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TRADE BARRIERS AND TRADE FLOWS ACROSS COUNTRIES AND INDUSTRIES

Jong-Wha Lee and Phillip Swagel

ABSTRACT

We use disaggregated data on trade flows, production, and trade barriers for 41 countries in 1988 to examine the political and economic determinants of non-tariff barriers, as well as the impact of protection (both tariff and non-tariff) on trade flows. We use an econometric framework that allows for the simultaneous determination of trade barriers and trade flows. Our results are consistent with political-economy theories of the determinants of protection: even after accounting for industry-specific factors, nations tend to protect industries that are weak, in decline, and threatened by import competition. Countries also give more protection to large industries; these might be thought of as politically important. Nations use tariffs, non-tariff barriers, and exchange rate controls as complementary instruments of protection.

Trade Barriers and Trade Flows Across Countries and Industries

Jong-Wha Lee and Phillip Swagel[1]

I. Introduction

Theoretical interest has recently focused on the determinants of nations' trade barriers. Underlying these theories is the implicit belief that there are common economic and political factors which can explain the structure of protection across countries and industries. This is in contrast to a literature exemplified by Hufbauer and Rosen (1986) which argues instead that at least in the United States, protection is "special" in the sense that it is best explained on a case-by-case or industry-by-industry basis.

The contribution of this paper is entirely empirical. We use disaggregated cross-country, cross-industry data on manufactured goods to examine the political and economic determinants of non-tariff barriers in 1988. As tariff levels have fallen and remained bound by GATT strictures, non-tariff barriers have increasingly become the instrument of choice for protection. The calls for protection from import-competing industries indicate that the pattern of trade is likely to have an effect on the structure of protection. Since protection (both tariff and non-tariff) clearly affects trade flows, we use an econometric framework that allows for the simultaneous determination of trade barriers and trade flows. Unlike previous studies, our

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[1]The authors are respectively: Assistant Professor, Korea University and NBER; and Visiting Assistant Professor, Northwestern University. This paper was written while the second author was a staff economist in the U.S. International Transactions section of the International Finance Division. We thank Judy Hellerstein, Mike Knetter, Kala Krishna, and Andrew Warner for helpful discussions, seminar participants at the 1994 Econometric Society Winter Meetings, the Federal Reserve Board, the New York Fed, and Fletcher for comments, and Refik Erzan and Will Martin for assistance in obtaining data. The opinions expressed in this paper are solely those of the authors, and are not necessarily shared by the Federal Reserve System or its staff.

sample includes both developed countries with low barriers, and developing countries with substantial protection across all manufacturing industries. Indeed, a novelty of this paper is combining disaggregated data on production, trade flows, and trade barriers for a broad range of countries.

Our results are consistent with political-economy theories of the determination of trade protection. We find that non-tariff barriers are determined by more than just industry-specific factors. Nations tend to protect weak industries, as well as industries in decline. Large industries, which we think of as being politically important, also receive protection in the form of non-tariff barriers. Lastly, we find some evidence, although not conclusive, that non-tariff barriers and exchange rate controls were more significant barriers to trade in manufactures than tariffs.

The paper proceeds as follows. The next section discusses political-economy theories of trade protection. In section III, we then specify a model of trade flows based on the monopolistic competition model of trade, along with a model of trade barrier determination. Section IV describes the data, after which we present our empirical results in Section V. Section VI concludes.

II. The Political-Economy of Trade Protection

1. Models of Trade Protection

Given the economic consensus regarding the efficiency of free trade, models of trade

barrier determination typically turn to political-economy explanations.[2] Baldwin (1982) discusses political motivations for trade protection, while Hillman (1989) and Magee, Brock, and Young (1989) survey a variety of models in which political factors influence trade policy. Bhagwati (1982) also contains several interesting models of protection besides those we discuss below.

The key insight is that the structure of the political system can be important in the determination of trade protection when a distinction exists between consumers and producers, or between different groups of consumers and/or producers. The benefits of trade protection typically accrue to a narrow group of stakeholders in the protected industry, while the costs are spread over a much larger number of consumers, each of whom loses only a small amount. This asymmetry means that protection may be politically efficient even if it is inefficient in an economic sense.

Hillman (1982) cites the transactions cost theories of Peltzman and Stigler as an underpinning to this political efficiency of protection. If there are costs to gathering information or voting (hiring a public relations or lobbying firm), then even with majority voting, atomistic consumers will not lobby against the protection sought by a small industry group. Instances of industry-led protection abound. For example, Irwin (1993) provides a fascinating account of the evolution of trade policy in the semiconductor industry, and details the important role played by the Semiconductor Industry Association.

This is formalized in political support models such as Hillman (1982), in which a

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[2]There is of course a large literature on strategic trade policy, but this typically examines trade barriers in a particular industry, rather than the determination of the entire structure of trade protection.

policymaker seeking to ensure reelection balances the welfare of consumer-voters who suffer from protection against the political support (i.e., campaign contributions) provided by an industry seeking protection. Grossman and Helpman (1992) provide a more rigorous theoretical foundation for this literature through an explicit model of the process by which different interest groups bid for protection. With perfect competition in the product market, their model predicts that the structure of protection depends on two factors: the elasticity of import demand, which indicates the degree to which trade barriers distort welfare, and the ratio of imports to domestic output, which reflects the political importance of the domestic industry.

As in Kasa (1991), protection for declining industries can be explained as an attempt to mitigate the adjustment costs incurred in factor reallocation. In Cassing and Hillman (1986), an industry's slow decline can turn to sudden collapse once the industry shrinks below the threshold where it is large enough to gain the ear of politicians. Mayer (1984), on the other hand, shows that small industries might be more likely to garner protection, since the welfare loss from the protection will be small and thus unlikely to raise opposition. Stole and Zame (1993) allow for the possibility of foreign direct investment, and show that domestic firms might reduce demands for trade relief in order to avoid more intense direct competition from transplant industries, particularly in expanding industries.

