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ABSTRACT

This article examines how domestic and foreign tobacco regulations affect tobacco trade flows and consumer health. We develop a gravity equation incorporating domestic and foreign tobacco regulations into a country's tobacco import demand. We estimate the bilateral trade effects of marketing, counter-advertising, age and smoking tobacco location regulations. After controlling for endogeneity of tobacco regulations, we find three striking results. First, smoking location regulations reduce tobacco imports while age regulations reduce tobacco exports. Second, marketing regulations significantly reduce tobacco imports and the magnitude of this effect is larger when the trading partners are rich exporters and poor importers. Finally, counter-advertising regulations reduce all tobacco trade. Using existing health effect elasticities in conjunction with our results, we show how these changes affect tobacco-related mortality and morbidity. Our results highlight the importance of implementing policies that account for potential spillover effects in an increasingly multilateral economy.

Keywords: bilateral trade effect; gravity model; tobacco regulation; mortality

JEL: F14, I18

1. Introduction

The World Health Organization estimates that tobacco use kills 5 million people annually and projects world tobacco consumption to continue increasing. Policy makers have attempted to reduce tobacco consumption using a variety of tobacco regulations, including regulations that limit cigarette advertising, impose age and smoking location restrictions as well as place warning labels on the damages of smoking (Laugesen and Meads, 1991).

The effects of these regulations on tobacco consumption have been extensively analyzed (Chaloupka and Warner 2000). Marketing bans have yielded mixed results. In OECD countries, the effect of comprehensive marketing bans on tobacco consumption has ranged from insignificant (Stewart 1993, Nelson 2003a, and Nelson 2003b) to a modest effect on adult tobacco use (Laugesen and Meads 1991; Saffer and Chaloupka 2000). However, when considering developing countries, the evidence suggests that comprehensive bans significantly reduce tobacco consumption (Blecher, 2008). There is a general consensus that smoke-free zones or smoking location regulations significantly reduce cigarette consumption (Chapman et al. 1999). Similarly, counter-advertising efforts have been found effective in reducing tobacco consumption in the US (Hu et al., 1995; Lewit et al., 1981; Schneider et al., 1981; Warner, 1981; Baltagi and Levin, 1986).

While tobacco consumption is projected to increase in developing economies, developed economies are experiencing a decline in consumption of tobacco due in part to a variety of related regulations, and are a significant contributor in the export of tobacco (FAO, 2003). The USA and European Union were two of the top three exporters of raw tobacco from 1998 to 2000 (Commission of the European Communities, 2003). Although there has been extensive analysis

on the impact of tobacco regulations on own-country consumption, we have not come across any study that investigates the spillover effects of tobacco-specific regulations on tobacco trade flow. Given the projected rise in tobacco consumption in developing economies and the importance of trade in facilitating this growth, an understanding of regulatory effects on trade flows is important for both tobacco-related regulation and trade policy.

This article fills this gap in the literature by examining the tobacco trade-flow effects of domestic and foreign tobacco regulations on the flow of tobacco trade and its consequent health effects. We extend the seminal theoretical gravity model developed by Anderson and van Wincoop (2003) by incorporating tobacco regulations. This model supports an estimable empirical specification where we test a set of hypotheses about the effectiveness of domestic and foreign regulations on tobacco trade. The empirical results also provide evidence about the extent to which domestic regulations have spillover effects on other countries. In addition, we simulate the spillover effects of tobacco regulations on mortality and morbidity from imported tobacco use by combining our estimates with complementary results from studies in the literature. Spillover effects have implications for local and global effectiveness of tobacco regulations. We provide implications for how these policies could be harmonized across countries.

Several strands of literature have investigated the spillover effects of regulations on trade patterns. In the context of food safety, sanitary and phytosanitary regulations have no significant impact on agricultural trade between OECD countries; however, they have a significant impact on developing countries where the regulations are more lax (Disdier, et al. 2008). In terms of environmental pollution, the pollution haven hypothesis suggests that if a country has very strict regulations, firms' environmental regulation compliance costs are high giving firms an incentive

to relocate to countries with less stringent environmental regulations (Grossman and Krueger, 1993 and 1995). The mechanism driving the impact of regulations on trade in these strands of literature is supply-oriented. However, the underlying mechanisms driving the effects of tobacco regulations on trade stems from both supply and demand-side factors.

Several studies have analyzed the effects of various policies on tobacco consumption and trade other than tobacco-specific regulations. Regional trade agreements significantly affect tobacco firms' marketing, lobbying, and organizational strategies (Holden et al. 2010) along with their market shares (Chaloupka and Laixuthai 1996). The elimination of tobacco production subsidies in response to trade agreements initially decrease tobacco consumption but tobacco production shift to other countries and tobacco imports significantly increase (Stoforos and Mergos 2004). Such a change in production, exports and imports highlight the need to investigate any potential effect of tobacco regulations on trade flows.

To examine the trade and health implications of tobacco regulations, we incorporate four categories of tobacco regulations — marketing regulations, counter-advertising and education mandates, smoking location regulations, and age restrictions — into Anderson and van Wincoop's (2003) model. Marketing regulations restrict where and to what audiences tobacco can be advertised. Tobacco counter-advertising includes health warnings or advertising campaigns designed to reduce smoking, or more broadly, any form of media or message contrary to the messages promoted by tobacco companies. Smoking location regulations prohibit smoking in specific types of public areas. Age restrictions are restrictions on the minimum age of tobacco product purchasers.

Regulatory instruments may affect trade flows differently. Age and smoking location regulations reduce aggregate tobacco demand because they remove a segment of the consumer base: those below the minimum smoking age or those residing and working in non-smoking areas. Marketing and counter-advertising regulations affect consumer preferences and may cause a shift in tobacco demand. Also, changes in marketing regulations between trading partners could affect tobacco trade flows away from developed toward developing countries where marketing regulations are less stringent, as firms reallocate advertising expenditures.

Tobacco regulations are likely to be endogenous since demand for imported tobacco could influence regulations affecting their consumption. Based on Keohane et al. (1998), we identify supply-side and demand-side factors affecting regulatory choice. We use average asbestos production and a measure of government response to lobbying as instruments for our tobacco regulations. The former instrument affects the perceived marginal damages from tobacco related illnesses, which shifts demand for tobacco regulations. The latter affects the marginal stringency of the tobacco regulation, which affects supply of tobacco regulations. Neither influence tobacco imports directly, but only indirectly through tobacco regulation.

The model we develop and hypotheses we test elucidate the different effects of tobacco regulations on tobacco trade. We find three important results. First, domestic smoking location regulations significantly reduce tobacco imports while age regulations reduce tobacco exports. Second, marketing regulations reduce tobacco imports, and the results are more pronounced when the trading partners are a rich exporter and poor importer. Finally, countries with more stringent counter-advertising have lower tobacco imports and exports.

Our results have important policy implications. First, since stringent marketing and smoking location regulations lead to lower imports but have little or no effect on exports, countries may unilaterally incorporate such tobacco regulations without worrying that there are any unintended adverse health consequences for their trading partners. Second, if the policy goal is to reduce tobacco consumption for both trading partners, we find evidence that counter-advertising regulations may be a relatively effective regulatory instrument since it decreases both tobacco imports and exports. Further, harmonizing this type of tobacco regulation among trading partners may increase its effectiveness in reducing aggregate tobacco consumption.

The next section of this article develops the theoretical model to support hypothesis development and the empirical estimation strategy. Section 3 presents the data. Section 4 presents the results of our analysis and section 5 concludes the study.

2. Model

We present a theoretical model that implies an estimable empirical equation linking the effect of tobacco regulations on tobacco trade flows. We adopt Anderson and van Wincoop's (2003) gravity model to estimate the effect of tobacco regulations on tobacco imports.

