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Unprotective Tariffs, Ineffective Liberalization and Other Mysteries: An Investigation of the Endogenous Dimensions of Trade Policy Formation in Australia

Abstract - At the forefront of empirical research on Australia's trade policies two items seem to have attracted considerable interest: (i) the host of determinants of the highly dispersed tariff concessions, and (ii) the impact of liberalization on imports. Studies that investigate the former, in the context of endogenous trade policy formation, examine the impact of import penetration on tariffs, and studies that investigate the latter consider the effect of tariffs on import penetration. Despite the obvious simultaneity of these variables, research lines (i) and (ii) followed separate paths by only considering uni-directional causal relationships. And yet, these paths do converge. The meeting point: perplexing results! Tariffs are found to protect those industries that have the least use for protection, and liberalization is often determined to be entirely ineffectual in stimulating imports. In this paper we argue that the source of these puzzling results is found in the misspecification of the employed frameworks of analysis that ignore relevant feedback effects. This is illustrated using a model that facilitates the simultaneous determination of import penetration and tariffs. The results are startling. When the bi-directional causal relationship between the two variables is "disentangled" the estimated impact of import penetration on the tariff level increases by a fivefold, and that of tariffs on import penetration doubles.

1. Introduction

Since its formation as a federation in 1901, Australia embraced a fairly comprehensive tariff schedule in relation to imported manufactures[1]. Tariff rates fluctuated considerably over the years. However, over the course of the century they remained sufficiently high to earn Australian manufacturing the reputation of one of the most heavily protected manufacturing sectors in the industrialized world [2]. In recent years a number of liberalization waves have surfaced. The most notable of these took place in 1973, 1977, 1988, 1991 and, most recently, in 1994 with the signing of the "Uruguay round" of the GATT agreement. Still, tariffs remain a principal actor in Australia's menu of industrial policies. In the latest edition of the

[1] For a historical analysis of Australian import tariff policy see Woodland (1992), Capling and Calligan (1992) and Corden (1996).

[2] By 1970 Australia assumed the unenviable position of one of the two most heavily protected industrialised nations, the other being New Zealand. For a relevant discussion see Anderson and Garnaut (1986, p. 162).

annual report of the *Productivity Commission*[3], published in November of 1999, it is noted that while tariffs have dropped considerably since 1994, they "remain an important form of assistance...tariff assistance still accounts for around 90% of measured effective assistance to the *manufacturing* sector"[4] (p. 52).

Given the pervasiveness of Australian tariff policy, the significant welfare implications of changes in that policy, and the particular importance of international trade for this country, ensuing from its idiomorphic cultural, resource-endowment and geographic characteristics[5], considerable research effort has been invested in the examination of various dimensions of this issue. At the forefront of pertinent empirical research two items seem to have attracted most interest: (i) the host of determinants of the highly dispersed tariff concessions, and (ii) the impact of liberalization on imports. Research that falls in the category that examines the former, including Anderson (1980), Conybeare (1984), Aislabie (1988), and Feaver and Wilson (1999), is consistent, at varying degrees, with the theory of endogenous trade policy formation[6]. According to the foundations of this theory, tariff concessions may be viewed as prices that generate a political equilibrium. The mechanics are rather elementary. When the profit loss that arises from import competition exceeds the transaction cost of a successful lobbying campaign for protection, private interests

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[3] See the *Trade Assistance Review* supplement of the Productivity Commission's *Annual Report for 1999.*

[4] Italics added for clarity.

[5] See Anderson (1995) for a relevant discussion.

[6] See Tullock (1967), Pincus (1975), Brock and Magee (1978), Findlay and Wellisz (1982), Mayer (1984) and Magee, Brock, and Young (1989). For a succinct review of the literature see Tombazos (2000).

will undertake such lobbying activities. The higher the loss from foreign competition, the more intense the lobbying effort. Hence, higher levels of import penetration will lead to greater protection. Unlike this line of inquiry, the critical causal relationship of interest to studies that fall in the category that investigates (ii), including Simmons and Smith (1994), relates to the effects of tariff changes on imports, rather than the reverse.