Cassing and Hillman (1985) show that political considerations will also apply to the choice of protectionist instrument--that it is sometimes advantageous to use a quota instead of a tariff despite the loss of quota rents. In practice, giving up quota rents to foreigners might be used to "buy off" the affected firms in exporting countries in order to forestall protectionist retaliation (Marvel and Ray (1987)).

2. Empirical Studies of Trade Protection

The papers by Marvel and Ray (1983, 1987, 1981a, 1981b, 1985) examine various aspects of the implication of the theoretical literature that the structure of protection across industries depends on the particular political and economic characteristics of each industry. Ray (1981b) estimates equations for the simultaneous determination of imports and trade barriers (both tariff and non-tariff) in the United States. The import equation is based loosely on the Heckscher-Ohlin model, while trade barriers are determined by industry characteristics such as a measure of capital intensity, the proportion of skilled labor, the domestic supply elasticity, and the concentration ratio. He finds that non-tariff barriers in the United States fell mainly on capital-intensive, low-skill industries. Ray (1981a) estimates trade and protection equations for both the U.S. and for an aggregate of foreign countries. While he finds that tariffs and NTB's were used as complements, he finds no effect of trade protection on U.S. imports. More recently, Trefler (1993) estimates trade and NTB equations for the United States and shows the importance of taking into account the simultaneous determination of imports and trade protection. Trefler also finds that political factors and proxies for industrial structure, such as measures of union density and industry concentration, have the expected positive impact on the level of protection in the United States.

Marvel and Ray (1983) estimate equations for the determination of U.S. tariffs and NTB's alone. They find that protection was given to politically important industries, and industries under threat, while healthy industries received less protection. They ascribe this to the Peltzman-Becker theory of regulation, which suggests that policymakers will seek to share an industry's good fortune with weaker sectors. Finally, Ray and Marvel (1985) estimate tariff

and NTB equations alone for the U.S., Canada, Japan, and the EC as a whole. They find broad similarities in the structure of protection in these countries. Although tariff rates were generally low, they find that NTB's were used to undercut this apparent liberality, particularly in the EC. Dick (1994) also finds that NTB's were used to compensate industries affected by reduced tariffs.

Like Ray (1981a, 1981b) and Trefler (1993), we combine the literatures on the determination of trade barriers and trade flows, and attempt to control for their simultaneous determination. One advantage of our analysis is that our sample includes both developed and developing countries, and thus encompasses substantially more variation in the structure of trade flows and trade barriers.

III. Models of Trade Barriers and Trade Flows

1. The Monopolistic Competition Model of Trade

Following Krugman and Helpman (1985), we assume a monopolistic competition model of trade, in which goods are imperfectly substitutable and differentiated by country of origin. With identical homothetic preferences for consumers, each country consumes identical proportions of each product. Since production of each variety of a product occurs in only one country, the model gives a prediction of the volume of trade as follows:

$$(1) \qquad IM_{ij} = s_j (Q_i - Q_{ij})$$

where:
- IM_{ij} = import of good i by country j
- Q_{ij} = production of good i in country j
- Q_i = total world production of good i
- s_j = share of country j in world income

Equation (1) states that country j's import of good i is proportional to the amount of good i produced outside country j, and provides a basic framework to estimate the volume of trade. For example, Lawrence (1987) estimates a logarithmic variant:

$$(2) \qquad \log(IM_{ij}/DU_{ij}) = \text{constant} + \alpha \log(Q_{ij}/Q_i) + \beta \log(\text{Distance}_j) + u_{1ij}$$

Domestic use, DU_{ij} equals production plus imports minus exports, while a trade-weighted measure of distance between the capital of each country and the capitals of its trading partners is used to proxy for transportation costs, as in Bergstrand (1989).

The monopolistic competition model gives a prediction of the volume of trade in the absence of trade barriers. When the Helpman-Krugman model is extended to include trade policies, as in Flam and Helpman (1987), it gives ambiguous predictions about the effects of protection on welfare, production, and trade flows. In the simple framework above, however, the model unambiguously predicts that the presence of trade barriers, such as tariffs, non-tariff barriers, and exchange controls, will diminish the volume of trade. As trade barriers increase the prices of foreign goods, consumption of imports falls while consumption of domestic goods rises.

Lawrence does not have measures of trade barriers, but instead identifies this with the residual; that is, he attributes any deviation of actual imports from predicted imports to the effects of protection. Because we have measures of trade barriers, we do not have to make this assumption, but can instead directly examine the impact of trade barriers on trade flows. We extend Lawrence's specification to consider the effects on the volume of trade of distortions such

as tariffs, non-tariff barriers, and exchange rate controls. This is similar to Harrigan (1993), who estimates the effects of tariff and non-tariff barriers (which are taken as exogenous) on bilateral trade flows in manufactures in OECD countries.

Adding the measures of trade barriers, the empirical specification in equation (2) becomes:

$$(3) \quad \log(IM_{ij}/DU_{ij}) = a_o + a_1 \log(Q_{ij}/Q_i) + a_2 \log(Distance_j) + a_3 \log(1+tariff_{ij}) + a_4 \log(1+NTB_{ij}) + a_5 \log(1+BMP_j) + u_{1ij}$$

The variables for tariff and non-tariff barriers (NTB) measure the intensity of trade barriers on good i in country j, while the black market premium (BMP) is meant to capture the distortionary effects of exchange controls that might hinder imports. These are described in Section IV.

Since production of each good is determined simultaneously with trade flows, we follow Harrigan (1992b) and use factor endowments to instrument for sectoral production. We use the economy-wide factor endowments of each nation's capital stock, labor force, human capital, and land area. These are also described in Section IV. Unfortunately, data on sector-specific inputs are not available for our wide range of countries. An immediate implication of this is that we cannot compare our results with those from a Heckscher-Ohlin model like the one Harkness (1978) estimates for the United States, in which factor-endowments determine the pattern of trade.