2.1. Tobacco Regulations and the Gravity Model

Assume a representative consumer who maximizes a constant elasticity of substitution utility function subject to a budget constraint, and *n* countries, each of whom may produce differentiated tobacco that is either consumed domestically or exported.

The utility function for country *j*'s consumer is given by

$$U_{ij}(c_{ij}) = \left[\sum_{i=1}^{n} \left(\frac{c_{ij}}{\beta_i}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}, \quad (1)$$

where c_{ij} is consumer *j*'s consumption of country *i*'s goods, β_i is the share parameter for country *i*'s good, and σ is the elasticity of substitution. The consumer's budget constraint is

$$y_j = \sum_{i=1}^{n} p_{ij} c_{ij}, \tag{2}$$

where y_j is country *j*'s total income and p_{ij} is the price country *j*'s consumers face for country *i*'s goods. The first order conditions that maximize (1) subject to (2) are

$$\left(\frac{\sigma}{\sigma-1}\right)\left[\sum_{i=1}^{n}\left(\frac{c_{ij}}{\beta_i}\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}-1}\left(\frac{1}{\beta_i}\right)^{\frac{\sigma-1}{\sigma}}\left(\frac{\sigma-1}{\sigma}\right)c_{ij}{}^{\frac{1}{\sigma}} - \lambda p_{ij} = 0 \quad \forall \; i = 1..n$$

$$y_j - \sum_{i=1}^{n} p_{ij} c_{ij} = 0$$

where λ is the marginal utility of income. Solving the first order conditions yield country *j*'s demand for country *i*'s goods,

$$x_{ij} = y_j \left(\frac{\beta_i p_{ij}}{\sum_{i=1}^{n} \beta_i p_{ij}}\right)^{1-\sigma}. \tag{3}$$

The prices country *j* face, p_{ij}, are different than the domestic prices in country *i* because they include trade costs, defined as all costs sustained in moving a good to its final non-domestic use other than production costs. These trade costs include transportation costs and costs incidental to policy barriers and regulations (Anderson and van Wincoop, 2004). Thus, we incorporate domestic and foreign tobacco regulations into an index function that incorporates the effects of trade costs. Domestic tobacco regulations affect the foreign tobacco firm's ability to increase demand for their products, while foreign regulations affect the supply of the foreign tobacco available for import. Both of these regulations therefore affect trade costs and consequently the prices of traded goods.

The price of foreign goods takes the form

$$p_{ij} = p_i t_{ij}, \tag{4}$$

where p_i is the exporter's supply price on the world market and t_{ij} is the per unit trade costs between country *i* and country *j*. Trade costs are directly affected by regulations, policy barriers, and are indirectly affected by geographic and cultural variables through transportation costs (Anderson and van Wincoop, 2004; Gallup et al. 1999).We extend the Anderson and van Wincoop (2003) gravity model by incorporating each of the regulations into trade costs, defining them as

$$t_{ij} = e^{\mathbf{R_{ij}A}} e^{\mathbf{C_{ij}B}} d_{ij}^{b}(1 + v_{ij}), \tag{5}$$

where $\mathbf{R_{ij}}$ is a row vector of regulation indices, $\mathbf{A}$ is a column vector of associated regulatory parameters, $\mathbf{C_{ij}}$ is a row vector of cultural and geographic characteristics, $\mathbf{B}$ is a column vector of associated cultural and geographic parameters, d_{ij} is the distance between country *i* and *j*, *b* is a trade elasticity of distance, and v_{ij} is country *j*'s ad valorem import tariff on country *i*'s goods.

We define four categories of regulatory indices to measure regulation intensity. Let r_i^c be counter-advertising, r_i^m marketing, r_i^a age regulation, and r_i^s smoking location regulation indices for country *i*. We then define the linear aggregation index representing tobacco regulations for a given country pair (*i*,*j*) as

$$\mathbf{R_{ij}A} \equiv \alpha_i^c r_i^c + \alpha_j^c r_j^c + \alpha_i^m r_i^m + \alpha_j^m r_j^m + \alpha_i^a r_i^a + \alpha_j^a r_j^a + \alpha_i^s r_i^s + \alpha_j^s r_j^s, \tag{6}$$

where the α elements are parametric weights associated with each country in the pair and each regulation type. Substituting (5) into (4) and (4) into (3) and using the market clearing conditions

to solve for the scaled prices provides the following import demand equation (see Appendix A for details):

$$x_{ij} = \frac{y_j y_i}{y_w}\left(\frac{e^{\mathbf{R_{ij}A}}e^{\mathbf{C_{ij}B}}d_{ij}^{b}(1+v_{ij})}{P_j\pi_i}\right)^{1-\sigma}, \tag{7}$$

where y_w is world income, $P_j \equiv \left(\sum_{i=1}^{n}\frac{y_i}{y_w}\left(e^{\mathbf{R_{ij}A}}e^{\mathbf{C_{ij}B}}d_{ij}^{b}(1+v_{ij})/\pi_i\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$ is a measure of inward multilateral resistance and $\pi_i \equiv \left(\sum_{i=1}^{n}\frac{y_j}{y_w}\left(e^{\mathbf{R_{ij}A}}e^{\mathbf{C_{ij}B}}d_{ij}^{b}(1+v_{ij})/P_j\right)^{1-\sigma}\right)^{\frac{1}{1-\sigma}}$ is a measure of outward multilateral resistance. Multilateral resistance terms account for barriers to trade affecting both country *i* and *j* in their trade with all trading partners and come in the form of differing price indices (inward) or competition (outward) (Anderson and van Wincoop, 2003).

We find that the tobacco regulations have two separate effects on a country's tobacco import demand. The first is the direct effect which is found in the term $e^{(1-\sigma)\mathbf{R_{ij}A}}$ in equation (7). The second is the indirect effect which is captured in the two multilateral resistance terms.

2.2. Empirical Model

Estimation of equation (7) presents four challenges. First, since there is a potential bi-causal relationship between tobacco regulations and tobacco imports, our regulatory variables are likely endogenous. Using a conceptual framework developed by Keohane et al. (1998) to classify political economy determinants of regulations, we identify two instruments – one affecting the demand for regulations and the other affecting supply. Demand for tobacco regulations is affected by consumers' perception of the marginal damage for tobacco use. Exposure from asbestos increases the marginal damages from tobacco thereby changing the *perceived* marginal damages from tobacco-related illnesses. Asbestos exposure exacerbates tobacco-related illnesses

leading to an increase in perceived marginal damages if the user attributes most of the illness to tobacco use or it can decrease it if the user attributes it more to asbestos exposure. We use a measure of asbestos production per capita as a proxy for asbestos exposure. The supply of regulations can also be affected by government influenceability from lobbying. A government more susceptible to lobbying contributions from a consumer lobbying group (tobacco manufacturer) is likely to establish stringent (lax) tobacco regulations. We use an index of corruption control as a proxy for government influenceability. Both factors are unlikely to affect tobacco imports directly but may affect it through tobacco regulations.

Second, the multilateral resistance terms are not directly measurable from the data. Because Anderson and van Wincoop (2004) were concerned with the parameter estimates of the multilateral resistance terms, they implement a complex algorithm to simulate them. Rather than simulating, they can be proxied using a fixed effects approach by including country specific dummies (Anderson and van Wincoop, 2003; Feenstra, 2004). This approach allows us to easily control for multilateral resistance from other trading partners, but the tradeoff is that while the fixed effects control for both of the multilateral resistance effects, we are not able to capture the indirect of tobacco regulations through these terms.

Third, there are a number of other barriers to trade affecting trade costs that need to be accounted for so that the estimated regulatory effects are unbiased. We use a country specific trade freedom index that captures both tariff and non-tariff barriers to trade to account for all other potential barriers to trade.

