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Measurement and Political Economy of Disputed Technical Regulations

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Technical regulations are increasingly visible in agricultural trade, yet their idiosyncratic nature has limited prior aggregate analysis. This article draws on a unique data source for systematic enumeration of the technical regulations questioned by one exporter among all of its trading partners in mid-1996. Political economy analysis indicates that barriers decrease when the relative contribution of agriculture to an economy increases, when the anticipated future level of protection through other forms of government intervention increases, and when economies are more open. Despite increased scrutiny and discipline by the World Trade Organization, technical barriers remain a significant impediment in world agricultural markets.

Key Words: limited dependent variable, sanitary and phytosanitary, WTO

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Technical regulations are nontariff barriers to international trade that are increasingly at the center of policy disputes, particularly in agriculture, where national regulations addressing plant, animal, and human health are widespread. A wide range of technical regulations are used by all nations to govern the sale of agricultural imports in domestic markets, and most of these measures are recognized to be justified regulatory interventions to protect health or to differentiate among products. Governments may also impose technical regulations as a nontransparent means to protect domestic producers from international competition or in response to pressure from other interest groups. In these latter cases, technical regulations are determined by political economy considerations, unnecessarily limit trade opportunities, and are likely to be welfare-decreasing, similar to tariffs and other trade impediments.

The World Trade Organization (WTO) agreements have increased the international scrutiny of technical trade regulations and provide disciplinary standards by which the legitimacy of individual measures are judged. Multilateral rules governing the application of technical regulations by member countries of the WTO were strengthened during the 1986–1994 Uruguay Round negotiations and remain points of discussion in the Doha Round, initiated in 2001.[1] However, neither the preva-

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[1] The WTO disciplines on the use of technical regulations were codified primarily through the Agreement on the Application of Sanitary and Phytosanitary Barriers (SPS Agreement) and the Agreement on Technical Barriers to Trade (TBT Agreement). Both agree-

lence of disputed regulations nor the economic impacts of such measures have been well quantified. This article presents empirical evidence on the extent and determinants of disputed technical regulations to U.S. agricultural exports in impact at the time that the WTO agreements were implemented. The enumeration of these regulations, even from the perspective of one country, offers insights on the measurement and discipline of technical barriers in world agricultural trade more broadly and provides an empirical basis to evaluate the political economy determinants underlying these regulatory decisions.

Several case studies have presented a conceptual framework for evaluating the impacts of technical regulations on markets and have provided empirical analyses of the scientific, economic, and political arguments relevant to specific disputes (e.g., Abbott; Calvin and Krissoff; Gallagher; Nielsen and Anderson; Orden and Romano; Paarlberg and Lee). Legal briefs and analyses presented in WTO proceedings and elsewhere have provided further evidence regarding the legitimacy of measures that have been formally challenged, most notably in the dispute of the United States and Canada with the European Union (EU) over the use of growth-stimulating hormones in beef cattle (McNiel; Roberts; Victor; World Trade Organization 1998). These case studies, briefs, and analyses offer valuable description and insights concerning individual technical regulations but cannot be used to explore the wider incidence of disputed regulations and their aggregate trade impacts on an economy or the role economic and political factors play across the spectrum of such regulatory decisions.

To assess these broader political economy issues, we undertook a unique survey that elicited comprehensive cross-sectional data on disputed technical regulations to U.S. agricultural trade in mid-1996, shortly after the WTO agreements came into effect.[2] Systematic enumeration of the technical regulations questioned by one exporter among all of its trading partners provides a basis for the econometric evaluation of the political economy determinants of these measures. These determinants suggest the difficulty in disciplining complex technical measures and the merit of multilateral institutional innovations that are designed to affect regulatory decisions in this arena.

Measurement of Disputed Technical Regulations

Concern over the transmission of pests and disease is intrinsic to agricultural trade, and the extensive use of regulations to protect against such unintended externalities make the assessment of the impact and political economy of these policy measures especially difficult to quantify (Maskus and Wilson). By definition, technical barriers are trade distorting, so multilateral governance focuses on guidelines that recognize the rights of government

ments reiterate earlier obligations under the General Agreement on Tariffs and Trade (GATT) to apply technical restrictions only to the extent necessary and to avoid unjustifiable discrimination among members where identical or similar conditions prevail (World Trade Organization 1999). SPS and TBT require members to acknowledge "equivalence" by accepting foreign technical measures that differ from domestic measures when objective evidence supports the claim that the same regulatory target is achieved. The agreements also encourage (but do not require) the harmonization of measures on the basis of international standards. SPS requires that plant, animal, and human health measures be based on a scientific risk assessment and that the absence or low incidence of pests or diseases in subnational regions of an exporting country be recognized by regulatory authorities. Transparency requirements in SPS and TBT have obligated countries to establish enquiry points and to provide notification through the WTO of proposed new or modified regulations that might affect trade. Other Uruguay Round legal instruments, including GATT articles III, IX, and XX, provide additional disciplines on the use of technical measures.

