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What's News

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Trade Liberalization and Productivity Performance: Evidence from the Australian Passenger Motor Vehicle Industry

Abstract: This paper contributes to the ongoing debate about the effects of trade liberalization on productivity performance of the Australian passenger motor vehicle industry, which has experienced significant liberalization over the years. Our analysis indicates that trade liberalization had a negative impact on productivity growth, at least in the immediate post-liberalization period. Empirical results suggest that economies of scale and tariff protection improve productivity, while industry assistance (such as the local content and duty drawback schemes and production subsidies) retards productivity. Policy implications of these findings are that there are dividends in terms of improved productivity by encouraging economies of scale, providing tariff protection and lowering industry assistance.

Keywords: liberalization, productivity growth, automotive industry

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1 Introduction

The views that trade liberalization improves productivity performance have led to a number of cross-sectional studies in the Australian manufacturing sector.[1] While these studies have shown that liberalization has led to an improvement in

1 These cross-sectional studies include Chand (1999), Oczkowski and Sharma (2001), Bloch and McDonald (2002) and Mahadevan (2002).

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manufacturing productivity growth, the lackluster growth performance of the Australian passenger motor vehicle (PMV) industry cast serious doubts if trade liberalization really helps improve productivity. On theoretical grounds, trade liberalization influences productivity growth through a number of channels. For instance, increased competition may lead to lower price–cost margin and improve allocative efficiency. It may also put competitive pressure to reduce x-inefficiency by using inputs more efficiently or securing them from most efficient suppliers. It is also possible that when the less efficient firms exit the market surviving firms move downward along their decreasing cost curve through economies of scale (ES), leading to productivity improvement (Tybout 1992; Tybout and Westbrook 1995; De Boyrie and Kreinin 2013). On the other hand, critics have argued that trade liberalization may lead to lower productivity growth by shrinking domestic firms' sales, which in turn reduces the incentives to invest in technological innovation (Rodrik 1992b; Rodriguez and Rodrik 1999). As the debate continues, the literature has been mushrooming, but with the mixed empirical findings. Despite this, relatively few empirical studies have examined the implied link between trade liberalization and productivity growth using industry-level data. The aim of this paper is to meet this gap through a systematic investigation of the experience of the Australian passenger motor vehicle industry.[2] The examination of the experience of this industry is particularly interesting given that it has experienced significant liberalization since 1970s (Truett and Truett 1997; Marks 2013). For instance, imports tariffs on motor vehicles, and parts and components have substantially fallen, in addition to the removal of quantitative restrictions (QRs) and subsidies, leading to a significant drop in the effective rate of protection (ERP).[3] ERP which was as

2 For a long time, the Australian passenger motor vehicle industry was dominated by four producers – namely, GM Holden, Ford Motor Company of Australia, Toyota Motor Corporation Australia and Mitsubishi Motors Australia (having bought out Chrysler in 1980). Following the closure of the Mitsubishi engine plant in 2004 and its vehicle assembly plant in March 2008 (both in South Australia), Ford, Holden and Toyota remain major players in the market. The Australian PMV industry contributes about 5% to manufacturing employment, 6% to value added and over 5% to export earnings in 2007 (DIISR 2008). It also has significant backward and forward linkages and technological spillover. For instance, its expansion (contraction) affects the producers of steel, rubber, plastics, paints, glass, and components and parts. Among the manufacturing industries, the Australian PMV industry has the highest R&D expenditures, accounting for 21.7% share in the total manufacturing sector R&D in 2006/2007 (ABS 2010).

3 The estimates of the effective rate of protection take into account all forms of assistance offered to an industry including tariffs on inputs, final products, export subsidies and import quotas.

high as 143% in the mid-1980s fell to 12% by 2008 (Productivity Commission 2002, 2009).