Finally, gravity equations are typically estimated using a log-linear specification. Using a data set with all possible trading partner combinations results in a large number of zero trade

flows. Taking the log of trade would create missing values for these observations and ignore a large amount of important information. Two common estimation strategies involve either dropping observations with zero trade or using $\ln\left(x_{ij}+1\right)$ and estimating via ordinary least squares. Neither approach is desirable because they produce inconsistent parameter estimates.

Other empirical strategies have been developed to address the zeros problem.[1] Silva and Tenreyro (2006) propose a Poisson pseudo-maximum likelihood (PPML) estimator for its natural solution to the zeros problem in part because of its superior performance in the presence of heteroskedasticity.[2] Using the PPML estimator, we estimate our gravity equation in levels rather than the log-linearized form. Rewriting (7) in levels yields

$$x_{ij} = \exp\left(\mathbf{Z_{ij}\Theta}\right) = \exp\begin{pmatrix}\ln y_j + \ln y_i - \ln y_w + (1-\sigma)\mathbf{R_{ij}A} + (1-\sigma)\mathbf{C_{ij}B} \\ +(1-\sigma)\mathrm{bln}d_{ij} - (1-\sigma)\ln P_j - (1-\sigma)\ln\pi_i\end{pmatrix}, \qquad (8)$$

[1] Felbermayr and Kohler (2006) set up a Wooldridge (2002) style corner solutions model and use a Tobit regression for estimation. Using a Heckman style selection process, Helpman et al. (2008) develop a two stage estimation procedure. However, both Felbermayr and Kohler and Helpman et al. estimate a log-linear form of the gravity equation.

[2] Using Monte Carlo simulations, the PPML estimator is favorable over the Tobit estimator when data is generated using a constant elasticity model and the probability of observing zero is not independent of the regressors (Silva and Tenreyro, 2011).

where $\mathbf{Z_{ij}}$ is a vector of covariates for each country pair, and $\boldsymbol{\Theta}$ is a vector of parameters. The resulting Poisson log-likelihood function is

$$\ln L = \sum_{k}^{n(n-1)}\left(-\exp\left(\mathbf{Z_{ij}}\boldsymbol{\Theta}\right) + x_{ij}\mathbf{Z_{ij}}\boldsymbol{\Theta} - \ln x_{ij}!\right) \quad (9)$$

where *n* is the number of countries. The PPML estimator represented by equation (9) can be calculated by selecting the parameters that equate the following score equations equal to zero:

$$\sum_{k}^{n(n-1)}\left(x_{ij} - \exp(\mathbf{Z_{ij}}\boldsymbol{\Theta})\right) z_{ij}^{h} \;\; \forall\, h = 1,2,\dots,H, \quad (10)$$

where *H* is the number of covariates, and z_{ij}^{h} is the h^{th} covariate. As the score equations suggest, the response data can include non-integers and need not be Poisson distributed for consistency as long as the conditional mean of trade is correctly specified as $E\left[x_{ij}\middle|\mathbf{Z_{ij}}\right] = \exp\left(\mathbf{Z_{ij}}\boldsymbol{\Theta}\right)$ (Silva and Tenreyro, 2010).

2.3. Hypothesis tests

We test the following hypotheses regarding the effects of tobacco regulations on trade:

1) The effect of smoking location regulations is to decrease tobacco imports and exports. Affirmation requires $\theta_j^s \equiv (1-\sigma)\alpha_j^s < 0$ and $\theta_i^s \equiv (1-\sigma)\alpha_i^s < 0$.
2) The effect of age regulations is to decrease tobacco imports and exports. Affirmation requires $\theta_j^a \equiv (1-\sigma)\alpha_j^a < 0$ and $\theta_i^a \equiv (1-\sigma)\alpha_i^a < 0$.
3) The effect of counter-advertising regulations is to decrease tobacco imports and exports. Affirmation requires $\theta_j^c \equiv (1-\sigma)\alpha_j^c < 0$ and $\theta_i^c \equiv (1-\sigma)\alpha_i^c < 0$.
4) The effect of marketing regulations is to decrease tobacco imports and increase tobacco exports. Affirmation requires $\theta_j^m \equiv (1-\sigma)\alpha_j^m < 0$ and $\theta_i^m \equiv (1-\sigma)\alpha_i^m > 0$.

Age and smoking location regulations affect only a specific number of consumers who are affected by the constraint. In contrast, counter-advertising regulations affect the entire market of tobacco users by changing consumer preferences. The higher these regulations, the lower the demand for tobacco products thereby reducing consumption and production and therefore both imports and exports, as stated in Hypotheses 1, 2 and 3 (Chapman et al. 1999).

Marketing regulations also decrease tobacco imports because it also affects the entire market. However, the second half of Hypothesis 4 is similar in spirit to the results from Stoforos and Mergos (2004) where changes in domestic tobacco policies that affect firms lead to a change in their production and marketing behavior away from the domestic economy and towards the world market.

If marketing regulations do lead to an increase in exports as consistent with Hypothesis 4, where do these exports go? One plausible class of destinations is countries where marketing regulations are less stringent. Strict domestic marketing regulations in exporting countries may free up resources that otherwise would have been spent marketing, allowing exporting firms to advertise in target countries that have less stringent regulations, as evidenced by relatively no change in advertising spending for UK tobacco firms (Elliot et al. 2010). Such a hypothesis is akin to the pollution haven hypothesis, but the effects in our case follow from demand rather than supply shifts as is the case in the pollution haven setting. The strictest form of this "relative stringency" effect would be the case where relative trade costs between countries depends not on the levels of both r_i^m and r_j^m, but only on the difference between them. If this were to hold, the trade cost index (equation 6) would take the restricted form

$$\mathbf{R_{ij}A^r} \equiv \varphi^m\left(r_i^m - r_j^m\right) + \alpha_i^c r_i^c + \alpha_j^c r_j^c + \alpha_i^a r_i^a + \alpha_j^a r_j^a + \alpha_i^s r_i^s + \alpha_j^s r_j^s, \qquad (11)$$

where $\mathbf{A^r}$ is a column vector of parameters from a restricted regression. The restriction implied by Equation (11) is $\varphi^m = \alpha_i^m = -\alpha_j^m$. Thus, we test the following hypothesis:

5) Countries with more stringent marketing regulations will reallocate advertising spending towards countries with less stringent regulations, leading to more tobacco imports in the latter. Affirmation requires $\bar{\theta}^m \equiv (1-\sigma)\varphi^m > 0$.

Here, as the difference between exporter and importer regulations increase, trade imports rise because the trade costs for the importing country decline when the restriction holds. The policy implication of this restricted trade cost structure is that matching marketing regulatory stringency between trading partners will reduce spillover effects. In fact, if equation (11) holds and the regulations across exporters and importers are the same, there is no spillover effect from the exporter's regulations on tobacco imports through trade costs.

3. Data

We compile cross-sectional data from the year 2000. The information includes tobacco trade flows, a trade freedom index, Gross Domestic Product (GDP), country specific tobacco regulations, and bilateral distances and characteristics. Appendix B presents the data sources.

The trade data include total import values in millions of US dollars of manufactured and unmanufactured tobacco from the year 2000. There are 97 countries in our sample. Zero trade is not reported, but for our analysis it is inferred for countries with no reported trade. We build a dataset including all possible trading partners, providing 97x96 = 9312 total observations.

The available information on tobacco regulations includes three levels of regulation — bans and complete restrictions, partial regulation, and no regulation. We use indicator variables representing bans and complete restrictions, so the partial and no regulation categories are

represented together as one of the two binary outcomes for each respective regulation type. There are only two counter-advertising regulations. We use a dummy variable to indicating whether either counter-advertising regulation is present.

There are a number of sub-categories for smoking location, marketing and age regulations as summarized in Appendix C. Indices representing the stringency of each tobacco regulation were created for each country by summing the number of tobacco regulations observed for each category and dividing the sum by the total number of tobacco regulations in each category. Each subcategory regulation within the index is equally weighted such that the index ranges between zero and one. This implies that a country who adopts all the subcategory criteria within a tobacco regulation will have the highest level of regulation with an index of 1. In contrast, a country with zero regulations will have an index of 0.