[2] An additional source of data on technical regulations has developed since 1996 from procedures for notification to the WTO of changes in technical regulations and comment by other countries (cross-notifications) established as part of the strengthened transparency requirements during the Uruguay Round. Countries have filed nearly 200 objections to new measures notified to the WTO since 1995. See Roberts and International Agricultural Trade Research Consortium for discussions of the WTO cross-notifications. These have been tabulated and described, but, to date, there has been no econometric analysis of their determinants.

to use technical regulations for legitimate purposes (correcting negative externalities) while seeking to constrain their proliferation and intentional misapplication as protectionist policies. Among technical measures that are disputed by trading partners, many conflicts are resolved informally or through bilateral negotiations before formal WTO panel hearings. Comprehensive measurement of technical regulations that could potentially be deemed "questionable" under WTO auspices has not been regularly undertaken.

Before the completion of the Uruguay Round, in the United States, intermittent case reports filed by field staff of the U.S. Department of Agriculture (USDA)'s Foreign Agricultural Service (FAS) were the primary source of information about possible misuses of technical regulations that limited U.S. agricultural sales abroad. These reports were useful in specific contexts, but the information collected was piecemeal, and assertions about abuses of international regulatory obligations were not subject to systematic evaluation. Most other countries had even fewer resources available to consistently monitor technical regulations applied to their exports (including those imposed by the United States).

The Uruguay Round agreements provided the impetus for a more extensive survey in 1996 to quantify those foreign technical regulations faced by U.S. agricultural exports that might potentially be subject to challenge under the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) or the Agreement on Technical Barriers to Trade (TBT) disciplines. Technical regulations applied by the United States were not within the purview of the survey, nor were technical regulations to non-U.S. products applied by other countries. Still, this systematic primary data collection provides the first comprehensive evaluation of disputed technical regulations faced by one country on a heterogeneous cross-sectional basis and allows an assessment of the determinants and discipline for these important trade policies on a wider scale than individual case studies.

Survey Design

The survey of disputed technical regulations involved a four-stage process designed to capitalize on FAS field-based operations, the multidisciplinary evaluative capacity of regulatory agencies within USDA, and external research expertise.[3] In the first stage, an initial list and partial descriptions of disputed technical trade regulations were compiled from a preliminary field survey undertaken on a pilot basis for selected countries in 1995 (from which 205 regulations were identified and the data-acquisition procedures refined) and from review of the FAS country reports for 1995 and early 1996. In the second stage of the survey, the initial list of disputed technical regulations was circulated for evaluation by scientists and other professional staff with regulatory responsibility in four USDA agencies.[4] Nearly 15% of the measures—those for which disputes had been resolved or issues judged by technical and trade experts not to be challengeable under the WTO—were deleted, and a more precise description was developed for each barrier retained on the list. Criteria considered in assessing potential challenges included a lack of scientific justification for a measure (e.g., prohibiting the import of products with additives that have been classified as "generally recognized as safe" by health authorities), reliance on excessively trade-restrictive means of mitigating acknowledged risks (e.g., using a ban instead of accepted quarantine treatments to prevent the introduction of an exotic pest), the application of regulations

[3] Roberts and DeRemer provided a description of the survey design, pretesting, and implementation and reported some preliminary descriptive survey results.

[4] Review of the survey was coordinated by the senior representative of each regulatory agency to a USDA Interagency Working Group on Technical Barriers. The reviews were conducted by scientists in the Veterinary Services and Plant Protection and Quarantine divisions of the Animal and Plant Health Inspection Service; by veterinarians in the Food Safety and Inspection Service International Programs Export Coordination Division; by specialists in the Agricultural Marketing Service Fruit and Vegetable Program; and by experts in the Grain Inspection, Packers and Stockyard Administration Grain Inspection Program.

in an apparently discriminatory manner (e.g., requiring treatments for potential microbial contamination of imported but not domestic products), and other substantive and procedural issues related to the disciplines of the WTO agreements.

The revised list of disputed technical regulations to U.S. agricultural exports identified through the agency-review process served as the basis for field analysis in the third stage of the survey. The list was distributed for review to FAS personnel at 50 foreign posts, monitoring 132 countries and two trading blocks that accounted for 98% of U.S. agricultural export sales, and to representatives of nearly 40 agricultural producer groups engaged in export activities. The FAS field staff was asked to verify the listed regulations, to identify additional foreign technical trade regulations that might be subject to challenge, and to estimate the annual U.S. export revenue losses resulting from each identified measure, taking into account both trade expansion and third-country substitution impacts. Field staff identified more than 140 additional regulations and deleted a small number of those from the second-stage list.

In the fourth stage of the survey, the list of disputed regulations based on field staff input was again reviewed by scientists in USDA's regulatory agencies, to confirm inclusion or exclusion as potentially challengeable. The estimates of export revenue losses by FAS field personnel were evaluated by commodity analysts in the relevant divisions of the FAS Commodity and Marketing Programs and economists in USDA's Economic Research Service, with any revisions to the original estimates determined jointly by these specialists.

