domestic demand for Australian made cars has been falling from 81% in 1988 to 45% in 2003.