The trade freedom index is a broad measure of trade barriers. It includes both tariff and non-tariff measures. The formula used to calculate the index consists of two parts. The first is a score based on the trade-weighted average tariff and the maximum tariff. The second is a penalty deducted from the first for non-tariff barriers (Heritage Foundation 2013). A perfectly open economy would have an index of 100.

Bilateral distances were calculated based on the shortest distances measured on the earth's surface regardless of actual transportation routes. The cultural and geographic characteristics include three dummy variables indicating whether the countries share a border, a common language or a colonial link.

The first instrumental variable is asbestos production per capita from the US Geological Survey. There are 61 countries with observation on production of asbestos from 1930 to 1970.

Historical population demographics from these countries were gathered to obtain average asbestos production per capita over the time period. If only 61 countries are used, we would only have 61x60= 3660 observations in the second stage regression which is less than half of our original sample. We utilize multiple imputation assuming a censored distribution at 0 since the remaining countries likely have no production of asbestos over that period. We take the average over 20 imputations for the 36 countries with missing observations.

The second instrumental variable to proxy for government influenceability is the corruption control index from the International Country Risk Guide. This variable measures the extent to which financial corruption (such as bribes for protection) and insidious forms of corruption (such as lobbying to affect policy) are prevalent within the country.[3] Scores range from 0 to 6 where a high index indicates more corruption control or less government influenceability to lobby groups. We take the average of the corruption control index from 1984 to 1995 and obtain 81 country observations. We also employ multiple imputation to fill in missing observations assuming a normal distribution. We take the average from 20 imputations to account for the 16 countries with missing observations.

[3] While lobbying and other legal forms of influence activities might not universally be identified as corruption, we retain the definition of corruption as defined in the International Country Risk Guide.

Table 1 presents the summary statistics. The average level of tobacco imports was $1.5 million. For developed countries (those with GDP per capita larger than $4,085), the average tobacco import level is higher at $2 million while for developing countries (those with GDP per capita lower than $4,085), average tobacco imports are lower at $0.25 million. Also, not surprisingly, developed economies have more stringent tobacco regulations than developing economies across our four measures of tobacco regulation indices.

4. Results

We estimate model parameters for the full sample and a subsample of observations where exporters and importers pairs have large income gaps (GDP per capita for the exporter that exceeds the GDP per capita of importers by $3,000 or more). We compare the results with and without imputed values for the instrumental variable (IV) estimates using PPML. The advantage of including imputed values for the first stage of regressions is that the sample size increases threefold.[4] However, the imputation method could introduce measurement error. We also include PPML estimates without adjusting for endogeneity but such results are likely biased. After discussing our regression results, we combine them with existing estimates on the health effects of tobacco consumption to examine the trade-mediated effects of regulation on health.

[4] With imputed values, there are 97 countries leading to 97x96 = 9312 observations. Without imputed values in the first stage regressions, there are only 57 countries with both asbestos production and corruption control index data which leads to only 57x56 = 3192 observations.

4.1. Regression Results

Since our tobacco regulatory variables are indices ranging from 0 to 1, we utilize a fractional logit model in the first stage regression for all regulations except counter-advertising, to which we apply a simple logit because the counter-advertising regulation variable is binary. We have two sets of first stage regressions- one with imputed values and one without as shown in Appendices D and E, respectively. The joint significance of the exogenous variables, based on the Pearson Chi-square statistic for the fractional logit and the pseudo-R2 for the logit are large highlighting the strength of our instruments. In all regressions, both instruments are significant. In most specifications, an increase in average asbestos production per capita leads to more stringent tobacco regulations. This may be explained by an increase in perceived marginal damages from tobacco use leading to more demand for stringent regulations. On the other hand, a lower corruption control index (higher government influenceability) leads to more stringent tobacco regulations. One potential explanation is that when the government can be lobbied to influence regulations, the consumer advocacy group has a greater influence on the government than tobacco firms.

Table 2 presents coefficient estimates of the determinants of tobacco imports using the PPML and IV-PPML models. The standard errors are robust to heteroskedasticity. The exporter and importer GDP coefficients are positive and statistically significant because larger countries tend to trade more. Furthermore, we fail to reject a t-test of the hypothesis that both exporter and importer GDP coefficients are equal to one when using IV-PPML with imputed values for the full sample, which gives some support for the theoretical specification relating the size of an economy to tobacco trade levels. Our theory also suggests that trade costs, in the form of

distance between countries, trade barriers, cultural differences, geographic locations and regulations, affect trade flows. Our empirical results show that the distance effect is negative and significant in all models suggesting distance reduces tobacco trade. The trade freedom index, which measures the impact of trade barriers, is consistently positive and significant in all specifications and having a common language also has a positive effect on trade to a lesser extent. Interestingly, being in the same colony historically is a negative determinant especially when the income gap between trading partners are large. However, sharing a border does not have any statistically significant effect.

When examining the IV-PPML results, we find general support for our hypotheses regarding the effect of tobacco regulations on import demand but only partial support when looking at the effect of the same regulations on exports. An importer's smoking location regulation consistently negatively affects imports of tobacco in all models. However, an exporter's smoking location regulation has a positive but mild or insignificant effect on exports. Thus, there is partial support for Hypothesis 1.

The age regulation has the opposite effect on tobacco trade. Age regulations significantly reduce tobacco exports but the effect on tobacco imports is inconsistent. Thus, there is only partial support for Hypothesis 2.

The effect of counter-advertising regulations on tobacco trade is consistent with Hypothesis 3. Counter-advertising regulations reduce both tobacco imports and exports from the IV-PPML model without imputed values. This implies that imposing counter-advertising regulations not only reduce domestic consumption of tobacco, but also yields a positive spillover to their trading partner in the form of reduced exports. Furthermore, as the income gap between

exporter and importer becomes larger, there is a slightly larger reduction in tobacco trade which implies that developing countries importing from developed countries will be more responsive to this type of tobacco regulation than two trading partners with similar wealth.

Marketing regulations negatively affect tobacco imports but have no significant effect on exports. Thus, there is partial support for Hypothesis 4. Interestingly, the marginal effect of marketing regulations on tobacco imports is larger between a rich exporter and poor importer than similarly wealthy countries. Our estimates show that marketing regulations do not decrease exports; instead it has no effect on it. One plausible explanation is that tobacco exporting firms continue to produce and export tobacco by targeting markets with relatively more lax tobacco marketing regulations. We test this idea by examining the restricted model.

We now examine the validity of Hypothesis 5, whether exporting countries with stringent marketing regulations target importing countries that have relatively lax marketing regulations. Table 3 shows the results from our restricted estimation in which Equation (11) is imposed. We find that as the difference in marketing regulatory stringency between exporters and importers of tobacco increase, more tobacco is exported to countries with less stringent regulations. Furthermore, the effect is magnified when the exporting country has a significantly larger income than the importing country. A reallocation of advertising spending may be the underlying mechanism leading to this result. Elliot et al. (2010) show that tobacco regulations do not significantly change aggregate advertising spending by UK tobacco firms. This hints at a reallocation of advertising spending by tobacco firms away from countries that have stringent marketing regulations towards other countries with lax marketing regulations.

However, a Likelihood Ratio test rejects the restriction in favor of the unrestricted model. This result has interesting policy implications as well. If the restriction had held, the policy recommendation for effective tobacco consumption reduction would be to harmonize tobacco marketing regulations across trading partners such that countries with lax regulations adopt more stringent policies similar to their trading partners to mitigate the spillover effects. However, given that the restricted model is rejected, such a simple policy applied uniformly over all trading partners would be inefficient as a means of reducing tobacco consumption. We infer that there are other unobserved factors that need to be considered when harmonizing marketing regulations to effectively mitigate these spillover effects.