The final set of technical regulations identified in the survey included policy instruments of differing degrees of trade restrictiveness (including import bans, mandatory standards on production processes or product and packaging attributes) and information remedies (including labeling requirements). These measures all decreased or potentially decreased U.S. agricultural exports to a specified market in mid-1996 and appeared to violate at least one of the disciplines of the WTO agreements.

Survey Results

The survey identified 302 technical regulations of concern among 61 countries and two regional trading blocks. Seventy-one additional countries were not found to be imposing or actively considering technical regulations to U.S. agricultural products that were judged to be questionable at the time of the survey.[5] The total estimated trade impact from the disputed regulations identified was over $4.9 billion. Of this total trade worth, almost $3.7 billion, equivalent to more than 5% of total 1996 U.S. agricultural export value, was restricted either because entry was prohibited (by 107 regulations blocking an estimated $700 million in trade) or because of less stringent measures that limited market expansion but did not completely block access (164 regulations constraining trade by an estimated $3.0 billion). An additional $1.2 billion of existing trade faced proposed new restrictions (31 regulations) that were under active consideration by a foreign government at the time of the survey.

Trade impacts averaged $16.2 million per barrier, but the distribution of impacts was skewed, with 69 regulations estimated to have impacts under $1 million each, whereas 14 regulations had impacts exceeding $50 million per barrier. Some examples of the measures identified are presented in Table 1 and include, among others, bans on imports of U.S. poultry meat, process standards in the form of re-

[5] The breadth of the survey coverage is illustrated by comparison to WTO cross-notifications and formal dispute proceedings. Between 1995 and October 2002, only 23 cases alleging violation of SPS or TBT (or both) have proceeded to the consultation phase of formal dispute settlement, and five of these have advanced to panels. Formal WTO dispute rulings will vastly understate the extent of technical barrier misuse, because diplomatic and cost considerations favor informal dispute resolution when possible. Not all of the measures identified as disputed in our survey, nor all subsequent notifications that are challenged in the WTO, can be expected to become part of a formal WTO dispute settlement procedure.

Table 1. Examples of Disputed Technical Trade Regulations Identified in the Survey

Policy Instrument	Regulatory Goal		
	Animal and Plant Health	Food Safety	Product Quality
Import ban	A ban on imports of stone fruit because of presence of rhagoletis, despite proven efficacy of postharvest treatments.	A ban on imports of poultry meat from countries that do not certify shipments as free of the ubiquitous pathogen *Salmonella enteriditis*, exceeding requirements for the domestic industry	A ban, rather than less trade-restrictive policies used to prevent diversion of tallow into the domestic food chain in violation of religious proscriptions
Process standard	Redundant postharvest treatment requirements (chlorine dip and cold treatment) required for apples imported from areas with fire blight	Imports of beef and offals from cattle treated with naturally occurring hormones for growth promotion are prohibited (although hormone use is allowed for other purposes)	Shelf-life standards more stringent than manufacturers' use-by dates for UHT milk restrict market access because of length customs clearance procedures
Product standard	Rice must be certified free from *Tilletia barclayana* despite scientific evidence that this fungus cannot be considered a quarantine disease because it already exists in the importing country	Maximum residue limits for mycotoxins (e.g., aflotoxin and vomotoxin) in grain that are lower than international standards and are not based on a risk assessment	Beef imported for human consumption must have <7% fat.

Table 2. Disputed Technical Regulations to U.S. Agricultural Exports by Geographic Region and Product

Product	Geographic Region						
	Africa	Americas	East Asia	Europe	Middle East	Oceana	Total
	Number of regulations (*estimated trade impact, million dollars*)						
Fruits and vegetables	1	43	47	—	—	14	105
	$4.0	*114.5*	*476.7*			*40.1*	*635.3*
Grains and feeds	5	8	5	12	1	8	39
	$62.7	*705.0*	*190.0*	*171.1*	*10.0*	*42.5*	*1,181.3*
Livestock and poultry	8	22	14	34	2	5	85
	$58.0	*158.1*	*38.0*	*513.5*	*20.0*	*65.5*	*853.1*
Processed foods	2	6	7	13	7	3	38
	$33.5	*38.6*	*1,059.1*	*112.9*	*6.8*	*12.7*	*1,263.6*
Other products	2	10	4	8	1	6	31
	$6.5	*202.1*	*61.5*	*102.1*	*2.8*	*69.1*	*444.1*
Across All Products	1	2	1	—	—	—	4
	$15.0	*15.5*	*500.0*				*530.5*
Total	19	91	78	67	11	36	302
	$179.7	*1,233.8*	*2,325.3*	*899.6*	*39.6*	*229.9*	*4,907.9*

Source: Authors' calculations from survey data.

quired postharvest treatments for apples, and product standards in the form of maximum fat-content levels for beef. Several of the more economically significant measures identified in the survey are "horizontal regulations" that prohibited a widely used input or broadly imposed extensive inspection requirements, thus restricting exports of entire categories of high-value products.