Causal directions of the nature examined by studies that investigate (i) and (ii) are, of course, not mutually exclusive. Higher import penetration increases tariffs, and higher tariffs, in turn, decrease import penetration. However, despite the obvious simultaneity of these variables, studies of Australia's trade policies, associated with research lines (i) and (ii), have followed separate paths by only considering uni-directional causal relationships. And yet, these paths do converge. The meeting point: perplexing results! On the one hand, studies of endogenous protection, such as Anderson (1980) and Aislabie (1988), have consistently failed to establish the expected result that an increase in import penetration will lead to higher tariffs. On the other, studies of trade liberalization often find that tariff reductions have a surprisingly small effect on imports, with a study by Simmons and Smith (1994) concluding that, at least in relation to the examined industry, "...removal of the tariff would have no effect on the level of imports..." (p. 57).

In the context of the existing pertinent literature, this paper constitutes the first attempt to model the determination of imports and tariffs, relevant to the Australian manufacturing sector, simultaneously. The objective is twofold. First, such a model will shed light on the relevant dimensions of endogenously determined tariff concessions while independently accounting for important "feedback" effects that have been ignored by similar studies. Second, this model will explore the extent to which the degree of misspecification inherent in previous studies that investigate research lines (i) and (ii) may be responsible for their unsettling results.

The remainder of this paper is organized as follows. The model is examined in the following section. In section 3 issues of econometric implementation and the empirical results are discussed. Concluding remarks are reserved for section 4.

2. The Model

Bi-directional causation masks the relationship between trade barriers and trade flows when estimated using single-equation regression techniques. The only attempts to "reveal" the magnitudes of relevant dimensions of this relationship using simultaneous equation frameworks were undertaken by Ray (1981b) and, more recently, by Trefler (1993). Both authors employed limited-depended-variable formulations in their efforts to investigate the joint determination of Non-Tariff Barriers (NTBs) and imports in the United States. However, while the former failed to find any impact of NTBs on imports, the latter failed to measure a statistically significant effect of imports on NTBs. In this paper we employ a continuous-variable interpretation of the analytical framework pioneered by Ray (1981b) to investigate the simultaneous determination of import penetration and tariffs in Australia.

The system of equations that are jointly estimated is given by:

$$T = \alpha_T + \beta_M \cdot M + \mathbf{c}'_T \cdot \mathbf{X}_T + \varepsilon_T \qquad (1)$$

$$M = \alpha_M + \beta_T \cdot T + \mathbf{c}'_M \cdot \mathbf{X}_M + \varepsilon_M \qquad (2)$$

While these equations represent a cross-sectional characterization of the Australian manufacturing sector, we suppress industry subscripts in the interest of parsimony. T denotes the nominal tariff that corresponds to the level of protection granted to an industry that faces a level of import penetration given by M; $\mathbf{X}_T$ and $\mathbf{X}_M$ represent vectors of industry characteristics that determine tariff concessions and the demand for imports, respectively; and $\mathbf{a}' \equiv [\alpha_T, \alpha_M]$ and $\mathbf{e}' \equiv [\varepsilon_T, \varepsilon_M]$ represent the vectors of constants and residuals, respectively.

Similarly to other studies of the political economy of trade barrier concessions, including the most seminal contributions in this area, such as Pincus (1975), Caves (1976), Anderson (1980), Ray (1981a, 1981b, 1987) and Trefler (1993), our model does not incorporate the desired level of rigor often evident in behavioral functions that are explicitly derived from fully specified optimization frameworks. This limitation is inherent in the relative invisibility of political processes. Magee, Brock and Young (1989) note that the degree of invisibility of such processes of endogenous policy formation is itself endogenous, and is far more pronounced in the case of political processes that redistribute rents such as those modeled in this paper. In the words of these authors, "redistributive activity, like criminal behavior, is most successful when undetected" (p. 2). In an effort to, at least partly, ameliorate this deficiency, inherent to the area of our study, we follow Leamer (1984) and Trefler (1993) in subjecting our model to extensive sensitivity analysis. The relevant details are discussed in section 3.

The specification of equations (1) and (2) is examined below.

The Tariff Equation

The dependent variable of the tariff equation represents the unweighed average nominal tariff rate that prevailed in fiscal year 1990/91 in the case of each of the examined industries. It should be noted that in this year tariff concessions in Australia were not constrained by the GATT in any significant way. While among the 22 original signatories to the 1947 GATT agreement, Australia did not take part in the

GATT negotiations of the 1950s or the Kennedy Round of 1964-67, and did not fully participate in the Tokyo Round of 1974-79. In fact, as noted by Anderson (1995, p. 100), previous to the Uruguay round, signed in 1994, only 20% of Australian tariffs were bound by the GATT[7]. Hence, the dispersion of tariff rates that prevailed in the 1990/91 industrial cross-section is consistent with our model of discretionary, endogenously determined levels of protection.