2. Endogenous Determination of Trade Barriers

As discussed in Section II, the structure of production is probably best thought of as

endogenously determined by both economic and political factors. To take into account the notion that the political power of the industry is likely to be important, we use two proxies for a sector's political influence: the size of the industry as measured by its share of value-added within a country, as well as the industry's share of labor. Of course, these are likely to be imperfect indicators of political importance, since small industries may be seen as crucial to national security, or in many countries, might be directly or indirectly owned by policymakers.

There may also be political pressure to protect "weak" industries, such as those with low productivity. To examine this, we use value-added per worker as a measure of industry productivity in our model of trade barrier determination. Of course, it may be impossible to make inferences about causality here, since protection could lead to a lazy industry with low productivity rather than a weak industry receiving protection. We need some instrument for productivity to better make this distinction. To examine the tendency of declining industries to receive protection, we include the five-year change in wage per worker (from 1982 to 1987) as an explanatory variable. If there is profit-sharing in an industry, declining wages would indicate declining rents, and thus shifting comparative advantage.

Not surprisingly, there are other determinants of trade protection for which we could not obtain data. For example, Grossman and Helpman (1992) show that trade barriers are more likely to exist the lower the own price elasticity of demand for an industry's product, since this entails a smaller deadweight loss to consumers. Similarly, the higher the foreign price elasticity of supply, the more effective will be a given trade barrier in changing the pattern of trade. Since we could not obtain cross-country, cross-industry data on elasticities and industry characteristics such as concentration ratios, we must instead rely on the inclusion of industry

fixed-effects to account for any omitted industry-specific effects. This will work to the extent that these omitted factors are constant across countries.

We take tariff rates as exogenous; while not strictly correct, this is probably not too bad an assumption relative to non-tariff barriers, since tariff rates in many countries are under GATT strictures. For the U.S., Ray (1981b) finds no feedback from NTB's to tariffs.

In our basic specification, then, non-tariff barriers in each industry of each country are expected to respond to sectoral imports and other economic and political factors:

$$(4)\quad \log(1+NTB_{ij}) = c_o + c_1 \log(IM_{ij}/DU_{ij}) + c_2 \log(VA_{ij}/L_{ij}) + c_3 \log(VA_{ij}/VA_j) + c_4 \Delta\log(W_{ij}/L_{ij}) + c_5 \log(1+tariff_{ij}) + c_6 \log(1+BMP_j) + u_{Nij}$$

where:

VA_{ij}/L_{ij}	=	labor productivity (value-added per worker)
VA_{ij}/VA_j	=	sectoral share of value-added
$\Delta(W_{ij}/L_{ij})$	=	five year change of real wage per worker

As discussed above, the labor productivity represents each sector's competitive position, while the sectoral share of value-added (or alternatively, the sectoral share of labor, L_{ij}/L_j) is meant as a proxy of political power. The change of real wages captures the evolution of each industry. Since declining industries typically call for protection, we would expect this to be negatively associated with non-tariff barriers. In addition, tariff rates and the black market premium are included in the regression to examine whether the different varieties of trade restrictions tend to be used as substitutes or in tandem. We also added several additional variables to this base specification; these are discussed in Section IV below.

The production share and distance measure are used as instruments for imports and thus

do not appear in the NTB equation, while the "political-economy" variables instrument for the level of protection, and do not enter into the import volume equation. This latter identifying restriction is clearly more troubling, since trade flows might have a direct effect on productivity, the industry share of value-added (or workers), and the evolution of wages.

As detailed in the next section, our measure of non-tariff barriers is a coverage ratio which is bounded from below at zero. To take this censoring into account, we specify the NTB equation (4) as a Tobit:

$$\log(1+NTB^{*}_{ij}) = c_o + c_1 \log(IM_{ij}/DU_{ij}) + c_2 \log(VA_{ij}/L_{ij}) + c_3 \log(L_{ij}/L_j) + c_4 \Delta\log(W_{ij}/L_{ij}) + c_5 \log(1+tariff_{ij}) + c_6 \log(1+BMP_j) + u_{Nij} \quad (5)$$

$$NTB_{ij} = NTB_{ij}^{*} \text{ if } NTB_{ij}^{*} > 0$$

$$= 0 \quad \text{otherwise}$$

We assume that the error terms u_I and u_N are distributed with a bivariate normal, and estimate equations (3) and (5) jointly using the simultaneous equations Tobit methodology of Nelson and Olson (1978). We estimate the equations both with and without industry fixed effects. Finally, we also estimate the equations using the corresponding single-equation methodologies (OLS and Tobit), and calculate a Hausman test of the null hypothesis of no simultaneity bias.

IV. Data

1. Trade and Protection Data

To measure the degree of trade barriers across industry and country, we use the dataset of

trade control measures (TCM) compiled by UNCTAD (1991). This provides information on both tariffs and additional charges on imports in 1988, as well as information on the coverage of non-tariff measures (NTM's) at the most detailed level of the Customs Co-operation Council Nomenclature (CCCN)--four digits plus up to two alphabetic codes.

The tariff provided by UNCTAD is the *ad valorem* rate for total import charges; this includes all duties and customs fees collected at national borders. The measure of non-tariff barriers reports the coverage ratio for "core" NTM's; this includes essentially all non-tariff restrictions applied at the border, including quantitative restrictions (QRs), Voluntary Export Restraints (VERs), and advance payment requirements. Note however, that the measures of both tariffs and NTB's do not include restrictions which apply inside national borders, such as consumption taxes in countries with no domestic production. See UNCTAD (1987, 1991) and Laird and Yeats (1990) for details.