The regulations identified in the survey are tabulated by geographic region and product category in Table 2. The highest number of disputed regulations was found in the Americas (91), followed by East Asia (78) and Europe (67). The largest total estimated trade impact among regions ($2.3 billion) was reported for East Asia. The regulations identified in the survey are broadly dispersed among product categories, with the highest number of barriers identified for fruits and vegetables (105) and livestock and poultry (85). The largest trade impacts by product were reported for processed foods ($1.3 billion) and grains and feeds ($1.2 billion), commodities for which a relatively small number of disputed regulations were identified with high average estimated impact per barrier. Seven regulations in East Asia dominate the estimated trade impacts for processed foods, whereas trade in livestock and poultry was restricted most often in Europe, where the EU beef hormone ban was among 34 measures limiting trade valued over $500 million. Disputed regulations affecting grains and feeds were also imposed more frequently in Europe than other regions, but the largest estimated trade impacts from such regulations ($705.0 million) occur in the Americas.

A second method of tabulating the survey results is by types of regulatory goals and policy instruments, as shown in Table 3. Regulatory goals related to commercial production (the protection of crops and livestock from pests and diseases), food safety (the protection of consumers from contaminants), and protection of the natural environment from harmful nonindigenous species have risk-reducing objectives, whereas the goals of product quality, compatibility (the capacity of products to function in association with others), and conservation (preserving natural resources) are not risk reducing.

Almost two-thirds (185) of the regulations identified in the survey address plant and an-

Table 3. Disputed Technical Regulations to U.S. Agricultural Exports by Regulatory Goal and Policy Instrument

Policy Instrument	Regulatory Goal								
	Risk-Reducing			Non–Risk-Reducing					
	Commercial Production	Food Safety	HNIS	Product Quality	Compatibility	Conservation	Multiple Goals	Not Classified	Total
	Number of regulations (*estimated trade impact, million dollars*)								
Import bans									
Total	50	8	1	1	—	—	6	—	66
	$264.8	*30.5*	*<0.1*	*30.0*			*58.5*		*383.8*
Partial	19	—	—	—	—	—	—	—	19
	$201.2								*201.2*
Mandatory standards									
Process	63	24	—	12	—	—	5	—	104
	$1,229.7	*810.8*		*78.7*			*255.8*		*2,375.0*
Product	*24*	23	—	12	—	—	1	—	60
	$130.2	*621.5*		*120.6*			*15.0*		*887.3*
Package	—	—	—	1	5	—	—	—	6
				<0.1	*40.3*				*40.4*
Information remedies	—	—	—	5	—	—	3	—	8
				42.4			*85.5*		*127.9*
Multiple instruments	9	2	—	2	—	—	1	—	14
	$80.9	*41.0*		*30.7*			*500.0*		*652.6*
Not classified	20	3	—	—	—	—	—	2	25
	$229.2	*5.7*						*4.5*	*239.4*
Total	185	60	1	33	5	—	16	2	302
	$2,136.1	*1,509.6*	*<0.1*	*302.5*	*40.3*		*914.8*	*4.5*	*4,907.9*

Source: Authors' calculations from survey data.

imal health risks to commercial production; these disputed regulations account for close to one-half ($2.1 billion) of the total estimated trade impacts. A relatively large number of additional regulations (60) address food safety, with estimated trade impacts of $1.5 billion, and fewer regulations address other regulatory goals. The most prevalent policy instrument used (104 regulations) was process standards (regulating production techniques), and these regulations had the largest estimated trade impacts ($2.4 billion). Another 60 regulations imposed product standards on attributes of final goods and account for $887.3 million of estimated trade impacts. Bans or partial bans were reported in 85 cases, with a total estimated trade impact of $585.0 million. Fewer regulations imposed either package standards or information remedies. Sixteen regulations had multiple goals, 14 used multiple instruments, and 25 regulations were not easily classified by specific instrument but arose from standards judged to be either nontransparent or arbitrarily enforced.

Political Economy Determinants of Disputed Technical Regulations

That regulatory processes can be captured by constituents with a vested interest in the policy outcome is well recognized in the economic theory of regulation, and technical-barrier regulation is no exception. The survey data make an empirical assessment possible for underlying political economy determinants of these regulatory policy decisions. The purpose of the estimated models is to identify the common factors underlying observed technical trade regulations facing U.S. agricultural exports that were subject to dispute and to quantify the economic and political relationships that give rise to these policy measures.

This empirical approach to analysis of agricultural policies was pioneered by Honma and Hayami, who identified a declining agricultural share of gross domestic product (GDP) or the labor force as significant determinants of higher sectoral nominal protection rates among 10 developed countries; that is, agriculture is more highly protected in more highly industrialized countries. Subsequent empirical analyses have extended the Honma and Hayami specifications to suggest a number of other important political and economic determinants of agricultural trade policies. Among more recent studies, DeGorter and Tsur found that agricultural subsidies of 18 developing countries were negatively related to the income gap between rural and urban sectors. Grilli and Sassoon found nontariff protection (measured as the frequency of petitions for antidumping, subsidy-countervailing, and safeguard actions) for the U.S. and EU to be positively dependent on market penetration by imports and the state of the domestic economy (measured by the unemployment rate). Similarly, Gawande found a positive relationship between U.S. protection levels and import penetration of the domestic market and identified a retaliatory aspect to U.S. nontariff regulations facing nine industrialized countries. Kherallah and Beghin found that the U.S. was more likely to pursue administered trade remedy actions when the U.S. export share in world markets declined or the U.S. was less dependent on the market in the targeted country.