In the choice of relevant explanatory variables for this equation we follow Ray (1981a) by assuming that the dispersion of tariff rates across the various industries reflects the maximization of industry profits subject to political constraints. If sufficiently profitable, and to the extent made feasible by organizational constraints, protection will be pursued via lobbying activities and is likely to elicit a positive response from self-interested politicians. We consider that industry characteristics affect the profitability of trade barrier concessions as well as the political parameters within which such concessions can be pursued. The relevant industry characteristics incorporated in the tariff equation are outlined in table 1 and are discussed below.

Import penetration is chosen over unscaled imports to capture the extent to which the infiltration of foreign products in domestic markets represents a legitimate source of competition for domestic producers. Following Trefler (1993), import penetration enters the tariff equation both directly, as well as indirectly, via Δ(import penetration). While a separate equation is not specified for the latter, both variables are treated as endogenous in the estimation of the model. For reasons outlined in the introduction, the coefficients associated with both variables are expected to be positive. Exports represent a variable that also relates to a given industry's

[7] "Although Australia has strongly supported the GATT in principle, that support has been tempered by domestic considerations" (Capling and Calligan, 1992, p. 106).

comparative advantage, and is expected to be negatively correlated with import tariffs. Industries with a more pronounced export orientation, that export a relatively substantial percentage of their output, are likely to profit less from protection for two distinct, but closely related, reasons. First, export orientation reflects relatively efficient production circumstances. Hence, foreign imports are not likely to represent a legitimate threat to domestic sales. Second, protection of export oriented industries may invoke retaliation by foreign nations which will affect profit adversely.

According to the Olson-Stigler lobby behavior [Olson (1965); Stigler (1971, 1974)] lobbying contributions for protection are linear homogeneous with respect to the expected reward, and inversely related with coordination transaction costs and existing entry barriers. To capture these elements vector $\mathbf{X}_T$ collects variables pertaining to industry concentration, the number of establishments scaled by turnover, and the unscaled capital stock. Greater concentration reduces the free rider problem and is expected to lead to higher protection. At the same time, as argued by Caves (1976) and Ray (1981b, p. 164), less concentrated, widely dispersed, industries may have a stronger political base to lobby for protection. In view of the conflicting dynamics it is not easy to form an 'a priory' expectation regarding the sign of this variable. As previously noted, the transaction costs associated with the coordination of industrial lobbies is further investigated through a regressor labeled "number of establishments". This variable corresponds to the number of establishments scaled by turnover to account for the expected linear relationship between lobby contributions and expected benefits of tariff concessions. A smaller number of establishments, relative to industry turnover, ameliorates the free rider problem, thus increasing the level of protection. In relation to existing, tariff-independent, entry barriers we follow Trefler (1993, p. 141) in considering that if such barriers apply symmetrically to domestic and foreign rivals they reduce the value and, therefore, the level of protection. The unscaled capital stock is employed as a proxy to such barriers.

An important dimension of endogenous trade policy formation relates to the extent to which industries lobbying for protection are "disadvantaged". From the protection demand perspective Magee, Brock, and Young (1989) assert that disadvantaged groups have a low opportunity cost of lobbying. From the supply standpoint it has been argued by Anderson (1980, p. 136) that Australian voters are more likely to disapprove assistance that is dispensed to industries not seen to be facing significant hardship. Following Anderson (1980), Ray (1981a) and Trefler (1993) an industry is viewed as disadvantaged if it experiences a slow growth rate[8] and if a considerable proportion of its workforce corresponds to production (i.e. unskilled) labor. To investigate the latter variable comprehensively we also incorporate two related occupational variables in the tariff equation pertaining to the proportion of white collar and semi-skilled labor in aggregate industry employment. Given our earlier discussion, the expected sign of industry growth is negative and that of production labor is positive. The remaining occupational variables are not signed ex ante. In addition to measures already discussed, the "labor interest" is further represented by aggregate industry employment and the geographic concentration of employment in each industry across the eight Australian states and territories. The former variable is expected to exhibit a positive relationship with the level of

[8] Using a rigorous theoretical framework of analysis Peltzman (1976) illustrates the dynamics that generate assistance bias in favour of declining industries. Empirical support for this result is provided by Cheh (1974) who found that, in the case of the US, tariff cuts during the Kennedy round were applied less frequently to industries experiencing slower growth rates.