While these reforms were introduced with a view to improving the efficiency of the automotive industry, which has traditionally been a highly protected sector only just behind the textile, clothing and footwear, it remains highly vulnerable to external competition. Frequent fluctuations in domestic production, rapidly expanding sectoral trade deficit, rising trading losses and job cuts in the industry are the major concerns (see Appendix 1). By 2007, the Australian automotive industry's trading loss as a percentage of total sales reached about 9% (or $722 million). As the Bracks Report (Bracks 2008, 13) correctly points out "justifying domestic production with such large trading losses presents a major challenge to the [industry]". As import competition intensifies, some of the components and parts producers have either closed down or relocated offshore. Significantly, Mitsubishi has ceased its vehicle production in South Australia (as of March 2008), with a resulting loss of 3,000 jobs. The recent announcement by Ford Australia and Toyota to reduce their production has already cost hundreds of jobs at Ford plants in Broadmeadows and Geelong, and the Toyota plant in Altona (Leys and Glover 2011). Have these occurred due to an improvement or a fall in productivity? This remains to be answered. The purpose of this paper is to investigate the effects of trade liberalization on the productivity performance of the Australian passenger motor vehicle industry and examine its determinants. This is done using a historical dataset from 1962 to 2008. The selection of the time period is guided by data availability.

Following this brief introduction, Section 2 documents the nature of trade policy regime. Section 3 discusses methodological issues related to productivity measurement and database construction, while the estimates of productivity growth are presented in Section 4. An econometric model designed to explore the determinants of total factor productivity (TFP) growth and results of its application to the Australian passenger motor vehicle industry data are presented in Section 5. The paper concludes with policy remarks in Section 6.

2 Nature of policy regime

The Australian automotive industry has a long history of protection although, prior to 1901, the nature of protection varied from colony to colony. It was only from 1907 that Australia had unified tariff rates in all States, and successive governments used both import tariff and quota to develop the automotive industry. In addition, the industry also had access to production and export subsidies and benefited from the duty drawback scheme. By the mid-1980s, with protection of other sectors being reduced, the Australian automotive industry remained one of the most highly protected industries behind only the textile, clothing and footwear sector. It was widely recognized that a high level of industry protection, which was as high as 140% by the mid-1980s, had led to significant inefficiency, giving way to a wide range of reforms under the Button Plan announced in May 1984 (Capling and Galligan 1992; Sharma 2012; Bopage and Sharma 2014a). As shown in Figure 1, the industry enjoyed a highly protective regime until 1985–1986 and has moved toward an increasingly liberal and open regime since 1986–1987. We call the two periods: the pre-reform (until 1985–1986) and the post-reform (from 1986 to 1987) periods.

2.1 Pre-reform era

The history of protection goes back to 1907 when the Australian government imposed an embargo on imported cars and introduced high protective tariffs. Not only did the country have high tariffs but also the rates varied significantly between trading partners (Lloyd 2008).[4] The 1920s and 1930s witnessed further increases in tariffs and quotas. By the mid-1940s, the "most-favored nation" tariff rates on passenger motor vehicles (PMV) reached 55% (Lloyd 2008, table 1) and the effective rate of protection was much higher. In 1950s, the government introduced preferential import licenses to help ease a balance of payment crisis, while in the 1960s an incentive was launched to reward vehicle producers who use at least 85% local content.[5] Furthermore, government also introduced producers and exports subsidies, and duty drawback scheme to encourage domestic production. In mid-1970s, the decision by the Labor government to introduce export facilitation scheme and preserve at least 80% market share for domestic producers through further increasing motor vehicle tariffs (from 55% to 57.5%) and import quotas, resulted in a significant rise in the effective rate of protection, reaching 143% by 1984–1985, with the effect that there was a significant gap in the effective and nominal rate of protection (NRP) (Figure 1).

By early 1984, it was obvious that the Australian motor vehicle industry was not competitive and that there was a need to restructure the industry. This

4 For instance, a preferential tariff was introduced for imports of motor cars from the United Kingdom in 1907 which continued until 1974.

5 For example, until 1975 manufacturers that meet the 85% local content requirements were allowed duty free import of components to 15% of the value of PMV production.

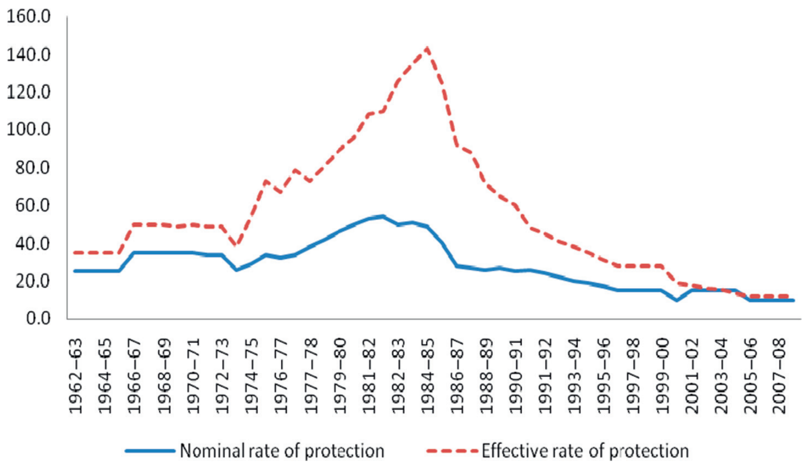

Figure 1: Nominal and effective rate of protection in the Australian PMV (%), 1962/1993–2008, 2009
Source: Productivity Commission (2002, 2009).