Incidence of Disputed Technical Regulations

Two quantitative measures of the incidence of disputed technical trade regulations from the survey provide an empirical basis to evaluate determinants of these regulatory decisions in reduced-form regression models. First, the presence or absence of any such barrier observed by country provides a proxy measure for emergence of these regulations as a political economy equilibrium. Let the equilibrium outcome for these barriers in country i be represented by y_i^* ($i = 1, 2, \ldots, N$) such that

$$y_i^* = \sum_{k=1}^{K} b_k x_{ik} + \varepsilon_i,$$

where b_k are parameters ($k = 1, 2, \ldots, K$), x_{ik} are the K explanatory variables for the policy of country i, and ε_i is an error term. Because the latent variable y_i^* is unobservable, it is rep-

resented by a discrete measure, denoted YN_i, equal to 1 if $y_i^* > 0$ and 0 otherwise. The observation of disputed technical regulations, denoted YN in Table 4, is binary, with a value of 1 for the 61 countries and two trading blocks where one or more disputed regulations are identified and zero for 71 countries where no such regulations are reported. Probabilities are constructed so that

$$P(YN_i = 1) = P\left(\varepsilon_i > -\sum_{k=1}^{K} b_k x_{ik}\right) = F\left(\sum_{k=1}^{K} b_k x_{ik}\right),$$

where F is the cumulative distribution function for the error term. Assuming $\varepsilon_i \sim N(0, 1)$, then the PROBIT model is applicable.

Second, when observed, the number of disputed barriers identified in the survey varied between 1 and 27 per country. This estimate of the number of separate applications of disputed technical trade barrier is a nonnegative integer variable (again with a value of zero for the 71 countries where no disputed technical barriers are identified). For this dependent variable, denoted NU, each observation is assumed drawn from a Poisson distribution, such that $P(NU = z_i | \varepsilon_i = \exp(-\lambda_i + \varepsilon_i)\lambda_i^{z_i}/z_i!$ where $\ln \lambda_i = b_k' x_{ik} + \varepsilon_i$, z_i is the observed number of disputed technical barriers in country i, $\exp(\varepsilon_i)$ has a gamma distribution, and b_k and x_{ik} are defined as above. Negative binomial regression models are used to explain this dependent variable, with an individual unobserved impact incorporated into the conditional mean to allow the variance of the process to differ from the mean and account for cross-sectional heterogeneity in the data, such that

$$E(NU | x_i) = \exp\left(\sum_{k=1}^{K} b_k x_{ik}\right).$$

Because of nonlinearity in the estimated models, marginal impacts of the explanatory variables are not constant, and estimated coefficients cannot be directly interpreted as [illegible] equations to report marginal impacts at a single point in the distribution of the data. For binary independent variables, however, mean values lack a plausible interpretation. A more informative alternative approach, which was adopted herein, is to report the change in the predicted value of the dependent variable when values one and zero of the binary independent variable are substituted into the estimated equation, holding all else constant at the mean values of the other independent variables. In the equations above, this entails an evaluation of the expressions for the predicted values of the dependent variables under

$$\sum_{\substack{k=1 \\ k \neq j}}^{K} \hat{b}_k \bar{x}_{ik} + \hat{b}_j \text{ versus } \sum_{\substack{k=1 \\ k \neq j}}^{K} \hat{b}_k \bar{x}_{ik}$$

where $\bar{x}_{ik}$ is the mean value of the independent variables and $\hat{b}_j$ is the estimated coefficient on the binary independent variable, $x_{ij} = [1, 0]$. Comparably interpretable measures are derived for continuous independent variables by calculating the change in the predicted value of the dependent variable when the mean and mean plus one standard deviation of the independent variable are substituted into the estimated equations in a similar fashion.[6] Using this strategy, the results presented for the impacts of a discrete change in a binary independent variable (or a one-standard-deviation increase from its mean for a continuous independent variable) are similar to the impulse response functions widely used in time-series analysis.

Measuring Political Economy Determinants

The independent variables selected to represent political economy determinants of disputed technical trade regulations are categorized into three groups in Table 4: characteristics of the importing country's agricultural sector, trade policy, and aggregate economy. In addition, whether FAS field staff are physically based