The coverage ratio indicates the extent to which the tariff lines within a CCCN category are affected by core NTM's. For instance, the index equals zero for a particular 4 or 5 digit CCCN category if no NTM's apply to any of the products which make up that category. The CCCN category for autos might include tariff lines for both small and medium-sized products. If a country has an NTM on small but not medium-sized cars, then the coverage ratio for that CCCN category would equal 0.5 regardless of the composition of auto imports. The NTM coverage ratio thus captures only the frequency of the non-tariff restrictions, but provides no information on the severity of the distortions or the distribution of the resulting quota rents.

The data set also provides the value of trade flows taken from the United Nations COMTRADE database. The trade flow data is at the level of disaggregation needed to match

the tariff and NTM data (either 4 or 5 digits of SITC Revision 2), so that the UNCTAD database facilitates combining the trade barrier data with import values.

Unfortunately, reliable cross-country, cross-industry production data is available only at the 3 digit level of the ISIC classification, so we must aggregate up the data on trade barriers and trade flows by weighting them by the country's import value. Weighting by the own import-values has the well-known problem that a high level of protection typically results in a low level of imports, and thus a low weight. As a check on this bias, Table 1 reports tariff and non-tariff barriers aggregated from the 3 digit level to a single value for each country (what might be thought of as the "0 digit" level), using both import and production weights. Just as import weights will understate trade barriers, production weights will overstate them, since a high trade barrier will result in larger domestic production than would occur in the absence of all barriers. At this "0" digit level, the simple correlation between the two weighting schemes is 0.959 for both tariffs and NTB's, while the rank correlations are 0.935 for tariffs and 0.945 for NTB's. These high values provide some hope that using import weights to go from 4 or 5 digits to 3 digits will not introduce too much bias into the measures of trade protection.

2. Production, Labor and Wage Data

Data on gross-output and value-added, as well as industry wages and employment at the 3 digit level of the ISIC classification system are from the United Nations Industrial Statistics Yearbook Volume 1, as found in the BESD database of the World Bank. The data on wages includes wages, salaries, and supplements. This wage data, along with the data for gross-output and value-added are in home-country currency. To match the trade flow data which is reported

in US dollars, we convert the currencies using the exchange rate series from the Summers and Heston dataset. Implicit GDP deflators from the Summers and Heston dataset are used to deflate lagged wages to obtain the change in wage per worker in 1988 dollars.

The data for the black market premium, distance, and the factor endowments of land, area, human capital, and labor force are from Barro and Lee (1993). The measure of distance is the import-weighted distance between a nation's capital and the capitals of its trading partners. The black market premium on foreign exchange is measured as an average of the period from 1980 to 1984.

3. Features of Trade Barriers

Table 1 gives a summary of protection by country, while Table 2 summarizes protection across industries. Our sample is limited by the availability of both the trade data and the production data. For example, the UNCTAD trade barrier database does not include non-EC developed countries such as Austria, Switzerland, Australia, and New Zealand. Similarly, reliable production data are not available for many countries, particularly developing countries.

Construction of the import- and production-weighted tariffs and NTB's are discussed above; the standard deviations shown in Tables 1 and 2 are of the unweighted tariff rates and NTM coverage ratios. As expected, import-weighting typically results in smaller measures of protection than production-weighting, although again, the two are highly-correlated.

Even a brief glance at Table 1 reveals the dramatically higher levels of protection in developing countries than in developed (the table is sorted by IMF country codes, so the developed countries appear at the top). On the other hand, while tariff rates are quite low in

most developed countries, these nations employ a notably higher level of non-tariff barrier protection. This is consistent with the findings of Marvel and Ray (1983) and Dick (1994) that NTB's were used to offset the diminished tariffs negotiated in the various GATT rounds. The higher tariff levels in developing countries probably also reflect the greater importance of these relatively easily collected revenues in government finance.

Table 2 shows that protection, particularly non-tariff barriers, is concentrated in certain industries, notably food, clothing, steel, and transport equipment. Of course, these are for the most part explained by industry-specific managed trade arrangements, such as the Multi-Fibre Arrangement for textiles and clothing, and the web of bilateral quantitative restraints that govern trade in steel and automobiles. This suggests that the pattern of protection Hufbauer and Rosen (1986) ascribe to the United States might apply to the rest of the world as well--that protection is "special" in that it is industry-specific. If this were the case, then including industry fixed-effects in the basic regression specification of equation (5) would eliminate the statistical significance of political-economic determinants such as the political importance or competitive position of an industry in each particular country.

We should note that outlying observations in Tables 1 and 2 are the effect of particularly large protection by specific countries in certain industries. For example, despite otherwise moderate barriers, Venezuela protected its furniture industry in 1988 with an 85% tariff and 93% non-tariff barrier coverage, accounting for the large standard deviations of Venezuela's protection found in Table 1. Similarly, Egypt protected its beverage industry with a tariff rate of 2200% [sic], accounting for the large standard deviation of Egypt's tariff rates in Table 1 as

well as the large standard deviation of the beverage industry in Table 2.[3] Finally, we should note that the United Nations concordance we use to go from the detailed CCCN classification to the 3 digit ISIC classification assigns no products to ISIC category 356, Plastic Products, but instead places these in various other categories.

V. Empirical Results

Equations (3) and (5) are estimated jointly using a simultaneous equations Tobit estimator, where the import equation (3) is the usual linear model, and the NTB equation (5) is censored at zero. The results are found in Tables 3 to 5. As discussed above, all exogenous variables are used as instruments, with the political-economy variables excluded from the import equation, and the production share and distance measure are excluded from the NTB equation. In order to examine the degree to which industry-specific factors determine protection, we estimate the models both with and without industry fixed effects. As noted before, factor endowments are used to instrument for the production share; this first stage regression has an adjusted-R^2 of 0.83 without industry fixed effects and 0.93 with fixed effects.