realization led to the announcement of the Automotive Plan by then federal minister for trade and industry John Button, which later came to know as the Button plan.

2.2 Post-reform era

The implementation of the Button plan began with the establishment of the Automotive Industry Authority (AIA) in 1984. Within a year of the establishment of the AIA, import quotas were replaced with tariffs and tariffs were brought down to 45% with further annual reductions of 2.5%. By early 2000s, PMV tariffs had been reduced to 15% and were kept at this level until 2004, with the expectation of a further reduction to 10% by 2005. In addition to tariff reforms, the local content scheme was abolished and the export facilitation scheme was replaced with the Automotive Competitiveness and Innovation Scheme (ACIS) to encourage investment in plant, equipment and R&D with the view to make the industry competitive. These reforms have led to a significant fall in the effective rate of protection from 143% in the mid-1980s, when the AIA was established, to 12% by 2007–2008, while over the same period the NRP fell from 46% to 10% (Figure 1). How did these reforms affect the productivity performance of the Australian motor vehicle industry? This is examined in the next section.

3 Methodological issues in productivity growth estimates and database

3.1 Methodological issue

While labor and capital productivity are often used as indicators of productivity, they are only partial measures of efficiency and do not reflect actual improvements in efficiency (Tybout and Westbrook 1995; Bertelsman and Doms 2000; Huang 2002). For example, labor productivity or output per unit of labor fails to disentangle the improvement in productivity due to an improvement in the efficiency of labor from that due to capital accumulation (that is to the use of more and better machines). When capital accumulation is rising, it may be that an improvement in labor productivity could be due to increased access to more capital rather than an actual improvement in efficiency. Likewise, estimates of capital productivity do not consider the contribution to output growth by harder-working or smarter labor. In the context of the effects of policy reforms on efficiency, this distinction is particularly important. Given these limitations of the partial measures of labor and capital productivity, we estimate the TFP growth, which takes into account the weighted average growth in inputs (labor, capital and intermediate inputs) in estimating productivity. Accordingly, TFP growth is defined as growth in output/value added minus the weighted averages growth in factor inputs. While TFP growth can be measured in value-added and/or gross output terms, our estimate is based on value-added terms.

Following Gollop and Jorgenson (1980), TFP growth is defined using the Tornqvist index number formula, with:

$$\begin{aligned} \text{TFP} = &\{In\, VA(T) - InVA(T-1)\} - \\ &\left\{ \overset{-i}{VL}[InL(T) - InL(T-1)] + \overset{-i}{VK}[InK(T) - InK(T-1)] \right\} \end{aligned} \quad [1]$$

where TFP is the total factor productivity growth, VA is value added, L is labor input, K is capital input and T is time. $\overset{-i}{VL}$ and $\overset{-i}{VK}$ represent the average value shares of labor and capital respectively.

Equation [1] defines TFP growth as the difference between the logarithmic of value added and the weighted averages of the logarithms of labor and capital inputs, where the weights are the average value shares of each input. The methodology assumes perfect competition and under this assumption the elasticity of output with respect to each input is equal to its value share in output. Further, these value shares of factor inputs sum to unity.

It must be mentioned that the above approach of estimating TFP growth not only captures technical efficiency but also improvements in capacity utilization, better management practices, improvements in the work place environment, training and learning by doing. Since there has been a good deal of capacity under-utilization in the Australian motor vehicle industry, the implications of not making such corrections are that our TFP growth estimates reflect in part changes in capacity utilization (Vollmer, Martínez-Zarzoso, and Nowak-Lehmann 2009).[6] Our estimated TFP growth rates, strictly speaking, should therefore be interpreted as the rates of improvement in the overall efficiency of resource use (including fixed factors of production), rather than as "pure" rates of technological progress.