protection given that large clusters of workers represent large clusters of votes. At the same time, as noted by Pincus (1975) and Anderson (1980), geographically concentrated industries with small employment may very well receive a disproportionately large level of assistance "...*particularly* the more marginal the electorates in which an industry is located...*and* especially since the possibility of 'log-rolling' amongst politicians in the party room or in the Cabinet helps to offset the disadvantage of supplying few votes" (Anderson, 1980, p. 137)[9]. Such positive effects are compounded by the fact that geographically concentrated employment is expected to complement the role of high industry concentration and a small number of firms by curtailing the free rider problem. Hence, we expect a positive relationship to be exhibited between geographic concentration and the dependent variable.

The Import Equation

The adopted specification of the import equation, outlined in table 1, is consistent with a Hecksher-Ohlin framework of trade similar to that adopted by Ray (1981b) and Trefler (1993). Unlike these two authors however, we choose to represent the primary factor inputs of capital and labor by the value of capital scaled by turnover and the sum of gross wages and salaries scaled by turnover, respectively. In the context of the model presented in this paper these input (or endowment) measures are preferable to alternatives used in the literature in three distinct ways. They are easily comparable; they capture, at least superficially, the (average) intensity with which they are used in production; and they are distinct from exogenous variables used in the Tariff equation which, at least in the context of our model, is a

[9] Italics added for clarity.

requirement for identification[10]. To form a fully simultaneous model, and account for all relevant feedback effects, the nominal average tariff level is finally added as an explanatory variable in the import equation.

3. Econometric Implementation and Empirical Results

The econometric results discussed in this section were generated using cross-section data for 109 Australian manufacturing industries for fiscal year 1990/91. The employed dataset was constructed using information obtained from the *Industry Profiles*, the *Australian Manufacturing Industry and International Trade Data 1968-69 to 1992-93*, the *Trade Analysis and Information System (TRAINS) CD-ROM*, the *1991 Census of Population and Housing* and additional customized information provided by the *Australian Bureau of Statistics* and the *United Nations Conference on Trade and Development (UNCTAD)*[11].

The equations of the model outlined in the previous section were estimated simultaneously as well as independently. Simultaneous equation regressions employed both two stage least squares (2SLS) and three stage least squares (3SLS) methods. To facilitate accurate estimations, our vector of instruments included not only the characterizations of the relevant model regressors that appear in table 1 but

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[10] Following Kennedy (1992, p. 165) and Maddala (1977, p. 234), if we assume that the tariff equation incorporates a maximum of three endogenous variables [tariffs, import penetration and Δ (import penetration)] then the model will be identified only if the import equation incorporates at least two exogenous variables not included in the tariff equation.

[11] A statistical appendix illustrating detailed sources and construction techniques for all data employed by the model can be supplied from the author upon request.

also alternative, comparably meaningful, definitions of these variables[12]. Independent estimations of the model equations were performed using ordinary least squares (OLS). Where possible, the covariance matrix was corrected for heteroskedasticity using the method proposed by White (1980) and Greene (1997).

The resulting parameter estimates of independent and simultaneous regressions of the model equations, outlined in the previous section, are reported in table 2 together with the associated t-statistics and adjusted r-squared measures[13]. As can be noted, the results generated using the 2SLS and 3SLS methods of simultaneous equations estimations are virtually identical. Furthermore, the majority of the coefficients estimated using these methods are statistically significant and qualitatively consistent with our expectations.

As noted from table 2 a *dynamic* change in import penetration [Δ(import penetration)] is negatively correlated with the prevailing nominal tariff rate. In our earlier discussion we predicted that the coefficient of this variable would be positive by considering not only that high tariff rates are correlated with high import

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[12] The additional instruments are EXP82 (Unscaled exports in year 1981/82), EXP91 (Unscaled exports in 1990/91), EMP90 (Employment in 1989/90), CURASS90 (Unscaled value of current assets in 1989/90), LACOST90 (Selected labor costs in 1990/91), TURN82 (Turnover in 1981/82) and GP92 (Gross product of fiscal year 1990/91 at factor cost using 1989/90 prices).