1. Determinants of Manufactured Imports

Table 3 contains estimates of four specifications of the import equation (3). Columns (1) and (3) are for the base case, without and with industry fixed effects; these correspond to first column of Tables 4 and 5, which contain the results for the NTB equation. Columns (2) and (4) in Table 3 correspond to the third column in Tables 4 and 5, in which we add the Summers-

[3]Dropping this observation from the sample does not affect our results.

Heston measure of openness, defined as the sum of imports and exports as a fraction of GDP, as an additional explanatory variable in the NTB equation (that is, as an additional instrument in the import equation). The reasons for considering openness are discussed below in the context of the results for the NTB equation (5).

The negative and highly significant coefficient on the output share in all four specifications indicates that the monopolistic competition model seems to work well. On the other hand, the low R^2's of columns (1) and (2) without fixed effects show that the simple version of the model we use does not explain most of the variation in world trade flows.[4] Adding industry fixed effects improves the fit of the equation; this most likely indicates that the products of certain industries are simply more frequently traded than others, or that global trade in certain industries is comprised to a larger degree of two-way shipments of differentiated products of the type best characterized by the monopolistic competition model. As expected, the coefficients on distance and the black market premium are always significant and negative.

The specifications in Table 3 give mixed evidence on the extent to which tariffs and non-tariff barriers reduce imports: as openness and industry fixed effects are added in going from column (1) to column (4), the coefficients on tariffs and NTB's change in both sign and significance. When industry fixed effects are included in columns (3) and (4), non-tariff barriers appear to be more substantial barriers to imports than tariffs, which have a statistically insignificant effect on imports. This result, though not incredibly robust, is the opposite of Harrigan (1993), who finds that "tariffs . . . were a more substantial barrier to trade in

[4]Leamer (1984, 1992) discusses many issues involved with the estimation of trade models.

manufactures between developed countries than were non-tariff barriers."[5] The values of the coefficients on NTB's in columns (3) and (4) imply that an increase in the coverage ratio of one percentage point leads to a two to three percentage point drop in import penetration.

The Hausman tests at the bottom of Table 3 show that we cannot reject the null hypothesis of no simultaneity bias in the import equation, particularly in the estimates with industry fixed effects. This implies that our finding of a significant response of imports to trade barriers is not simply the result of endogenizing NTB's. This is borne out in the top half of Table 6, which shows the results for the coefficient on NTB's in the import equation for both single equation OLS and the linear equation of the simultaneous equations Tobit. In all four single-equation specifications, we find a negative and statistically significant effect of NTB's on import penetration. Allowing for feedback from imports to NTB's gives an estimate of at most only slightly more than twice the magnitude (-2.918 and -2.327 versus -1.130 and -1.165 for the equations with fixed effects) as when this endogeneity is ignored. This contrasts with Trefler's results for the US, in which he strongly rejects the null hypothesis of no simultaneity bias, and finds that taking into account the endogeneity of trade barriers gives an estimate of the effect of NTB's on import penetration ten times larger than when the simultaneity is ignored. While we also find a statistically significant effect of NTB's on import penetration, the fairly small impact which comes solely from endogenizing trade barriers points to the importance of not generalizing US-specific results to other nations.

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[5]Of course, we use a different dataset and a more diverse set of countries. Our specification is also substantially different, since Harrigan estimates bilateral trade flows, whereas our data is limited to each nation's overall trade in each industry.

2. Determinants of Non-Tariff Barriers

Table 4 contains the results for the non-tariff barrier equation without fixed effects, which are then added in Table 5. In general, the results are well-reconciled with political-economy theories of protection. In both tables, the coefficient on the share of imports is always significant and positive, showing that "threatened" industries receive protection. In contrast to the import equation, the large statistics for the Hausman tests on nearly all specifications reject the null hypothesis of no simultaneity bias for the NTB equation, indicating that the simultaneity of trade barriers and trade flows matters for the determinants of trade barriers. This can be seen clearly in the bottom half of Table 6, which shows the coefficients on import penetration in the NTB equation for both the single-equation and the simultaneous equations Tobit estimators. In the single-equation estimates, where the effect of NTB's on imports is neglected, we find either an insignificant or negative effect of imports on NTB's; this no doubt reflects the usual import-reducing effects of NTB's. But this is strongly reversed in the simultaneous equations estimates, in which we find a positive effect of import penetration on NTB's. In other words, our results indicate that it is not simply that industries with high import penetration receive protection, but rather that industries receive more protection to the extent that they have high import penetration after taking into account the level of NTB's. And in results not shown, we find that adding the three-, four-, or five-year change in import penetration to the NTB equation results in all cases in an insignificant coefficient on this new variable. These results are again the opposite as Trefler, who finds that the level of import penetration has no effect on the level of U.S. trade barriers, while the change in penetration has a highly significant positive effect.

The significant negative coefficient on the change in wage per worker indicates that

declining industries receive more protection; this too is robust to different specifications for the number and range of years of the change in wages. In results not shown, we add the five-year change in the sectoral share of labor, but this additional measure of industry decline has no explanatory power beyond the change in wages.

The significant positive coefficient on the industry share of value-added indicates that large industries, which we interpret as politically important, also tend to receive more protection. As seen in column (2), this result (as well as those in all other rows and columns) holds when the industry share of labor is used instead as the measure of political importance--this might better reflect the actual number of voters and thus the raw political importance of the sector rather than the economic importance indicated by the share of value-added. As expected, the coefficient on value-added per worker is negative and significant, showing that nations give more protection to "weak" industries. The positive and significant coefficients on tariffs and the black market premium indicate that other trade measures and exchange rate controls are used in conjunction with non-tariff barriers; this matches the findings of Marvel and Ray.