3.2 Database

In the absence of readily available time-series data on the Australian motor vehicle industry, the database for this study developed was from various sources including the Commonwealth Bureau of Census and Statistics (various issues), Australian Bureau of Statistics (ABS) (2004, 2008, 2010), Australian Automotive Intelligence Yearbook (various issues) as well as unpublished files and reports of the Australian automotive industry (AAI). However, data gathered from these sources were not in consistent format and frequent changes in classification of the industry sub-sectors further complicated the matter. For instance, automotive data compiled by the ABS from 1968 to 2003 did not have a consistent ANZSIC classification of the industry sub-sectors. Consequently, data for these years were mapped using a concordance.[7] In addition, data for 1971 and 1986 were not collected by the ABS and they were extrapolated. The collected data were edited to reduce measurement errors by identifying abnormal data.

The value-added data were obtained from the ABS and the AAI. It is derived by deducting intermediate input from the value of output and was deflated using the wholesale price index for transport equipment. This is the most appropriate way of estimating value added (ABS 2010). Labor input was measured in terms of the number of workers who receive payment in cash. The ideal measure of labor input is hours worked by each category of laborers disaggregated by their sex, age and education level rather than number of workers

6 It must be noted that Kendrick (1973, 26) and Denison (1974, 56) have argued strongly against correcting capital stock series for capacity utilization in productivity growth analysis, and Gollop and Jorgenson (1980) did not make such corrections. Since policy reforms are aimed at improving the efficiency of resource use, it is appropriate not to adjust capital stock data for capacity utilization.

7 The concordance used in data mapping exercise can be obtained from the authors on request.

because hours worked by a worker could vary over time (Sharma 2001; Rogers 1998). Furthermore, the labor input growth rate should be obtained by aggregating the weighted continuous growth rates of different quality of laborers using the wage bill for each category as weights. However, as labor input data were not available in such a disaggregated form for all the years under consideration, we used the total number of paid workers as a proxy for labor input and the growth in labor input is calculated on this basis.[8]

There is no universal method of estimating capital input. Following the Sharma (1999), we use the motor vehicle industry capital stock data from the Australian System of National Accounts. Our capital stock data is based on the end of the year capital stock after making allowances for depreciation. The capital stock was deflated by the wholesale price index for capital goods. The value share (weight) of labor input was obtained by dividing expenditure on labor (i.e. wages and salaries) by value added. Wages and salaries data include all payments in the form of wages and salaries, employers' contribution to social security, pension and other welfare expenses. The weight of capital input was defined as one minus the weights of intermediate inputs and labor input.

4 Productivity performance of the Australian passenger motor vehicle industry

The estimates of TFP growth in the Australian passenger motor vehicle industry are reported for the entire period (1962–2008) as well as for the separate pre- and post-reform periods in Table 1. The table also provides estimates of growth in value added, labor, capital, weighed labor and weighted capital. During the entire study period, TFP grew at about 1.5% on average per annum – much lower than growth in factor inputs and value added (Table 1). When productivity growth is separated into the pre- and post-reform period performance, the average annual growth in TFP dropped from over 4% per annum in the pre-reform period to −0.91% in the post-reform period (Bopage and Sharma 2014b). This absolute fall in productivity appears to have been linked with poor capacity utilization brought about by intense competition in both domestic and export markets, leading to a fall in output (see Appendix 1, column two). As Bracks (2008) notes intense import

8 It should be noted that our estimates of labor input might have suffered from aggregation errors as we lump together (i) different categories of labor into a single category and (ii) assume that different types of employees work the same number of hours. Unable to make allowances for changes in skill composition over time may also have introduced a bias in the measurement of labor input.

Table 1: Growth (%) in value added, labor, capital, weighted labor, weighted capital and TFP

Growth in	Entire study period (1962–2008)	Pre-reform (1962–1984)	Post-reform (1985–2008)
Value added	5.89	9.64	2.15
Labor	9.52	14.621	4.42
Capital	7.14	10.44	3.84
Weighted labor	3.52 (59.76)	4.57 (47.41)	2.47 (114.88)
Weighted capital	0.83 (14.09)	1.06 (10.99)	0.60 (27.91)
TFP	1.54 (26.14)	4.00 (41.49)	−0.91 (−42.32)

Source: Bopage and Sharma (2014b).
Note: Figures in parentheses are percentage contribution of factor inputs and TFP to growth in value added.

competition, together with strong Australian dollar, led to a fall in domestic market share of the Australian motor vehicle producers, from 32% in 2002 to 19% by 2007, while international market share remains stagnated at about 0.5%.