le 4. Description of Variables

ıble	Definition	Units	Mean	SD	Minimum	Maximum
ːndent variables						
ʼN	Disputed technical regulations identified (1 = yes, 0 = no)	0, 1	0.47	0.50	0	1.00
ıU	Number of disputed technical regulations reported	Integer	2.26	4.50	0	27.00
ɔendent variables						
aracteristics of the agricultural sector						
ıGGDP	1995 GDP from the agricultural sector	%[a]	0.12	0.14	0	0.67
.ABAG	1995 labor force employed in agriculture	%[a]	0.31	0.23	0	0.95
ıGPENT	1995 agricultural import penetration relative to domestic value-added in agriculture	%[a]	1.54	6.21	0.03	51.08
ıGBAL	1992–1995 average change in agricultural trade balance with U.S. (exports to the U.S. − imports from the U.S.)	%[a]	−0.03	0.46	−2.44	3.34
ıde policy						
ıRDMEA	Expected applied post-Uruguay round MFN average protection rate for agricultural imports	%[a]	0.08	0.17	−0.21	0.65
JRCMT	Reduction in tariffs faced by agricultural exports as a result of Uruguay Round commitments from the country's trading partners	%[a]	0.20	0.19	0.01	1.04
VTO	1996 WTO membership (1 = full, 0 = other)	0, 1	0.71	0.46	0	1.00
aracteristics of the aggregate economy						
ɡDP	1995 GDP	$ per capita	7,106.11	10,217.79	91.81	42,929.71
MPGDP	1995 aggregate imports relative to GDP	%[a]	0.42	0.24	0.08	1.60
ʼRDBAL	1995 aggregate trade balance (exports − imports)	$ per capita	129.94	723.44	−1,543.83	4,788.67
ɔld staff						
ʼOST	FAS post in country (1 = yes, 0 = no)	0, 1	0.37	0.48	0	1.00

ːes: Data were obtained from the authors' survey (YN, NU, and POST); *U.S. Export/Import Statistics,* USDA/FAS, 1997 (AGBAL); *FAOSTAT Statistics Database,* UN/ 1997 (AGPENT); *World Development Indicators,* World Bank, 1997 (AGGDP, LABAG, GDP, IMPGDP TRDBAL); *About the WTO,* WTO, 1997 (WTO); and *The uay Round Statistics on Tariff Concessions Given and Received,* Finger, Ingco, and Reincke, The World Bank, 1996 (BRDMEA, URCMT).
orted as 1.00 = 100%.

in a potential importing country is included. Inclusion of specific political economy measures in our empirical models reflects insights drawn from the earlier empirical studies of the determinants of agricultural trade policies.

Characteristics of the Agricultural Sector

The relative contribution of agriculture to the economy (AGGDP) is measured as a percentage of national GDP. Agriculture has been widely shown to be more likely to be protected in more industrialized economies; if this result holds for disputed technical regulations, the estimated coefficients will be negative. The percentage of the labor force in agriculture (LABAG) is an alternative measurement of the sector's relative size within the economy. Although less pressure for protection may be exerted by a smaller agricultural constituency, the ability of agricultural interest groups to organize increases as group size decreases or as the constituency becomes more geographically concentrated in regions with political influence, so the net impact of LABAG is uncertain *a priori.* Among countries included in the survey, values of the contribution of agriculture to GDP or the agricultural labor share ranged from less than 0.2% (Singapore) to two-thirds of GDP provided by the agricultural sector (Georgia) and 95% of the workforce engaged in agriculture (Malawi).

Because agricultural import penetration increases relative to domestic value-added in agriculture (AGPENT), import-competing producers have more to gain from regulatory intervention, whereas consumers lose more from regulations that insulate the domestic sector from international markets. If producer interests dominate, then the estimated coefficients will be positive.[7] A second agricultural trade variable (AGBAL) measures the average percentage change during 1992–1995 in the net bilateral agricultural trade balance (agricultural exports from a country to the U.S. minus agricultural imports by the country from the United States). When the bilateral trade balance improves, agricultural producers in a country have relatively less to gain from their own regulatory interventions, and disputed technical regulations to U.S. exports may be less evident. Agricultural import penetration among the survey countries ranged from 2.7% (India) to 5,108.6% (Hong Kong). The percentage change in bilateral trade ranged from −243.7% (Serbia) to 333.7% (Uzbekistan), with a mean of −2.8%.

Trade Policy

The overall levels of protection for agriculture by countries could be reflected in complementarity among policy measures, as indicated by a positive correlation between the existence and prevalence of disputed technical regulations and other forms of border intervention. An alternative hypothesis is that there is substitution among protectionist policy instruments, shown by countries with low tariffs and other nontariff regulations making more use of disputed technical regulations to maintain protection for domestic agriculture. To evaluate these hypotheses, the regression models include as an independent variable the applied rates of protection (weighted by traded agricultural products and including the tariff equivalents of nontariff barriers) that resulted from Uruguay Round commitments (BRDMEA). A positive sign on BRDMEA would support the hypothesis of complementarity, whereas a negative sign would indicate substitution among policy instruments. These expected rates of protection among countries included in the survey ranged from −21.4% (exports taxed in Brazil) to 65.1% (protection in Japan). Membership in the WTO, measured by a discrete binary variable, could also affect use of disputed technical regulations. Countries that are WTO members and face the possibility of international challenge to their regulations may be less likely to provide

[7] Statistical simultaneity is avoided by measuring the level of agricultural import penetration in the previous year (1995). Without time lags, total agricultural imports could be simultaneously determined with technical regulations. However, because governments typically enact many types of trade restrictions, it is reasonable (particularly with the lag) to model the use of disputed technical regulations as dependent on the aggregate level of agricultural import penetration.

disputed regulatory protection than nonmembers. Ninety-five of 132 countries included in the survey were members of the WTO in 1996.