In column (3), we add country openness to the regression. This is to examine the possibility that the outward orientation of each nation's political system has explanatory power for the inter-industry structure of trade protection. For example, political entities such as Singapore and Hong Kong which by their institutional nature are "open" may eschew trade barriers regardless of sectoral conditions, while "closed" countries such as India may erect across-the-board barriers as a matter of course. The significant negative coefficient on openness seems to bear this out. In results not shown, we find that including a complete set of country fixed effects instead of just the single openness variable gives the odd result that a higher level

of NTB's leads to strongly significant greater import penetration, though it does not greatly change our other results. While the industry fixed effects are meant to capture omitted industry characteristics, a similar rationale does not exist for country fixed effects. Since the openness variable is meant to capture a crucial dimension along which countries differ, this can be thought of as a parsimonious alternative to including country fixed effects.

In column (4), we add the share of industry output which is exported, and find that this has a significant negative relationship with the level of protection. This accords with the idea that nations refrain from protecting industries for which exports are important out of fear that their trading partners will retaliate for any import restraints.

Column (5) replaces the measure of productivity, value-added per worker, with wages per worker. As before, the coefficient is significant and negative, indicating that high-wage sectors receive less protection. The significant negative coefficient on the labor share of value-added in column (6) indicates that less protection is given to labor-intensive industries, which probably correspond to low-skill industries. This matches Ray's finding for the U.S. that protection tends to be given to capital-intensive and skill-intensive industries. Finally, column (7) includes both wages per worker and value-added per worker. The coefficient on wages remains negative and significant, indicating as before that nations give less protection to industries with labor rents--industries in which wages are high after controlling for productivity. And this negative coefficient somewhat allays our fears regarding the endogeneity of our right-hand-side variables, since we would usually expect wages to rise if there were affect by trade barriers.

Table 5 adds industry fixed effects to the specifications of Table 4. What is most

encouraging is that all of the sector-specific political-economy variables remain significant, even after taking into account the possibility that certain industries get protection across countries. As in Table 4, the significant negative coefficients on value-added per worker and the change in wage per worker indicate that nations protect weak industries and industries in decline, while the positive coefficients on the shares of workers and valued-added show that large, politically important, industries receive more protection. The coefficient on country openness remains negative and statistically significant. And again, all columns of Table 5 indicate that tariffs and exchange rate controls are used in conjunction with non-tariff barriers.

VI. Conclusion

Our results indicate that protection is not specific to particular countries and industries, but instead that the structure of non-tariff barriers across countries and industries can be explained by sectoral conditions. This is consistent with political-economy explanations of trade protection. Of course, we have not tested a specific model of protection, but rather examined some of its general determinants.

Also, we have only a single cross-section of data on tariffs and NTB's, and are thus not able to look at the effects of changes in protection over time. This is clearly a concern for our identifying restrictions, which use industry conditions such as labor productivity and wages per worker to instrument for the level of non-tariff barriers. If protective measures are long-standing, the causality might be the reverse; that is, the existence of barriers could influence industry conditions, rather than policymakers responding to industry-specific calls for protection. However, the significant negative coefficients we find on wages per worker and changes in

wages per worker somewhat mitigate this concern, since we would expect wages to rise rather than fall in response to protection.

Further work is needed to examine the impact of variables such as demand and supply elasticities which figure prominently in the theoretical literature but for which we were unable to obtain data. Also, our measures of an industry's political importance--industry shares of labor and value-added--are probably far from ideal. For some countries, unionization data might be an important measure, while for others, the extent of ownership by the ruling party or family would no doubt be closely tied to the structure of trade protection. And as mentioned before, disaggregated data on factor endowments would allow us to compare the results of a Heckscher-Ohlin model with those from our monopolistic competition model of trade.

The limitations imposed by data availability notwithstanding, we obtain remarkably robust results that sectoral factors are important determinants of the structure of trade protection, even after taking into account industry-specific fixed effects. Our results thus provide encouraging support for the burgeoning literature on the political-economy of trade protection.

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Table 1: Measures of Protection by Country

Country	Sectors	Tariff Rate			Non-Tariff Barriers		
		import-weighted	prodn-weighted	std. dev.	import-weighted	prodn-weighted	std. dev.
United States	27	4.9	4.5	4.2	37.5	26.6	29.9
United Kingdom	27	7.1	7.1	6.8	17.9	18.3	27.8
Belgium	27	7.0	7.0	7.6	19.6	29.5	28.2
Denmark	27	7.1	7.2	4.1	18.2	21.0	27.0
France	27	7.4	7.1	14.3	18.4	18.7	26.1
Germany, West	27	7.4	7.1	6.0	22.3	15.1	27.4
Italy	22	7.6	7.6	14.4	20.9	23.7	27.1
Netherlands	27	7.1	7.1	7.6	20.6	21.4	28.1
Sweden	27	4.3	3.6	3.5	7.7	8.4	21.0
Canada	27	7.4	7.5	5.1	4.1	6.0	12.7
Japan	26	4.9	3.5	7.7	11.3	6.9	11.0
Greece	27	7.0	8.5	8.6	25.5	34.3	25.8
Ireland	25	7.5	7.5	8.4	20.8	29.0	27.0
Portugal	24	7.1	7.1	3.4	19.1	22.7	20.2
Spain	27	6.8	6.9	4.8	13.9	17.7	22.1
Turkey	27	27.9	26.0	28.2	90.4	84.8	29.4
Chile	27	26.7	28.8	14.9	8.8	15.3	23.5
Colombia	27	45.6	50.4	22.5	64.1	74.8	29.7
Ecuador	27	38.4	50.3	27.0	51.5	72.3	28.9
Guatemala	27	14.8	26.5	26.7	100.0	98.8	9.6
Venezuela	27	24.9	33.3	24.4	0.5	3.2	23.8
Barbados	18	20.7	17.7	13.7	33.9	38.7	32.1
Cyprus	23	19.0	26.5	18.7	49.0	53.3	36.2
Jordan	25	30.9	26.1	18.5	25.6	22.5	31.1
Syria	25	22.0	26.6	27.7	61.0	61.7	25.0
Egypt	27	16.6	59.1	425.8	38.6	47.8	33.6
Bangladesh	25	61.9	76.5	50.4	57.5	65.9	30.0
Sri Lanka	24	39.5	58.6	35.0	14.7	39.5	32.3
Hong Kong	25	0.0	0.0	0.0	0.0	0.0	0.1
India	26	152.5	153.4	45.2	94.5	93.4	11.6
Indonesia	23	17.7	21.7	16.7	10.7	6.6	11.4
Korea	26	16.8	17.7	13.1	1.8	3.3	14.9
Malaysia	26	11.7	16.1	12.5	6.8	7.7	8.6
Pakistan	26	41.4	44.0	34.0	9.7	19.3	34.1
Philippines	26	27.2	26.8	13.4	61.1	53.2	32.8
Singapore	20	0.9	0.6	1.8	1.2	1.1	1.7
Thailand	27	35.2	46.4	21.5	5.5	13.7	20.0
Kenya	20	30.7	33.9	21.6	23.9	31.1	35.2
Mauritius	22	65.2	88.5	91.5	37.5	43.3	15.2
Zimbabwe	26	26.3	26.7	11.8	96.0	96.1	20.5
Tunisia	15	27.7	34.0	37.4	63.7	66.5	31.2