4.2. Tobacco Regulations, Trade and Mortality

To better understand the impact of the regulations, we simulate a policy change to measure the effect on tobacco imports and mortality from tobacco related diseases. Based on IV-PPML estimates in Table 2, when one more marketing regulation is adopted by an importer, tobacco imports decrease by 84%. Given the mean tobacco import value of developing countries, this decline in tobacco imports due to an importer adopting one more marketing regulation would lead to a decrease in tobacco imports at a value of $1.28 million annually from an average country in our sample. In contrast, the effect of an importer adopting one more smoking location restriction also decreases tobacco imports but such an effect is not as large. When one more smoking location regulation is adopted by the exporter, tobacco imports decrease by 13%. Given the mean values of tobacco imports in our sample, these changes corresponds to a decrease in trade imports of approximately $200,000 annually for an average country in our sample.

Using our estimates along with those in the literature, we can also forecast the effect that regulations have on mortality and morbidity rates in an importing country. We use the estimates from two studies in the literature along with our own estimates to obtain an elasticity measure of mortality given a change in regulations. Escario and Molina (2004) estimate the effect of per capita consumption of tobacco on mortality rates for cancer of the lung, trachea and bronchi in select European Union countries. They find that a 1% increase in tobacco consumption per capita leads to a 0.34% increase in total tobacco related mortality. Hsieh et al. (1999) estimate the effect of import market shares of tobacco on consumption of tobacco to show that a 1% increase in import market shares leads to a 0.031% increase in tobacco consumption per capita. Using their estimates along with our estimates from Table 2, we derive an approximate elasticity of tobacco related mortality in an importing country brought about by a change in an exporting country's tobacco regulations as shown in Table 4.

We find that a one standard deviation increase in an importer's marketing regulation from the mean level leads to a 2.3% decrease in mortality for imported tobacco-related cancer in the importing country. The magnitude of the decline is slightly higher at 2.4% when a rich exporter trades with a poor importer. Given that the average mortality rate from 12 European Union countries due to tobacco related cancer is 309 deaths per million people (Escario and Molina 2004), a standard deviation increase in an importer's marketing regulation translates to a decrease in imported tobacco cancer related deaths by 7 to 8 smokers per million people annually. Approximately 20 smokers suffer from tobacco related diseases for every one tobacco related death (CDC 2003). The importing country also experiences a reduction in morbidity from 140 to 160 smokers per million people annually due to an increase in the importer's marketing

regulation stringency. For a large developing country such as Indonesia with a population of 242 million, the regulatory effects can be significant.

Next, we investigate the spillover effects of counter-advertising regulations. We find that a one standard deviation *decrease* in counter-advertising regulations in the exporting country (non-adoption of counter-advertising regulations) can lead to an increase in tobacco related cancer mortality by 0.9 % in the importing country and is higher when there is a large income gap between exporter and importer at 1.3%. This would correspond to an increase in tobacco cancer mortality by 3 to 4 deaths annually and 60 to 80 smokers incurring tobacco related diseases annually per million people. As a point of comparison, there are 25 and 4 deaths annually of males and females, respectively, worldwide from alcohol use disorders per million people (WHO, 2004). Thus, the spillover effects from *not* adopting counter-advertising regulations are comparable to female deaths from disorders from alcohol use. These effects hint at potential health benefits of coordinating tobacco regulatory policies across countries.

5. Concluding Remarks

Given that the consumption of tobacco is projected to continue rising worldwide, tobacco-related disease is likely to remain a public health policy concern. Although there has been much debate regarding the efficacy of tobacco-related regulation, little has been done to investigate their bilateral effects through trade. In this article, we extend the theoretical framework of the gravity model to arrive at an empirical specification that estimates the bilateral effects tobacco regulations.

For some regulations, we find these effects to be significant in determining the flow of tobacco trade. There are three striking results with important policy implications. First, smoking

location regulations decrease tobacco imports while age regulations decrease tobacco exports. Developing countries generally have fewer of these regulations. If they can be effectively enforced, these regulations offer developing countries a simple policy tool that may reduce tobacco trade.

Second, marketing regulations reduce tobacco imports but has no effect on exports. We find that some exporting countries may target other countries with lax marketing regulations to reallocate their export distribution. This may hint at a potential "tobacco disease haven" where developing countries experience a rise in tobacco-related illnesses due to increased marketing regulation stringency in developed countries.

Finally, counter-advertising regulations decrease tobacco imports and exports and the effects are slightly larger between rich exporters and poor importers. This suggests that counter-advertising regulations have a positive spillover effect to their trading partners. If a country implements counter-advertising regulations in order to reduce tobacco consumption and they happen to be an exporting country, our results suggest there will be less tobacco on the world market. This makes a case for coordinated increases in counter-advertising regulations to internalize the spillover effect and further decrease trade flows of tobacco. Given the potential spillover from counter-advertising regulations and potential targeting of countries as a response to marketing regulations, some form of harmonizing marketing and counter-advertising policies across trading partners can reduce these spillover effects.

References

Anderson, J. and van Wincoop, E. 2003. Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review* 93(1): 170–192.

Anderson, James E., and Eric van Wincoop. 2004. Trade Costs. *The Journal of Economic Literature*, 42(3): 691-751. DOI: 10.1257/0022051042177649.

Baltagi, B.H., Levin, D., 1986. Estimating dynamic demand for cigarettes using panel data: the effects of bootlegging, taxation, and marketing reconsidered. *Review of Economics and Statistics* 68: 148–155.

Blecher, E. 2008. The impact of tobacco advertising bans on consumption in developing countries. *Journal of Health Economics* 27: 930–942

Center for Disease Control (CDC). 2003. Cigarette smoking – attributable morbidity – United States 2000. Morbidity and Mortality Weekly Report Sept 5, 2003.

Chaloupka FJ, Laixuthai A., 1996. *US Trade Policy and Cigarette Smoking in Asia*. Cambridge, Mass: National Bureau of Economic Research; Working paper 5543.

Chaloupka F, Warner K., 2000. The economics of smoking. In: Culyer AJ, Newhouse JP, eds. Handbook of health economics, Vol 1B. Amsterdam, The Netherlands: Elsevier Science:1539–627.

Chapman S, Borland R, Scollo M, Brownson RC, Dominello A, and Woodward S. 1999. The impact of smoke-free workplaces on declining cigarette consumption in Australia and the United States. *American Journal of Public Health* 89: 1018–23.

Commission of the European Communities. 2003. Raw Tobacco. Available at: http://ec.europa.eu/agriculture/markets/tobacco/reports/rep_en.pdf.

Disdier, A-C., L. Fontagne, M. Mimouni. 2008. The Impact of Regulations on Agricultural Trade: Evidence from the SPS and TBT Agreements. *American Journal of Agricultural Economics*. 90(2): 336-350.

Elliott, C.; Y. Wei; P. Lenton. 2010. "The Effect of Government Policy on Tobacco Advertising Strategies." Bulletin of Economic Research, July 2010, v. 62, iss. 3, pp. 243-58.

Escario, J.J. and J.A. Molina. 2004. Will a special tax on tobacco reduce lung cancer mortality? Evidence for EU countries. *Applied Economics*. 36: 1717-1722.

Feenstra, R. C., 2004. Advanced International Trade: Theory and Evidence. Princeton, NJ: Princeton University Press.

Felbermayr, G. J. and W. Kohler. 2006. Exploring the Intensive and Extensive Margin of World Trade. *Review of World Economics* 142: 642–74.

Food and Agricultural Organization (FAO). 2003. Projections of Tobacco Consumption and Trade to the Year 2010. Available at: http://www.fao.org/docrep/006/Y4956E/Y4956E00.HTM.