Lackluster productivity performance in the post-reform period does not seem to confirm the conventional theory that trade liberalization improves efficiency (see for example, Tybout and Westbrook 1995). Instead, our analysis provides support for Rodrik's (1992b) view that liberalization, by reducing the market share of domestic firms, lowers incentives to invest in technological innovation, which in turn leads to poor productivity outcomes.

The contribution of labor input to productivity growth has been far greater than capital input regardless of the nature of the policy regime (Table 1). While TFP growth contributed positively to value added in the entire study period (26.14% per annum) as well as in the pre-liberalization period (41.49% per annum), its contribution fell significantly in the post-liberalization period (−42.32% per annum). The absolute fall in TFP suggests that the industry is rapidly losing its competitiveness. So, what are the determinants of productivity growth in the Australian automotive industry? The next section sheds light on this issue in an econometric framework.

5 The determinants of productivity growth

5.1 The model

This section, based on theory and empirical literature, develops hypotheses to explain the determinants of productivity growth and empirically tests the model.

It is argued that trade liberalization helps overcome the small size of domestic market and encourages large-scale production (Krueger 1997; Bartelsman and Doms 2000; Ng 2012). Opportunities to produce in a large scale allow exploitation of ES, which results in a fall in average cost and hence an improvement in competitiveness. Thus, one possible link between trade policy regime and productivity growth occurs through ES. Following standard practice in the literature, ES is proxied by growth in value added.

Higher export intensity can lead to productivity improvement as exposure to the export market increases familiarity with and absorption of new technologies (Urata 1994; Sharma and Gunawardana 2012). Export growth also brings local industries close to foreign firms, giving opportunities to become familiar with better management practices. In addition, international exposure encourages domestic firms to better train their workers and increase the number of skill-intensive jobs, leading to productivity growth (Sanidas and Jayanthakumaran 2007). Hence, a positive relationship between export intensity (XI) and productivity growth may be expected. Export intensity is defined as export–output ratio in 2007/2008 constant prices.

Conventional theory suggests that liberalization, by increasing competition in the domestic market, improves productivity growth, while protection discourages foreign competition, innovation and the use of best technology, leading to X-inefficiency (Krueger 1997; Madsen 2008). However, Rodrik (1992b) argues that there are no theoretical reasons to believe that protection of domestic market discourages productivity improvement. If the incentive for greater technological progress is linked to scale of operation, protection may in fact improve efficiency by increasing the domestic firm's output and its market share, while import liberalization induces inefficiency by reducing domestic sales (Rodrik 1992b). Rapid removal of protection can also adversely affect efficiency in industries with long gestation periods and technologies that are difficult to master. Hence, the effect protection would have on TFP growth is ambiguous. To capture the effects of protection, we use two separate measures.[9] They are NRP and industry assistance (IA) variables. The former captures the impact of tariff protection while the latter captures the effects of government assistance (such as subsidies and duty drawback scheme) on the industry's productivity performance. It is reasonable to expect that capital intensive technology offers scope for technological advancement and

9 Note that the ERP has not been used as a measure of protection. Instead, we use the NRP as an indicator of tariff protection because we are also interested in capturing separately the effects of industry assistance (IA) on productivity performance.

innovation in industries such as automotive. This led us to believe a positive link between capital intensity (KI) and productivity growth. Following standard practice in the literature capital intensity is defined as the ratio of fixed capital to total employment in 2007/2008 constant prices (see, Sharma, Jayasuriya, and Oczkowski 2000).

The above theoretical considerations lead to the following specification of a model of TFP growth. The expected signs are given below the equation in parentheses.

$$\begin{aligned} \mathrm{TFP}_t = \; & \alpha_1 \mathrm{ES}_t + \alpha_2 \mathrm{XI}_t + \alpha_3 \mathrm{NRP}_t + \alpha_4 \mathrm{IA}_t + \alpha_5 \mathrm{KI}_t \\ & \quad (+) \qquad\quad (+) \qquad\quad (?) \qquad\qquad (?) \qquad\quad (+) \end{aligned} \qquad [2]$$

where

- TFP_t is total factor productivity growth, defined as growth in value added minus the weighted average growth in labor and capital
- ES_t is economies of scale, proxied by growth in value added
- XI_t is export intensity is defined as export–output ratio in 2007/2008 constant prices
- NRP_t is the nominal rate of protection, which includes all tariffs including customs duties and addition duties
- IA_t is industry assistance dummy, which captures the effects of subsidies and duty drawback scheme. The value of the dummy is 1 for the years assistance was available and 0 otherwise
- KI_t is capital intensity, defined as the ratio of fixed capital to total employment in 2007/2008 constant prices
- $t = 1,\ldots, n$ (Years)
- α_j are parameters to be estimated where $j = 0–5$, and
- U is a standard classical error term

Appendix 2 discusses data sources and variable measurements.