[13] Since regressions of equation systems do not minimise the sum of the squared errors of each independent equation, but instead the determinant of the residual cross-product matrix, single equation r-squared measures are flawed in the context of equation systems. Hence, in the case of 3SLS results we report the generalised r-squared, $\widetilde{R}^2$, suggested by Berndt (1991, p. 468).

penetration rates but also that, despite the overall downward trend exhibited by Australian tariffs over the 1981/82-1990/91 period, changes in import penetration that have taken place during this period may explain the *relative* dispersion in the *levels* of assistance that prevailed in 1990/91. This does not seem to be the case. The implication of this result is that a large change in import penetration in the case of an industry that, despite this change, is still experiencing a relatively small amount of foreign competition, will not drive the level of protection dispensed to this industry sufficiently high so that it is protected to a greater extent than, say, another industry, that is facing a higher overall import penetration. This result may reflect the presence of certain rigidities in the system which may derive from the increasingly unpalatable nature of tariffs. Large increases in import penetration in the case of industries that traditionally only received a moderate level of protection may lead to small relative changes in the level of assistance, whereas a higher degree of institutional flexibility to increase the relative level of protection may be present in the case of industries that have a long tradition of receiving considerable assistance from the government.

Given the conflicting dynamics associated with changes in the level of industry concentration we were not able to sign this variable a priori. The estimated coefficient is negative and statistically significant, suggesting that protection favors more widely dispersed industries. This result is novel in the Australian context as previous studies of endogenous trade policy formation have not explored the empirical relevance of this variable. Comparing this result with corresponding findings of studies that employ US and Canadian data is not particularly instructive. Whereas Caves (1976) identifies a negative, and Trefler (1993) a positive coefficient for similar variables, Ray (1981a, 1981b) finds mixed results that are sensitive to the adopted specification. A second measure of the centrality of industrial organization pertains to geographic concentration. While not previously investigated in an empirical setting, geographic concentration has been long viewed as an important industry characteristic in the context of the political economy of policy formation in Australia. Given our earlier discussion, which relied primarily on Anderson's (1980) theoretical analysis of the channels through which geographic concentration may influence industry assistance, this variable is expected to exhibit a positive correlation with the level of protection. Our findings provide support for Anderson's prediction, at least to the extent suggested by a positive, but statistically insignificant coefficient. Also in accordance with our earlier predictions, Capital stock is found to exhibit a negative relationship with the level of assistance. It is worth noting that the coefficient of this variable is statistically significant at the 1% level and highly insensitive to the various estimation methods that are employed. This result provides strong evidence consistent with the notion that existing barriers to entry diminish the value, and therefore the incidence, of protection.

Contrary to our expectation, we find that production labor, which represents one of the variables intended to capture the extent to which an industry may be viewed as disadvantaged, and therefore "worthy" of assistance, is negatively correlated with the level of protection. Furthermore, we find that the proportions of the other two occupational categories, given by white collar and semi-skilled workers, that are employed in the various industries, are also negatively related to the level of protection. A comprehensive interpretation of these results is not readily evident. It is however important to emphasize that the employed occupational variables are fairly crude representations, and may easily disguise aspects of prevailing occupational biases of industry assistance that may relate to more detailed labor disaggregations.

The remaining coefficients estimated in this study are comparable with those that are empirically investigated by Anderson (1980). With the exception of import penetration, the remaining variables, pertaining to exports, number of establishments, industry growth and aggregate employment, reinforce Anderson's findings and are all consistent with our a priori expectations. Specifically, we find that the level of assistance dispensed by the government in terms of tariff concessions is biased towards industries that are characterized by comparative disadvantage, few establishments, slow growth and a large workforce.

Despite considerable convergence between our results and those of previous studies, the two do differ in the case of the most fundamental dimension that is investigated: import penetration. Consistently with the predictions of the theory of endogenous protection we find that an increase in import penetration is positively and significantly correlated with the nominal rate of assistance. However, using single equation estimation techniques and Australian data, similar studies, including Anderson (1980) and Aislabie (1988), consistently found import penetration to be negatively correlated with the level of protection. The implication that trade barriers are unprotective presented a puzzling proposition to these authors. Anderson (1980) notes characteristically, "The negative though mostly insignificant coefficient for IMP (*i.e. import penetration*) indicates that the more assisted industries have not necessarily been those whose domestic markets have been supplied largely by imports. But this is probably because industry assistance itself has reduced import penetration ratios in highly assisted industries to well below what they would have been in the absence of assistance. Certainly one should not conclude from this result that the stronger the import competition, the less assistance an industry is likely to receive"[14] (p. 139). Anderson was correct in suspecting that his single equation estimation technique facilitated the disguise of the complex, bi-directional, relationship between import penetration and the level of protection. Our model allows