Gallup, J., J. Sachs and A. Mellinger, 1999. Geography and Economic Development. *International Regional Science Review*. vol. 22 no. 2 179-232

Grossman G.M., and A.B. Krueger, 1993. Environmental Impacts of a North American Free Trade Agreement. *The US-Mexico Free Trade Agreement*, ed. P. Garber, MIT Press, Cambridge, MA.

Grossman G.M., and A.B. Krueger, 1995. Economic Growth and the Environment. *Quarterly Journal of Economics* 110(2): 353-377.

Helpman, E., Melitz, M. J. and Rubinstein, Y. 2008. Estimating Trade Flows: Trading Partners and Trading Volumes. *The Quarterly Journal of Economics* 123(2): 441-487.

Heritage Foundation. 2013. "2013 Index of Economic Freedom: Explore the Data" available at: http://www.heritage.org/index/explore?view=by-region-country-year

Holden C, Lee K, Gilmore A, Fooks G, Wander N. 2010. Trade policy, health and corporate influence: British American Tobacco and China's accession to the World Trade Organization. *International Journal of Health Services* 40(3):421-441.

Hsieh, C-R., T-W. Hu, C-F J. Lin. 1999. The Demand for Cigarettes in Taiwan: Domestic Versus Imported Cigarettes. *Contemporary Economic Policy*. 17(2): 223-234.

Hu, T.-W., Sung, H.-Y., and Keeler, T. E. 1995. Reducing cigarette consumption in California: tobacco taxes vs an anti-smoking media campaign. *American Journal of Public Health* 85(9).

Keohane, N., R. Revesz and R.S. Stavins. 1998. "The Choice of Regulatory Instruments in Environmental Policy." *Harvard Environmental Law Review.* 22(2): 313-367.

Laugesen, M. and Meads, C. 1991. Tobacco marketing restrictions, price, income and tobacco consumption in OECD countries 1960–1986. *British Journal of Addiction* 86: 1343–54.

Lewit, E.M., Coate, D., Grossman, M. 1981. The effects of government regulation on teenage smoking. *Journal of Law and Economics* 24: 545–569.

Nelson, J. P. 2003a. Cigarette demand, structural change, and marketing bans: international evidence, 1971–1995. *Contributions to Economic Analysis & Policy* 2: 1–29.

Nelson, J. P. 2003b. Youth smoking prevalence in developing countries: effect of marketing bans. *Applied Economics Letters* 10: 805–811.

Saffer, H. and Chaloupka, F. 2000. The effect of tobacco marketing bans on tobacco consumption, *Journal of Health Economics* 19: 1117–37.

Schneider, L., Klein, B., Murphy, K. 1981. Government regulation of cigarette health information. *Journal of Law and Economics* 24: 575–612.

Silva, J. M. C. and S. Tenreyro, 2006. The Log of Gravity. *The Review of Economics and Statistics*, vol. 88(4), pages 641-658.

Silva, J. M. C. and S. Tenreyro, 2010. On the existence of the maximum likelihood estimates in Poisson regression. *Economics Letters*, vol. 107(2), pages 310-312.

Silva, J. M. C. and S. Tenreyro, 2011. Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator. *Economics Letters* 112: 220-222

Stewart, M. J. 1993. The effect on tobacco consumption of marketing bans in OECD countries. *International Journal of Marketing* 12: 155–80.

Stoforos, C. and Mergos, G. 2004. Modelling EU Tobacco Policy Reform. *Applied Economics* 36 (19): 2167-2175.

Warner, K. E. 1981. Cigarette smoking in the 1970s: the impact of the antismoking campaign on consumption. *Science*, 211, 729–31.

Wooldridge, J. M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Mass.: MIT Press.

World Health Organization (2004). "Annex Table 2: Deaths by cause, sex and mortality stratum in WHO regions, estimates for 2002" The world health report 2004 - changing history. Available at: http://www.who.int/whr/2004/annex/topic/en/annex_2_en.pdf.

Table 1
Summary Statistics.

	All				Countries with GDP per capita >=4085)	Countries with GDP per capita <4085)
Variable	Mean	St. Dev	Min	Max	Mean	Mean
Tobacco Imports (in millions US dollars)	1.528	31.022	0.000	2539.341	2.046	0.251
Log of total GDP	3.501	2.066	-0.184	9.239	3.494	1.881
Log of trade freedom index	4.160	0.289	2.708	4.500	4.217	4.02
Contiguous	0.024	0.153	0.000	1.000		
Common language	0.132	0.338	0.000	1.000		
Common colony	0.018	0.135	0.000	1.000		
Log of trade distance	8.687	0.848	4.088	9.894		
Counter-advertising regulations	0.340	0.474	0.000	1.000	0.362	0.286
Marketing regulation index	0.330	0.253	0.000	1.000	0.384	0.196
Age regulation index	0.291	0.282	0.000	1.000	0.337	0.179
Smoking location regulation index	0.281	0.234	0.000	0.923	0.300	0.234
Corruption control index	3.658	1.501	0.016	6.000	4.004	2.654
Average asbestos production per capita from 1930 to 1970 (metric tons per capita)	0.003	0.014	0.000	0.100	0.004	0.00002

Table 2
Unrestricted Model Estimating the Determinants of Tobacco Imports using a Gravity Equation.

	PPML		IV – PPML (with imputed values)		IV – PPML (without imputed values)	
Variable	Full sample	Large income gap subsample	Full sample	Large income gap subsample	Full sample	Large income gap subsample
Log of exporter GDP	0.528*** (0.096)	0.646*** (0.137)	1.081*** (0.244)	0.464* (0.313)	0.879*** (0.150)	2.688*** (0.415)
Log of importer GDP	0.427*** (0.104)	0.643*** (0.096)	1.667*** (0.340)	1.244*** (0.306)	0.437*** (0.139)	2.345*** (0.329)
Log of trade freedom index	2.275*** (0.696)	6.591*** (1.260)	3.982*** (1.645)	6.593*** (2.411)	12.461*** (5.062)	18.868*** (5.090)
Contiguous	0.175 (0.579)	0.495 (0.665)	0.169 (0.488)	-0.097 (0.728)	-0.441 (0.518)	-1.344 (1.024)
Common language	0.527** (0.312)	-0.058 (0.519)	0.661*** (0.308)	0.908** (0.470)	0.043 (0.310)	0.400 (0.511)
Common Colony	-0.181 (0.361)	-1.046*** (0.525)	-0.446 (0.482)	-1.808*** (0.465)	-0.007 (0.422)	-0.771** (0.461)
Log of distance	-0.847*** (0.188)	-1.224*** (0.200)	-0.728*** (0.157)	-1.031*** (0.192)	-0.855*** (0.197)	-1.145*** (0.204)
Exporter Counter-advertising regulation index	-3.432*** (0.972)	-2.010* (1.329)	-0.310 (1.132)	1.257 (1.206)	-5.027*** (1.924)	-7.016*** (2.041)
Exporter Marketing regulation index	-0.342 (0.948)	3.561*** (1.742)	0.699 (4.011)	-1.515 (4.447)	-3.112 (4.061)	5.647 (7.148)
Exporter Age regulation index	-3.934*** (0.846)	-8.467*** (1.531)	-6.256*** (2.744)	-1.513 (3.804)	-4.571** (2.456)	-3.479 (3.463)
Exporter smoking location regulation index	-2.155*** (0.866)	-4.067** (2.328)	2.568* (1.651)	0.328 (3.010)	9.122* (5.995)	8.906 (6.735)
Importer Counter-advertising regulation index	-4.541*** (0.962)	-4.114*** (1.187)	-0.093 (1.133)	2.030* (1.306)	-6.247*** (2.112)	-6.887*** (2.071)
Importer Marketing regulation index	-1.352** (0.725)	1.159 (1.265)	-20.270*** (5.695)	-25.888*** (6.243)	-23.800*** (5.986)	-25.210*** (6.270)
Importer Age regulation index	-2.743*** (0.582)	-6.697*** (1.754)	3.680** (1.924)	6.104*** (2.185)	-1.174 (2.148)	2.150 (2.809)
Importer smoking location regulation index	-0.0002 (0.737)	-0.611 (1.413)	-6.105*** (2.317)	-5.629* (3.663)	-12.687*** (5.438)	-14.548*** (5.162)
Constant	-2.360 (3.182)	-19.375*** (5.597)	-24.300*** (7.738)	-23.759*** (11.639)	-48.300*** (21.422)	-87.075*** (26.621)

Multilateral Resistance Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	9312	3620	9312	3620	3192	1264

Note: All standard errors are in parentheses and are robust to heteroskedasticity. * = significance at the 15% level; * * = significance at the 10% level; *** = significance at the 5% level

Table 3
Restricted Model Estimating the Determinants of Tobacco Imports using a Gravity Equation.