Table 2: Measures of Protection by Industry

ISIC code	Industry	Countries	Tariff Rates			Non-Tariff Barriers		
			import-weighted	prodn-weighted	std. dev.	import-weighted	prodn-weighted	std. dev.
311	FOOD PRODUCTS	40	9.8	11.6	33.6	45.9	37.2	30.0
313	BEVERAGES	40	7.2	20.7	355.6	43.1	37.1	38.1
314	TOBACCO	38	39.7	25.5	68.2	2.3	5.5	40.5
321	TEXTILES	39	11.7	15.9	24.5	69.8	63.4	38.2
322	WEARING APPAREL,EXCEPT FOOTWEAR	35	12.3	17.2	30.4	71.7	57.6	35.7
323	LEATHER PRODUCTS	38	6.1	12.9	31.3	1.4	7.7	40.0
324	FOOTWEAR,EXCEPT RUBBER OR	36	13.3	20.3	44.5	33.8	23.2	41.9
331	WOOD PRODUCTS,EXCEPT FURNITURE	39	5.0	5.5	30.3	0.5	1.0	42.1
332	FURNITURE,EXCEPT METAL	40	6.4	7.7	46.2	0.9	10.1	46.5
341	PAPER AND PRODUCTS	41	6.5	4.5	22.0	1.7	1.8	34.3
342	PRINTING AND PUBLISHING	40	6.5	4.9	22.7	1.2	0.7	29.8
351	INDUSTRIAL CHEMICALS	41	10.2	9.9	23.5	9.1	10.1	30.1
352	OTHER CHEMICALS	40	8.0	9.9	24.2	7.4	11.7	31.3
353	PETROLEUM REFINERIES	37	7.9	11.1	26.9	2.3	5.8	40.0
354	MISC. PETROLEUM AND COAL	28	1.0	7.5	19.8	1.6	7.6	33.1
355	RUBBER PRODUCTS	39	9.3	14.5	32.2	4.9	8.6	35.5
361	POTTERY,CHINA,EARTHENWARE	37	9.4	12.4	41.5	0.6	7.4	43.6
362	GLASS AND PRODUCTS	39	10.1	9.6	29.0	6.0	8.8	34.5
369	OTHER NON-METALLIC MINERAL PROD.	40	6.9	8.2	26.3	10.2	13.1	34.8
371	IRON AND STEEL	36	9.8	12.2	38.0	47.7	41.1	34.6
372	NON-FERROUS METALS	34	6.4	6.7	24.0	1.4	2.9	35.1
381	FABRICATED METAL PRODUCTS	41	6.3	5.3	27.7	3.9	4.4	32.7
382	MACHINERY,EXCEPT ELECTRICAL	39	7.0	4.7	23.8	10.5	12.2	32.0
383	MACHINERY ELECTRIC	41	8.6	5.8	28.3	11.3	10.1	33.3
384	TRANSPORT EQUIPMENT	40	7.9	6.1	30.7	25.5	27.0	38.8
385	PROFESSIONAL & SCIENTIFIC EQUIPM.	35	6.5	4.7	23.6	2.7	3.8	30.3
390	OTHER MANUFACTURED PRODUCTS	38	6.6	7.6	35.2	1.7	2.0	33.0

Table 3: Determinants of Manufactured Imports

Dependent Variable: imports/domestic use — 1031 Observations

Independent Variables	No Fixed Effects		with Industry Fixed Effects	
	(1)	(2)	(3)	(4)
output share	-0.279 (-11.50)	-0.299 (-8.89)	-0.377 (-8.72)	-0.359 (-12.65)
distance	-0.668 (-6.70)	-0.805 (-5.78)	-0.947 (-5.90)	-0.957 (-7.92)
1 + tariff rate	-1.766 (-5.36)	-0.680 (-1.84)	0.205 (0.25)	0.029 (0.09)
1 + NTB coverage ratio	0.884 (1.61)	-1.358 (-2.98)	-2.918 (-1.64)	-2.327 (-5.27)
1 + black market premium	-3.129 (-6.82)	-1.740 (-3.20)	-1.116 (-0.98)	-1.357 (-2.81)
openness in NTB equation?	no	yes	no	yes
adjusted R^2	0.179	0.185	0.488	0.507
Hausman test statistic, χ^2 (significance level)	4.581 (0.40)	5.397 (0.51)	6.778 (0.00)	18.687 (0.03)
degrees of freedom for test	6	6	32	32

Notes:
1. linear equation in simultaneous equations Tobit estimation
2. t-statistics in parentheses, except for Hausman test
3. all variables in logs
4. results for constant omitted
5. a low significance level for the Hausman test means that the null hypothesis of no simultaneity bias cannot be rejected.