5.2 Estimation procedures and results

The model specified above is estimated using time series data for 1962–2008. Chow tests indicated significant differences in parameters between the pre- and post-reform periods, therefore the model is estimated for the entire study period with slope and interaction dummies, Ds (1 for the post-liberalization period and 0 for the pre-liberalization period) to capture the effects of trade liberalization. A prefix "D" at the beginning of each explanatory variable denotes an interaction with the liberalization dummy. A significant interaction "D" variable indicates that the regression coefficients are statistically different between the pre- and post-reform periods. If the interaction "D" variable is insignificant then the marginal impact on productivity growth is statistically the same for both periods.

Before estimating the model, we performed the model specification errors test (namely RESET test) and conducted an *F*-test for the overall fitness of the specified model. Model misspecifications were corrected by changing the functional form and/or adding or deleting variables. We performed the Breusch–Godfrey (B-G) LM test for first-order autocorrelation. Tests for multi-collinearity and outliers were also carried out. Outliers did not seem to be a problem in our dataset. In an attempt to improve the explanatory power of the model variables with *t*-ratios less than unity were deleted one by one. However, this did not improve the explanatory power of the model. The estimates for both the full and reduced models are reported in Table 2.

Table 2: OLS results for the determinants of TFP growth, 1962–2008

Independent variables	All variables TFP growth	Variables with | *t* | < 1 excluded
Intercept	−0.2742 (−1.5451)*	−0.1754 (−1.7644)*
Intercept dummy (D)	−0.4368 (−1.2513)	−0.1569 (−0.9175)
ES	0.0001 (2.1214)**	0.0001 (2.3332)**
XO	0.1020 (0.7184)	Excluded
NRP	0.0052 (1.7280)*	0.0039 (2.0991)**
KI	0.0046 (0.3501)	Excluded
IA	−0.2149 (−1.9640)*	−0.2214 (−2.1545)**
DES	0.0001 (2.2992)**	0.0000 (0.9914)
DXO	−0.7763 (−0.7124)	Excluded
DNRP	0.0019 (0.4198)	Excluded
DKI	0.0020 (0.1498)	Excluded
No. of observations	46	46
F (K-1, K-45)	1.2011	1.6851
R^2	0.1788	0.1722
RESET F (4, 42-K)	1.1821	1.6643
B-G LM AR(1) Test	3.935	4.4

Notes: Linear equations: *t*-ratios are given in parentheses. *K* is the number of explanatory variables including constant. Significant levels are: ** = 5%, and * = 10%.

As expected the coefficient for ES variable is statistically significant and has a positive sign for the entire study period, suggesting that opportunities to exploit ES lead to higher productivity growth in the Australian passenger motor vehicle industry. This finding is consistent with the "Verdoon's Law" that ES are a source of productivity growth. The impact of ES remains statistically significant and positive in the post-liberalization period, indicating that its marginal impact grew following the opening up the economy. Our finding about the link between ES and productivity growth is similar to previous studies on the productivity performance of the Australian manufacturing industries by Chand (1999) and Oczkowski and Sharma (2001). There is no statistical evidence to conclude whether higher export intensity improves or retards productivity growth as the coefficient for export intensity (XI) variable is statistically insignificant for the entire period as well as for the post-liberalization period.