[14] Italics added.

the simultaneous determination of the two variables thereby "disentangling" the impact of a higher import penetration on tariffs, and, in turn, the effect of such higher tariffs on import penetration. To evaluate the extent to which single estimation techniques that are employed in the context of endogenous trade theory models may underestimate the impact of import penetration on protection, we proceed to compare the relevant coefficient derived by estimating our tariff equation independently using OLS, and simultaneously with the import equation, using 2SLS or 3SLS. As it may be noted from table 2, the coefficients of import penetration in the case of 2SLS and 3SLS estimations are virtually identical and correspond to 0.25. However, the corresponding coefficient assumes the value 0.05 when estimated with OLS. Hence, when the bi-directional relationship between import penetration and the level of protection is disentangled the coefficient of the former increases by a staggering fivefold!

Turning our attention to the import equation we note that while labor intensity is positively and significantly correlated with imports, the coefficient pertaining to capital intensity does not exhibit statistical significance. While this study does not concentrate on the determinants of comparative advantage, it is important to note that these results are roughly consistent with relevant stylized facts, as well as the main findings of studies that investigate aggregate Australian import demand functions such as Tombazos (1999). Finally, we note that, as expected, tariffs are negatively and significantly correlated with import penetration. Similarly to the case of single equation studies of endogenous protection, previous investigations of the impact of tariffs on imports, such as Simmons and Smith (1994), did not account for the bi-directional nature of the relationship between the two variables. This generated equally puzzling results as tariff decreases were generally found to have a surprising small effect on imports. To shed light on this issue we proceed to compare the corresponding coefficients of tariffs (in the import equation) derived using OLS and simultaneous 3SLS techniques. The parameter estimate generated with the former method is –0.21 and the coefficient that corresponds to the latter technique is –0.48. Hence, at least in the context of our model, accounting for the relevant feedback effects leads to an estimate of the relevant coefficient that is twice as large as the corresponding estimate that ignores the issue of simultaneity.

To investigate the robustness of our results we consider that they may be sensitive to the choice of specification of the tariff equation. In this vein we proceed to estimate alternative formulations of the simultaneous model that entail dropping regressors, other than import penetration – our key variable, from the tariff equation, one at a time[15]. In addition, the model is also estimated after dropping all peripheral instruments[16]. The outlined sensitivity analysis protocol requires the estimation of a total of twelve models. To facilitate a meaningful comparison between analogous estimates derived from simultaneous equation and single equation regressions, we also perform similarly specified independent estimations of the tariff equation using OLS. Table 3 summarizes the results. In the case of the 3SLS estimations we report the likelihood ratio test pertaining to each alternatively specified edition of the tariff equation. In addition, for each set of corresponding simultaneous and independent regressions we report the 3SLS estimate of the coefficient of import penetration β_M^{3SLS}, the ratio between corresponding import penetration coefficients derived via 3SLS and OLS, $\beta_M^{3SLS} / \beta_M^{OLS}$, the 3SLS estimate of the coefficient of the tariff variable β_T^{3SLS}, and the ratio between corresponding tariff level coefficients derived via 3SLS

[15] It should be noted that when a regressor is dropped all associated instruments are also dropped.

[16] These are instruments other than those that appear as regressors in the model.

and OLS, $\beta_T^{3SLS} / \beta_T^{OLS}$. Finally, where applicable, we report coefficient sign reversals in the case of both single equation and system of equations estimations.

As can be noted from table 3, the likelihood ratio test renders significant results in the case of the majority of the regressors used in the 3SLS estimation. Furthermore, the values of β_M^{3SLS} and β_T^{3SLS} are reasonably stable across alternative specifications. More importantly, as the reported values for $\beta_M^{3SLS} / \beta_M^{OLS}$ and $\beta_T^{3SLS} / \beta_T^{OLS}$ show, irrespectively of the specification, single equation estimations invariably underestimate (the absolute value of) the coefficients of both import penetration and tariffs. Furthermore, while sign reversals are generated by both single equation and system of equations estimations, only the former reverse the sign of import penetration. Sign reversals that are generated by the simultaneous models are confined to the case of only three coefficients, all of which were found to be statistically insignificant in the original, unconstrained, model.