Governments may also impose disputable technical regulations in a "tit-for-tat" approach to trade policy. Under such an approach, technical regulations on products from a particular country are imposed in retaliation for similar measures applied on exports to that country. Unfortunately, no comprehensive direct measure is available for the disputed technical regulations imposed against agricultural products of foreign countries by the United States. In lieu of such a variable, the 1994 Uruguay Round commitments for reductions in the average tariff faced by agricultural exports of each country (URCMT) are included in the regression analysis. Tit-for-tat implies that the incidence of disputed technical regulations imposed by a country is negatively related to the tariff-reduction commitments (measured as positive numbers) by its trade partners. Values of commitments for tariff reductions among the surveyed countries averaged 20.3%.

Characteristics of the Aggregate Economy

Conditions within the aggregate economy may also affect the use of disputed technical trade regulations in agriculture. Consumers demand more food safety and are less likely to protest food price increases as per-capita income (GDP) rises, whereas producers in wealthy countries more effectively lobby policymakers; for both of these reasons, higher national incomes might be observed to increase the use of disputed technical regulations. Conversely, a country may be less likely to use disputed technical regulations as its economy is more integrated into the world economy, either in response to its dependence on imported goods or to fear of retaliatory action against its exports. Global integration is measured by aggregate imports relative to GDP (IMPGDP) and the aggregate trade balance (exports minus imports) of a country (TRDBAL). Disputed measures may be less frequently observed in countries where all segments of the economy are more integrated with global markets. The IMPGDP averaged 42.0% among surveyed countries, and TRDBAL ranged from −$1,544 (Israel) to $4,789 (Singapore).

Field Staff

Another characteristic of the importing country that may influence the identification of disputed trade measures is the physical presence of a USDA FAS office. FAS field staff normally assess multiple countries from a single office. Thus, for example, staff in the Netherlands FAS office also have responsibility for Belgium and Denmark, and staff in the Argentine FAS field office also have responsibility for Uruguay and Paraguay. Awareness of disputed technical barrier policies may differ systematically among countries on the basis of whether or not an FAS office is physically present in a country. Hence, a variable (POST) is included in the models to determine whether the location of an FAS office affects the extent of reported disputed technical regulations to U.S. agricultural exports. FAS field staff were present in 49 of 132 countries and one of two trading blocks (approximately 37%) of the destinations in the survey.

Empirical Evidence

Results from the empirical models provide evidence of a political economy basis underlying disputed technical regulations, as shown in Table 5. Significant regression coefficients in the models are interpretable as supporting the hypothesis that these regulations arise from political economy as well as scientific and product differentiation considerations. For each of the measures of disputed technical regulations (YN and NU), results are reported for a fully specified model that includes all of the independent variables and a more parsimonious specification. All of the regression models reported are highly significant based on a likelihood ratio test ($p < 0.001$, χ^2 statistic).

When AGGDP increases, both the probability of enacting a disputed technical barrier and the number of regulations decrease (the negative coefficients on AGGDP were signif-

Table 5. Determinants of Disputed Technical Regulations to U.S. Agricultural Exports

	Political Economy Determinants										
	Characteristics of the Agricultural Sector				Trade Policy			Characteristics of the Aggregate Economy			Field Staff
Technical Barrier Measures	AG GDP	LAB AG	AG PENT	AG BAL	BRD MEA	UR CMT	WTO	GDP	IMP GDP	TRD BAL	POST
YN	−0.260	−0.229	−0.193	−0.445	−0.162	0.045	0.195	−0.089	−0.103	0.119	0.621
	(0.047)	(0.065)	(0.086)	(0.049)	(0.096)	(0.659)	(0.344)	(0.508)	(0.234)	(0.115)	(0.001)
YN	−0.246	−0.167	−0.195	−0.398	−0.171			−0.054			0.626
	(0.041)	(0.125)	(0.006)	(0.042)	(0.047)			(0.613)			(0.001)
NU	−0.483	−0.178	−0.227	−0.246	−0.010	−0.292	−0.076	−0.011	−0.313	0.134	1.676
	(0.060)	(0.498)	(0.389)	(0.595)	(0.952)	(0.043)	(0.832)	(0.963)	(0.061)	(0.558)	(0.001)
NU	−0.474	−0.139	−0.158	−0.205		−0.267		0.012	−0.311		1.684
	(0.050)	(0.531)	(0.328)	(0.569)		(0.044)		(0.941)	(0.035)		(0.001)

Notes: Shown are changes in predicted values of the dependent variable resulting from an increase of each continuous independent variable by 1 SD above its mean, holding all others constant at their mean, or for the binary independent variables WTO and POST, the effects when values of 1 versus 0 are substituted into the estimated equations. *P*-values are shown in parentheses for the estimated regression coefficients on which the reported effects are based. $P < 0.10$, for example, implies statistical significance of the reported effect at the 10% level. All models are significant at the 1% level on the basis of a χ^2 test.

icant at the 10% level in all four models specified). These outcomes for disputed technical regulations are consistent with results from earlier empirical analyses of nominal protection coefficients by Honma and Hayami or DeGorter and Tsur, who showed increased protection as industrial transformation proceeds (as measured by a decreasing agricultural share in the total economy). A one-standard-deviation increase in the agricultural share of GDP decreases the probability of observing one or more disputed technical regulations to trade by approximately 25% and decreases the number of such regulations by approximately one-half of a barrier. Corroborating evidence about the influence of the relative size of the agricultural sector on existence of disputed technical regulations is provided by the negative impact of LABAG, although the latter coefficients were statistically significant in only one case.