The coefficient for NRP variable is statistically significant and has a positive sign for the entire study period, providing some support for the view that tariff protection improves rather than retards productivity growth in the Australian motor vehicle industry.[10] As Rodrik (1992b) argues it may be that tariff protection, by increasing domestic firms' market share, raises incentives to invest in technological innovation, leading to productivity improvement. However, its interaction with the post-liberalization dummy (DNRP) is statistically insignificant, suggesting that the marginal impact of tariff protection on productivity growth is statistically the same regardless of policy regime. The coefficient for industry assistance (IA) dummy is statistically significant and has a negative sign, suggesting that industry assistance retards productivity growth, probably by promoting rent-seeking behavior.[11] These results suggest that while tariff protection improves productivity growth, industry assistance in the form of duty drawback scheme and subsidies can, in fact, retards productivity improvement. Our findings about the link between industry assistance and productivity growth are similar to the results of Sharma et al. (2001) for the Nepalese manufacturing sector. The statistically insignificant coefficient for capital intensity (KI) variable tends to indicate that capital intensive has neither positive nor negative impact on productivity growth in the Australian automotive industry. Policy implications of these findings are that there are dividends in terms of improved productivity by encouraging ES and lowering industry assistance.

10 As suggested by the referee of this journal, we also re-estimated the model by replacing the NRP with the ERP variable to see the sensitivity of the results. When this is done the re-estimated model fails to pass the diagnostic tests but the impact on TFP remains unchanged.

11 Note that to avoid dummy variable trap the interaction dummy (DIA) was not included in the estimated model.

While protection in the form of industry assistance retards productivity, tariff protection appears to encourage it, probably the former is less transparent than the latter.

6 Conclusion

This article contributes to the ongoing debate about the effects of trade liberalization on productivity growth by examining the case of the Australian passenger motor vehicle industry, which has experienced significant liberalization over the years. Our results indicate that trade liberalization had a negative impact on the motor vehicle industry's productivity, at least in the immediate post-liberalization period. Productivity growth declined significantly from over 4% per annum in the pre-liberalization period to −0.9% per annum in the post-liberalization period. It appears that as import competition intensified the domestic producers lost market share, leading to excess production capacity and an absolute fall in productivity growth, especially following trade liberalization. However, it should also be kept in mind that the long-run impact of trade policy reforms is probably not fully reflected in the period covered by our study, and our results may have underestimated the long-run benefits of outward-orientation on productivity performance. Nevertheless, it is clear that no major improvements in productivity emerged because of trade policy reforms. The post-liberalization fall in productivity may signal the beginning of a turnaround, but only if appropriate strategies are implemented to promote innovation.

Econometric evidence suggests that ES, NRP and industry assistance are the major determinants of productivity growth in the Australian motor vehicle industry. While ES and tariff protection contribute positively to productivity improvement, the impact of industry assistance appears to be negative. The reason we think industry assistance retards productivity growth is that such assistance are less transparent, naturally leading to the rent-seeking behavior. These results together bring home an important message that industry assistance should not be viewed as a means of developing automotive industry in Australia. Instead, tariff protection could be used which is more transparent than industry assistance, proving opportunities for competition and hence productivity enhancement. Furthermore, attempts should be made to promote ES through bilateral and multilateral trade negotiations, and agreements like Australia-Thailand Free Trade Area should be viewed positively.

Appendix 1: Key indicators of the Australian motor vehicle industry: 1962–2008 (value in million Australian $, 2007/2008 prices)

Year	Domestic production units	Exports units	Imports units	Exports in $ million	Imports in $ million	Trade balance in $ million
1962	na	na	na	75.0	79.92	−4.92
1963	na	na	na	200.0	130.27	69.73
1964	na	na	na	300.0	148.71	151.29
1965	na	na	na	320.8	226.33	94.47
1966	na	na	na	280.67	200.25	80.42
1967	na	na	na	246.3	209.78	36.52
1968	419,479	na	na	200.1	330.48	−130.38
1969	476,215	na	na	190.51	340.73	−150.22
1970	451,041	na	na	234.76	333.48	−98.72
1971	471,071	na	na	300.59	392.14	−91.55
1972	453,726	na	na	248.5	365.58	−117.08
1973	469,414	na	na	181.69	369.79	−188.1
1974	472,663	na	na	133.4	583.34	−449.94
1975	449,863	na	na	104.16	887.14	−782.98
1976	467,349	na	na	107.67	371.29	−263.62
1977	390,721	na	na	127.33	840.73	−713.4
1978	422,724	na	na	134.94	694.09	−559.15
1979	455,104	na	na	154.21	714.17	−559.96
1980	365,334	3,184	186,905	119.09	612.6	−493.51
1981	376,595	2,500	204,778	116.33	742.69	−626.36
1982	378,978	861	101,243	37.23	743.63	−706.4
1983	317,239	2,987	93,997	119.67	782.07	−662.4
1984	370,393	1,525	93,853	58.8	825.83	−767.03
1985	383,763	2,541	114,525	93.32	1,004.85	−911.53
1986	317,690	4,594	69,628	164.0	787.36	−623.36
1987	309,928	10,119	52,759	342.05	630.08	−288.03
1988	317,289	1,921	76,311	56.64	1,009.26	−952.62
1989	356,904	6,392	126,262	177.67	1,546.97	−1369.3
1990	360,918	34,426	115,151	954.01	1,394.44	−440.43
1991	278,423	29,730	123,708	869.57	1,416.05	−546.48
1992	270,170	27,926	147,406	815.51	1,926.53	−1,111.02
1993	285,076	24,532	158,663	1,055.15	2,100.80	−1,045.65
1994	309,512	23,263	182,256	938.01	2,588.75	−1,650.74
1995	293,631	23,940	214,843	958	2,742.88	−1,784.88
1996	304,741	44,055	243,848	1,503.32	2,965.72	−1,462.4
1997	301,280	51,757	281,265	1,887.74	3,714.42	−1,826.68