It is worth noting from table 3 that the sign of the coefficient of import penetration which appears in the tariff equation exhibits a reversal in the case of the single equation estimation when certain occupational variables are dropped. Interestingly, these are variables not used by studies of endogenous policy formation that employed Australian data such as Anderson (1980) and Aislabie (1988). Hence, in a sense, the single equation regressions that exclude the relevant occupational industry characteristics "reproduce" the puzzling results of these authors, using, of course, an entirely distinct dataset. It is important to note that even in such an extreme case, in which the coefficient of import penetration is underestimated to the extent that it exhibits a sign reversal, the simultaneous estimation of this coefficient is sufficiently robust to maintain its positive qualitative dimension intact.

4. Concluding Remarks

Previous studies of endogenous protection, on the one hand, and trade liberalization, on the other, that employ Australian data have generated perplexing results. The findings of the former are consistent with a framework of unprotective tariffs, and the results of the latter suggest that liberalization is generally ineffectual in stimulating imports. In this paper we argue that the source of such puzzling results is found in the misspecification of analytical frameworks employed by the relevant studies which ignore the bi-directional causal relationship between levels of protection and import penetration.

The model that we estimate in this paper improves upon similar studies that employ Australian data in two distinct ways. First, it investigates the significance of a number of dimensions of the theory of endogenous trade policy formation not previously examined in the relevant literature using relatively recent data. Second, and most importantly, it facilitates the simultaneous determination of import penetration and tariffs. This approach disentangles the relevant feedback effects which can now be estimated independently. The results are startling. When the bi-directional causal relationship is correctly specified the estimated impact of import penetration on the tariff level increases by a fivefold and that of tariffs on import penetration doubles.

Our results may inform a number of pertinent debates directly, but we feel that they are most useful in introducing a new framework of analysis of the nexus between endogenous tariffs and liberalization initiatives in Australia, with policy relevant implications.

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Table 1. Regressors of Model Equations

The Tariff Equation[a]	
Import penetration	Nominal imports as a percentage of domestic consumption defined as domestic production (turnover) plus net imports
Δ (import penetration)	Import penetration in 1990/91 minus import penetration in 1981/82
Exports	Exports as a percentage of turnover
Concentration	Four firm concentration ratio (Output of the four largest firms as a percentage of aggregate industry output)
Establishments	Number of establishments scaled by industry turnover
Capital stock	Value of total industry assets in fiscal year 1989/90
Industry growth	Change in turnover from 1981/82 to 1990/91 as a percentage of turnover in 1981/82
Geographic Concentration	Index of employment concentration across the eight Australian States and Territories given by: $\sum_{i=1}^{8} \left\| Emp_i / \sum_{j=1}^{8} Emp_j - Pop_i / \sum_{j=1}^{8} Pop_j \right\|$ where Pop_i (Emp_i) corresponds to the population (number of workers in a given industry) residing (employed) in state or territory *i*.
Employment size	Unscaled number of workers in industry
White collar workers[b]	Percentage of Managers and Professionals in aggregate industry employment
Semi-skilled workers[b]	Percentage of Paraprofessionals, Tradespersons, Clerks, Salespersons and Personal service workers in aggregate industry employment
Production workers[b]	Percentage of Laborers and related workers in aggregate industry employment
The Import Equation[a]	
Tariff	Nominal (unweighed) average tariff of 1991
Capital intensity	Value of total assets of fiscal year 1989/90 scaled by turnover of 1990/91
Labor intensity	Gross wages and salaries scaled by turnover

Notes: "a" unless otherwise indicated the relevant observations correspond to fiscal year 1990/91. "b" to avoid a collinear relationship between these variables, one occupational category (operators and drivers) was dropped. The data used to construct these variables was extracted from the census of 1991.