	PPML		IV – PPML (with imputed values)		IV – PPML (without imputed values)	
Variable	Full sample	Large income gap subsample	Full sample	Large income gap subsample	Full sample	Large income gap subsample
Log of exporter per capita GDP	0.863*** (0.153)	0.607*** (0.129)	0.657*** (0.183)	0.752*** (0.320)	0.876*** (0.164)	1.671*** (0.189)
Log of importer per capita GDP	0.756*** (0.161)	0.600*** (0.080)	1.063*** (0.203)	1.381*** (0.263)	0.436*** (0.183)	1.568*** (0.194)
Log of trade freedom index	2.221*** (0.686)	6.517*** (1.212)	5.988*** (2.306)	7.487*** (2.855)	12.558*** (4.724)	14.619*** (3.886)
Contiguous	0.176 (0.578)	0.508 (0.661)	0.258 (0.517)	0.065 (0.739)	-0.515 (0.623)	-1.335 (0.989)
Common language	0.526** (0.312)	-0.044 (0.517)	0.464* (0.285)	0.691* (0.478)	0.111 (0.348)	0.192 (0.546)
Common Colony	-0.184 (0.361)	-1.055*** (0.525)	0.043 (0.394)	-1.256*** (0.595)	-0.0002 (0.393)	-0.489 (0.466)
Log of distance	-0.847*** (0.187)	-1.224*** (0.200)	-0.859*** (0.183)	-1.070*** (0.186)	-1.014*** (0.195)	-1.091*** (0.179)
Marketing regulation difference	0.953 (0.896)	2.408*** (1.100)	19.417*** (6.101)	18.772*** (8.404)	20.283*** (6.609)	29.440*** (6.488)
Exporter Counter-advertising regulation index	-1.253 (1.100)	-1.719 (1.366)	-0.291 (1.228)	0.893 (1.243)	0.082 (1.017)	-3.284*** (1.370)
Exporter Age regulation index	-1.619* (1.082)	-5.916*** (1.468)	-7.441*** (3.361)	-3.169 (4.039)	-5.430*** (1.570)	-5.638*** (2.790)
Exporter smoking location regulation index	-0.817 (1.015)	-1.569 (1.566)	4.427*** (2.254)	0.924 (3.473)	12.076*** (5.644)	7.361 (5.192)
Importer Counter-advertising regulation index	-2.366*** (1.066)	-3.825*** (1.197)	-0.280 (1.264)	2.222** (1.306)	-0.886 (0.780)	-2.325* (1.582)
Importer Age regulation index	-0.436 (0.895)	-4.123*** (1.127)	1.243 (2.024)	2.803 (2.162)	-3.356*** (1.216)	-2.643 (2.204)
Importer smoking location regulation index	1.279 (0.952)	1.791* (1.199)	-7.554*** (2.721)	-5.746* (3.789)	-9.378** (4.941)	-5.868 (4.590)
Constant	-9.588*** (3.942)	-20.246*** (5.637)	-35.162*** (11.270)	-43.793*** (14.980)	-59.392*** (22.971)	-81.800*** (19.927)

Multilateral Resistance Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Likelihood Ratio Test for Validity of Restriction	77***	77***	1384***	881***	3366***	1136***
Number of Observations	9312	3620	9312	3620	3192	1264

Note: All standard errors are in parentheses and are robust to heteroskedasticity. * = significance at the 15% level; * * = significance at the 10% level; *** = significance at the 5% level

Table 4
The Elasticity of Regulations on Mortality.

	PPML		IV – PPML (with imputed values)		IV – PPML (without imputed values)	
Variable	Full sample	Large income gap subsample	Full sample	Large income gap subsample	Full sample	Large income gap subsample
Exporter Counter-advertising regulation index	-0.004* (0.003)	-0.003 (0.002)	-0.0004 (0.001)	0.002 (0.002)	-0.007 (0.005)	-0.009* (0.006)
Exporter Marketing regulation index	-0.0004 (0.001)	0.004 (0.003)	0.001 (0.005)	-0.002 (0.006)	-0.004 (0.006)	0.007 (0.010)
Exporter Age regulation index	-0.004* (0.003)	-0.009* (0.006)	-0.007 (0.005)	-0.002 (0.004)	-0.005 (0.004)	-0.004 (0.004)
Exporter smoking location regulation index	-0.002 (0.002)	-0.004 (0.004)	0.003 (0.002)	0.0004 (0.003)	0.010 (0.009)	0.010 (0.009)
Importer Counter-advertising regulation index	-0.006* (0.004)	-0.005* (0.004)	-0.0001 (0.001)	0.003 (0.002)	-0.008* (0.006)	-0.009* (0.006)
Importer Marketing regulation index	-0.002 (0.001)	0.001 (0.002)	-0.026* (0.017)	-0.033* (0.021)	-0.030* (0.019)	-0.032* (0.020)
Importer Age regulation index	-0.003* (0.002)	-0.007* (0.005)	0.004 (0.003)	0.007 (0.005)	-0.001 (0.003)	0.002 (0.003)
Importer smoking location regulation index	-0.0000002 (0.001)	-0.001 (0.002)	-0.007 (0.005)	-0.006 (0.005)	-0.014 (0.010)	-0.016 (0.011)

Note: * = significance at the 15% level.
The elasticity is derived using the following formula $\epsilon_R^M = \theta_{i/j}^R$ x ϵ_I^C x ϵ_C^D x ϵ_C^M where $\theta_{i/j}^R$ is the elasticity of the value of tobacco imports with respect to regulations by the importer or exporter, ϵ_I^C is the elasticity of tobacco import market share from the value of tobacco imports, ϵ_C^D is the elasticity of tobacco consumption per capita from the tobacco import market share and ϵ_C^M is the elasticity of mortality from the tobacco consumption per capita. We convert the regulation coefficients in Table 2 into elasticities by multiplying them with mean regulations. Based on the existing literature, we adopt the following values: ϵ_C^M = 0.3409 with a standard error of 0.0602 (Escario and Molina 2004), ϵ_C^D = 0.031 with a standard error of 0.017 and ϵ_I^C = 0.366 in the latest value of their sample in 1995 (Hsieh et al. 1999). We use the formula for the variance of a non-linear univariate function g(A) to calculate the variance of each estimate. It is equal to the following $V\left(g(\mathbf{A})\right) = \left(\frac{\partial g}{\partial \mathbf{A}}\right)^T \mathbf{V}(\mathbf{A}) \left(\frac{\partial g}{\partial \mathbf{A}}\right)$ where $\frac{\partial g}{\partial \mathbf{A}}$ is a vector whose ith element is partial derivative with respect to g and $\mathbf{V}(\mathbf{A})$ is the variance covariance matrix of parameters (Kennedy 1998). The corresponding standard error in the parenthesis is the square root of this variance.

Appendix A.

Deriving Import Demand.