Table 4: Determinants of Non-Tariff Barriers, No Fixed Effects

Dependent Variable: 1 + Non-Tariff Barrier Coverage Ratio — 1031 observations

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Import Share							
imports/domestic use	0.065 (5.00)	0.059 (4.17)	0.172 (13.39)	0.078 (5.37)	0.057 (4.56)	0.085 (4.83)	0.058 (3.98)
Sector's Comparative Advantage							
labor productivity (value-added/worker)	-0.018 (-2.40)	0.000 (0.04)	0.002 (0.42)	-0.023 (-3.41)			0.028 (1.62)
wage per worker					-0.035 (-5.03)		-0.061 (-3.77)
labor share of value-added						-0.056 (-2.78)	
Sector's Political Importance							
share of value-added	0.058 (10.57)		0.063 (19.18)	0.059 (11.29)	0.056 (9.90)	0.052 (7.80)	0.053 (9.53)
share of workers		0.055 (9.18)					
Demand for Protection							
change in wage per worker	-0.138 (-5.42)	-0.120 (-4.19)	-0.094 (-9.32)	-0.111 (-4.48)	-0.130 (-4.89)	-0.130 (-3.95)	-0.127 (-4.72)
share of exports in gross output				-0.018 (-5.66)			
Other Trade Influences							
1 + tariff rate	0.516 (12.94)	0.537 (11.93)	0.586 (24.89)	0.503 (13.47)	0.464 (12.27)	0.572 (13.97)	0.465 (11.66)
1 + black market premium	0.702 (13.75)	0.732 (12.61)	0.771 (28.77)	0.540 (12.33)	0.645 (12.69)	0.746 (12.87)	0.640 (12.39)
Country Openness			-0.251 (-15.64)				
Hausman test statistic (significance level)	36.089 (0.99)	24.368 (0.99)	183.811 (0.99)	37.829 (0.99)	28.144 (0.99)	26.741 (0.99)	21.787 (0.99)
degrees of freedom	7	7	8	8	7	7	8

Notes:
1. Tobit equation in simultaneous equations Tobit estimation
2. t-statistics in parentheses, except for Hausman test
3. all variables in logs
4. results for constant omitted
5. a low significance level for the Hausman test means that the null hypothesis of no simultaneity bias cannot be rejected.

Table 5: Determinants of Non-Tariff Barriers, with Industry Fixed Effects

Dependent Variable: 1 + Non-Tariff Barrier Coverage Ratio — 1031 observations

Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Import Share							
imports/domestic use	0.057 (3.71)	0.054 (3.54)	0.141 (7.08)	0.071 (4.43)	0.055 (3.75)	0.090 (5.25)	0.066 (4.30)
Sector's Comparative Advantage							
labor productivity (value-added/worker)	-0.020 (-2.46)	-0.014 (-1.60)	-0.023 (-3.21)	-0.023 (-2.83)			0.062 (3.42)
wage per worker					-0.037 (-4.79)		-0.090 (-5.27)
labor share of value-added						-0.090 (-4.95)	
Sector's Political Importance							
share of value-added	0.038 (2.99)		0.081 (5.88)	0.044 (3.44)	0.036 (2.85)	0.043 (3.23)	0.035 (2.86)
share of workers		0.031 (2.33)					
Demand for Protection							
change in wage per worker	-0.124 (-4.09)	-0.115 (-3.78)	-0.086 (-3.34)	-0.098 (-3.29)	-0.115 (-3.84)	-0.101 (-3.30)	-0.102 (-3.51)
share of exports in gross output				-0.023 (-2.83)			
Other Trade Influences							
1 + tariff rate	0.442 (10.40)	0.454 (10.25)	0.395 (11.09)	0.431 (10.51)	0.398 (9.86)	0.501 (13.61)	0.419 (10.46)
1 + black market premium	0.719 (11.70)	0.723 (11.50)	0.752 (13.62)	0.592 (10.06)	0.673 (11.47)	0.791 (13.56)	0.694 (11.99)
Country Openness			-0.233 (-10.99)				
Hausman test statistic (significance level)	40.624 (0.83)	43.611 (0.90)	68.549 (0.99)	46.663 (0.93)	42.279 (0.87)	54.658 (0.99)	47.674 (0.94)
degrees of freedom	33	33	34	34	33	33	34

Notes:
1. Tobit equation in simultaneous equations Tobit estimation
2. t-statistics in parentheses, except for Hausman test
3. all variables in logs
4. results for constant omitted
5. a low significance level for the Hausman test means that the null hypothesis of no simultaneity bias cannot be rejected.

Table 6: Coefficients on NTB's and Import Penetration

Import Equation: Effect of Non-Tariff Barriers on Import Penetration

	No Fixed Effects		with Industry Fixed Effects	
	(1)	(2)	(3)	(4)
openness included?	no	yes	no	yes
Single Equation	-0.798 (-3.49)	-0.829 (-3.62)	-1.130 (-5.92)	-1.165 (-6.09)
Simultaneous Equations	0.884 (1.61)	-1.358 (-2.98)	-2.918 (-1.64)	-2.327 (-5.27)

NTB equation: Effect of Import Penetration on Non-Tariff Barriers

	No Fixed Effects		with Industry Fixed Effects	
	(1)	(2)	(3)	(4)
openness included?	no	yes	no	yes
Single Equation	-0.006 (-1.07)	0.003 (0.55)	-0.036 (-5.35)	-0.023 (-3.24)
Simultaneous Equations	0.065 (5.00)	0.059 (4.17)	0.057 (3.71)	0.054 (3.54)

Note: t-statistics in parentheses

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