The probability of enacting disputed technical regulations is also affected by other characteristics of the agricultural sector of the importing country. First, the probability of observing one or more disputed technical regulations is negatively related to AGPENT. In contrast to the empirical identification of policy determinants within a particular country where producer interests have been found to dominate, consumer interests in open markets seem to dominate producer interests in regulatory protection as the import dependence of a country rises. Countries included in the survey of disputed technical trade regulations to U.S. agricultural exports are heterogeneous; thus, a plausible interpretation of our result is that a city-state like Hong Kong is likely to be less protective of its limited agricultural production resources through disputed technical trade regulations than a net agricultural exporter like New Zealand. Second, the likelihood that one or more disputed technical regulations to U.S. exports are observed declines as the recent AGBAL becomes more favorable for a country. On the basis of p values for the estimated regression coefficients, NU is not shown to depend on these two agricultural trade measures.

The reported models also provide some evidence of a political economy influence from trade policy on disputed technical regulations. The likelihood of disputed technical regulations being observed is negatively related to BRDMEA. This result is consistent with the hypothesis that technical regulations are used as substitutes for tariffs and other nontariff trade restrictions. URCMT values are significant (at the 5% level) in explaining the number of disputed technical regulations: when the reduction in these tariff rates is larger, NU is smaller. This can be interpreted as evidence of a tit-for-tat aspect of trade policy, supporting conclusions drawn from a case study of U.S.-Mexico sanitary and phytosanitary disputes by Orden and Romano and for other U.S. nontariff regulations by Gawande.

There is relatively little empirical evidence to link the incidence of disputed technical regulations to the variables included to characterize the aggregate economy. An exception is that the estimated number of disputed regulations decreases (by 0.31) when IMPGDP increases by one standard deviation. This provides some support for the hypothesis that the imposition of disputed technical regulations is lessened in more globally integrated economies, as was inferred for other nontariff policies by Kherallah and Beghin.

Last, POST in a country proves to be an important determinant in the identification of disputed technical regulations. The estimated impacts from the presence of an FAS post are to increase the probability of observing one or more disputed technical regulations by more than 0.60 (60%) and the number of such regulations by 1.68. Because the final determination of legitimacy for any particular policy is based on negotiated or legal outcomes, this result does not provide direct evidence concerning the extent of regulations that might ultimately be judged inappropriate in any country. Neither the overidentification of disputed regulations in countries with an FAS post present nor underidentification in those countries without the physical presence of a post was statistically determined.

Conclusions

Analysis of the incidence of disputed technical regulations to U.S. agricultural exports based

on cross-sectional primary survey data collected at the initiation of the Uruguay Round agreements serves to profile a vexing problem in world agricultural trade. These regulations can be legitimate policy instruments to protect plant, animal, and human health or to differentiate among products, but some of the imposed measures cannot be justified on the basis of scientific evidence alone or adherence to other WTO disciplines. Even when evaluated from the perspective of one country, the survey results confirm that technical regulations applied to agricultural exports and potentially subject to challenge under international trade laws were widespread when the WTO agreements came into effect. More than 300 such regulations to U.S. agricultural exports were identified, limiting trade by nearly $5 billion in 1996.

Our econometric analysis indicates that the implementation of disputed technical regulations has a political economy dimension consistent with that identified for other types of trade intervention. A robust result arises in the negative relationship between the relative contribution of agriculture to an economy and the application of disputed technical regulations to U.S. agricultural exports. This is similar to the political economy of other agricultural policies: greater protection is offered in countries where agriculture is a smaller component of the domestic economy. There is also evidence that technical regulations may serve as substitutes for other forms of border protection and that increased openness of an economy or trade opportunities faced by its agricultural exports reduces the use of technical regulations subject to dispute.

The ongoing challenges faced in world trade with respect to the legitimate application of technical regulations are apparent from this analysis. With the Doha round of WTO negotiations, launched in November 2001 and still ongoing, the discipline of technical regulations to trade remains a concern that may affect the achievement of a new agreement in agriculture and, hence, the success of the whole negotiating effort. We have shown that technical trade regulations, like other agricultural policies, are subject to significant political economy determination. The institutional innovations brought about by the WTO create enhanced opportunities for international scrutiny of the technical regulations of individual countries and may contribute to enhanced discipline for these measures. Nevertheless, the WTO agreements operate within the framework of broader economic and political forces that determine trade policy outcomes and continue to result in high levels of intervention in world agricultural markets.

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