Table 2. Estimated Model Coefficients

Dependent Variable: Tariff	OLS[a]		2SLS[a]		3SLS	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Constant	61.3557*	5.250	73.2737*	5.129	72.9685*	6.669
Import penetr.	0.0456	1.356	0.2468**	2.110	0.2519**	2.109
Δ (import penetr.)	-0.0526	-0.723	-0.5335**	-2.004	-0.5284**	-2.033
Exports	-0.0907*	-7.111	-0.0833**	-2.293	-0.0831**	-2.033
Concentration	-0.1570*	-2.660	-0.1389***	-1.837	-0.1399**	-2.170
Establishments	-0.0314	-1.355	-0.0468	-1.580	-0.0472	-1.472
Capital stock	-0.0087*	-3.920	-0.0088*	-3.282	-0.0088*	-3.098
Industry growth	-0.0039	-0.432	-0.0150	-0.899	-0.0150	-0.869
Geograph. concentr.	7.4751***	1.942	2.6155	0.508	2.7075	0.618
Employment size	0.0006***	1.877	0.0006***	1.793	0.0006	1.623
White collar workers	-0.7011*	-3.676	-0.9256*	-3.521	-0.9176*	-3.616
Semi-skilled workers	-0.3969*	-3.561	-0.5387*	-3.752	-0.5383*	-4.725
Production workers	-0.5624*	-4.409	-0.6384*	-3.841	-0.6376*	-4.908
$\tilde{R}^2$	0.45		0.25		0.37[b]	
Dependent Variable: Import penetr.						
Constant	7.2627	0.830	8.2056	0.927	8.2628	0.972
Tariff	-0.2126	-1.110	-0.4816	-1.575	-0.4768***	-1.674
Capital intensity	7.1253	0.830	6.6516	0.746	6.5708	1.062
Labor intensity	92.9693**	2.525	109.6587*	2.850	109.3310*	2.845
$\tilde{R}^2$	0.04		0.03		0.37[b]	

Notes: Superscripts of one, two and three asterisks denote significance at the 1%, 5% and 10% level with a two-tailed test, respectively. Superscript "a" indicates heteroskedasticity correction of the covariance matrix using the method proposed by White (1980) and Greene (1997). Superscript "b" denotes Berndt's (1991, p. 468) generalized adjusted R-squared.

Table 3. Sensitivity Analysis

Specification	Likelihood Ratio Test[e]	Sign reversal in OLS estimations	Sign reversal in 3SLS estimations	β_M^{3SLS}	$\frac{\beta_M^{3SLS}}{\beta_M^{OLS}}$	β_T^{3SLS}	$\frac{\beta_T^{3SLS}}{\beta_T^{OLS}}$
Unconstrained model							
	n.a.	n.a.	n.a.	0.25	5.52	-0.48	2.24
Omitted regressor in Tariff equation							
Δ (import penetration)	-26.84	Я		0.12	3.59	-0.47	2.23
Exports[b]	66.32*			0.16	6.74	-0.42	1.98
Concentration	10.69*			0.26	4.53	-0.58	2.72
Establishments	-5.12	Я		0.23	5.71	-0.45	2.13
Capital stock[a]	2.63			0.26	5.01	-0.53	2.50
Industry growth	5.46**	Я	Я	0.28	6.18	-0.48	2.25
Geographic concentr.	9.84*		Я	0.29	3.77	-0.54	2.52
Employment size[c]	5.67	Я	Я	0.32	6.71	-0.45	2.12
White collar workers	42.99*			0.25	-19.57	-0.29	1.34
Semi-skilled workers	4.17			0.08	-18.44	-0.52	2.43
Production workers	41.74*			0.40	11.53	-0.39	1.83
Peripheral instruments[d]	106.03*			0.17	3.70	-0.60	2.80
Non-omitted regressor in Tariff equation							
Import penetration	n.a.	Я		n.a.	n.a.	n.a.	n.a.
Non-omitted regressor in import penetration equation							
Tariff	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.
Capital intensity	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.
Labor intensity	n.a.	n.a.		n.a.	n.a.	n.a.	n.a.

Notes: The first section of this table provides information derived from the unconstrained simultaneous model estimated using 3SLS and OLS. Each row of the second section of this table represents a different specification in which the regressor listed in the row, and associated instrumental variable(s), are omitted from the Tariff equation in 3SLS and OLS estimations (this section summarizes the results of these twelve specifications). If in at least one of these specifications, estimated via 3SLS and OLS, a variable exhibited sign reversal, this is indicated with an "Я" in the appropriate column. "a" related instrumental variable CURASS90 was also excluded from the estimations. "b" related instrumental variables EXP82 and EXP91 were also excluded from the estimations. "c" related instrumental variable EMP90 was also excluded from the estimations. "d" These include EXP82, EXP91, EMP90, CURASS90, LACOST90, TURN82 and GP92. "e" The Likelihood ratio test was performed using the log-likelihood values of the 3SLS estimation of the Tariff equation corresponding to the constrained and unconstrained models. Superscripts of one and two asterisks denote significance at the 1% and 10% levels, respectively. "n.a." denotes "non applicable".

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