(*continued*)

(*Continued*)

Year	Domestic production units	Exports units	Imports units	Exports in $ million	Imports in $ million	Trade balance in $ million
1998	335,653	58,389	316,704	1,833.93	3,961.52	−2,127.59
1999	322,613	83,205	288,176	2,709.20	4,128.00	−1,418.8
2000	329,726	101,018	319,471	3,314.05	10,275.94	−6,961.89
2001	317,500	117,661	330,464	4,046.40	9,835.77	−5,789.37
2002	326,000	112,088	321,763	4,002.05	11,863.29	−7,861.24
2003	366,000	120,178	360,247	3,949.39	13,890.17	−9,940.78
2004	339,500	131,474	371,161	3,565.25	15,973.11	−12,407.86
2005	315,000	142,022	440,159	3,676.56	17,782.01	−14,105.45
2006	275,000	132,742	476,251	3,082.30	17,535.84	−14,453.54
2007	292,000	140,233	506,136	3,246.00	20,909.00	−17,663
2008	285,000	159,876	505,602	3,510.65	22,236.47	−18,725.82

Source: AAIYB (2009), DIISR (various issues) and ABS (2010). Production data for 1968–1979 is from Truett and Truett (1997).

Appendix 2: data sources and variable measurements

TFP is defined as growth in value added minus the weighted average growth in labor and capital inputs. Data for TFP growth estimates were obtained from Commonwealth Bureau of Census and Statistics (1963–1973), Automotive Industry Authority (1992), Australian Automotive Intelligence Yearbook (2008–2009), Australian Bureau of Statistics (2006 and 2010) and Department of Innovation, Industry, Science and Research (2006, 2007, 2008, 2009, 2010).

Economies of scale (ES) is estimated by growth in value added. The value added is derived by deducting intermediate inputs from the value of output. This was then deflated using the wholesale price index for transport equipment and growth rate was obtained. Data sources: Commonwealth Bureau of Census and Statistics (1963–1973), ABS (2006 and 2010) and AAI (1992).

Export intensity (XI) is measured as the ratio of exports to domestic production in 2007–2008 prices. Production and export data were obtained from Automotive Industry Authority (1992), Australian Automotive Intelligence Yearbook (2008–2009), Australian Bureau of Statistics (2006 and 2010) and Department of Innovation, Industry, Science and Research (2006, 2007, 2008, 2009, 2010).

Nominal rate of protection (NRP) captured tariffs on imported motor vehicles, including excise and additional duties. Data sources: Industry Commission (1995 and 1997), Lloyd (2008) and Productivity Commission (2002, 2009).

Industry assistance (IA) dummy. Industry assistant covers production subsidies and duty drawback scheme that were available to the AAI. The value of IA dummy is 1 for the years assistance was available and 0 otherwise. The construction of industry assistance dummy was based on DIISR (various issues), interviews with automotive executives, Lloyd (2008).

Capital intensity (KI) defined as the ratio of fixed capital to total employment in 2007/08 constant prices. Data sources: Automotive Industry Authority (1992), Australian Automotive Intelligence Yearbook (2008–2009), Australian Bureau of Statistics (2006 and 2010) and Department of Innovation, Industry, Science and Research (2006, 2007, 2008, 2009, 2010).

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