When markets clear, we have the following condition,

$$y_i = \sum_{j=1}^{n} y_j \left(\frac{\beta_i p_i t_{ij}}{\sum_{i=1}^{n} \beta_i p_i t_{ij}} \right)^{1-\sigma}. \qquad \text{(A1)}$$

We control for the endogeniety of prices by solving (A1) for the scaled prices,

$$y_i = (\beta_i p_i)^{1-\sigma} \sum_{j=1}^{n} y_j \left(\frac{t_{ij}}{\sum_{i=1}^{n} \beta_i p_i t_{ij}} \right)^{1-\sigma}. \qquad \text{(A2)}$$

Re-arranging (A2) yields,

$$\beta_i p_i = \left(y_i \left(\sum_{j=1}^{n} y_j \left(\frac{t_{ij}}{\sum_{i=1}^{n} \beta_i p_i t_{ij}} \right)^{1-\sigma} \right)^{-1} \right)^{\frac{1}{1-\sigma}}. \qquad \text{(A3)}$$

Define $y_w \equiv \sum_i y_i$ as world income. Multiplying the numerator and denominator of (A3) by world income yields,

$$\beta_i p_i = \left(\frac{y_i}{y_w} \left(\sum_{j=1}^{n} \frac{y_j}{y_w} \left(\frac{t_{ij}}{\sum_{i=1}^{n} \beta_i p_i t_{ij}} \right)^{1-\sigma} \right)^{-1} \right)^{\frac{1}{1-\sigma}}. \qquad \text{(A4)}$$

Substituting (5) into (A4) yields,

$$\beta_i p_i = \left(\frac{y_i}{y_w} \left(\sum_{j=1}^{n} \frac{y_j}{y_w} \left(\frac{e^{\mathbf{R_{ij}A}} e^{\mathbf{C_{ij}B}} d_{ij}^{b} (1+v_{ij})}{\sum_{i=1}^{n} \beta_i p_i e^{\mathbf{R_{ij}A}} e^{\mathbf{C_{ij}B}} d_{ij}^{b} (1+v_{ij})} \right)^{1-\sigma} \right)^{-1} \right)^{\frac{1}{1-\sigma}}. \qquad \text{(A5)}$$

Finally, substituting (A5) into (3) yields (7),

$$x_{ij} = \frac{y_j y_i}{y_w} \left(\frac{e^{\mathbf{R_{ij}A}} e^{\mathbf{C_{ij}B}} d_{ij}^{b} (1+v_{ij})}{P_j \pi_i} \right)^{1-\sigma}.$$

Appendix B

Data Sources

Variable	Description of Variables	Source
Tobacco trade	Value of manufactured and unmanufactured tobacco in thousands of US dollars.	World Bank's COMTRADE data set
GDP	Per capita gross domestic product for 2000 in US dollars.	World Bank
Trade freedom index	Composite index calculated using trade-weighted average tariff rates and not-tariff barriers. Ranges from 0 to 100. For example, a perfectly open economy would result in an index of 100 and a perfectly closed economy an index of 0. The index is calculated as the ratio of the difference between the trade-weighted tariff rate and the maximum observed tariff rate over the maximum tariff rate. This is then penalized by the severity of observed non-trade barriers. The severity of non-trade barriers are "binned" into 5 categories, each with a fixed penalty. The more severe the not-trade barriers, the larger the penalty. The penalties are 0, 5, 10, 15, and 20 points. The penalty is deducted from the initially calculated ratio.	Heritage Foundation
Tobacco regulations	All tobacco regulation information	World Health Organization Tobacco Control Country Profiles, 2000
Contiguous borders	Dummy variable indicating whether the trading pair share a border.	Centre d'Etudes Prospectives et d'Informations Internationales
Common language	Dummy variable indicating whether the trading pair shares an official language.	Centre d'Etudes Prospectives et d'Informations Internationales
Common colonizer	Dummy variable indicating whether the trading pair has ever shared a colonial link.	Centre d'Etudes Prospectives et d'Informations Internationales
Trade distance	A measure of distance between the trading pair's largest cities. Calculated using the great circle formula and the cities' longitude and latitude coordinates.	Centre d'Etudes Prospectives et d'Informations Internationales
Average asbestos production per capita	Average production of asbestos from 1930-1970 divided by total population	Data for asbestos is derived from the US Geological Survey and population data is from www.populstat.info
Corruption control index	An indicator of corruption within the political system, characterized by financial corruption and insidious corruption. A score of 0 (low corruption control) to 6 (high corruption control) is assigned.	International Country Risk Guide published by The PRS Group, Inc

Appendix C

Tobacco Regulation Subcategories.

Counter-advertising regulation index	Marketing regulation index	Age regulation index	Smoking location regulation Index
Mandated education	Marketing in certain media	Sales to minors	Smoking in government buildings
Mandated health warnings	Marketing to certain audiences	Age verification for sales	Smoking in private worksites
	Marketing in certain locations	Vending machines sales	Smoking in educational facilities
	Sponsorship or promotion for certain audiences	Free tobacco products	Smoking in health care facilities
	Sponsorship marketing of events		Smoking on buses
	Brand stretching		Smoking on trains
	Misleading information on packaging		Smoking in taxis
	Package health warning/ message		Smoking on ferries
			Smoking on domestic air flights
			Smoking on international flights
			Smoking in restaurants
			Smoking in nightclubs and bars
			Smoking in other public places

Appendix D

First stage regressions with imputed values.

Dependent Variable	Exporter Marketing regulation index	Exporter Age regulation index	Exporter smoking location regulation index	Exporter Counter-advertising regulation index	Importer Marketing regulation index	Importer Age regulation index	Importer smoking location regulation index	Importer Counter-advertising regulation index
Model	Fractional logit	Fractional logit	Fractional logit	Logit	Fractional logit	Fractional logit	Fractional logit	Logit
Exporter Corruption Control	-233.738*** (50.190)	-217.429*** (31.688)	223.923*** (71.461)	-4224.84*** (252.990)	-167.216*** (50.086)	-2.758* (1.704)	-711.964*** (72.668)	-5859.40*** (277.119)
Importer Corruption Control	-237.759*** (50.193)	-230.283*** (31.690)	224.094*** (71.465)	-4213.96*** (252.930)	-163.095*** (50.089)	10.320*** (1.931)	-712.519*** (72.673)	-5870.70*** (277.234)
Exporter Asbestos production per capita	245.261*** (52.704)	228.398*** (33.282)	-235.850*** (75.041)	4436.500*** (265.656)	175.680*** (52.595)	3.041** (1.784)	746.600*** (76.308)	6151.572*** (290.984)
Importer Asbestos production per capita	249.746*** (52.707)	242.106*** (33.285)	-236.258*** (75.046)	4423.775*** (265.587)	171.070*** (52.598)	-10.930*** (2.025)	747.458*** (76.313)	6164.792*** (291.116)
Log of exporter per capita GDP	0.108*** (0.023)	0.175*** (0.023)	0.580*** (0.033)	-0.384*** (0.097)	0.268*** (0.023)	0.143*** (0.015)	0.866*** (0.033)	0.553*** (0.095)
Log of importer per capita GDP	0.277*** (0.023)	0.198*** (0.024)	0.694*** (0.033)	0.451*** (0.096)	0.095*** (0.023)	0.115*** (0.014)	0.758*** (0.033)	-0.286*** (0.095)
Log of trade	-0.107***	1.800***	2.509***	4.154***	0.355***	-1.212***	-3.271***	-4.829***

freedom index	(0.049)	(0.077)	(0.069)	(0.252)	(0.049)	(0.061)	(0.071)	(0.273)
Contiguous	0.005 (0.068)	0.043 (0.084)	-0.044 (0.097)	0.388 (0.284)	0.0001 (0.068)	0.069 (0.086)	-0.025 (0.098)	0.274 (0.284)
Common language	0.047 (0.034)	-0.024 (0.040)	-0.125*** (0.048)	-0.181 (0.152)	0.041 (0.034)	-0.017 (0.042)	-0.082** (0.049)	-0.106 (0.153)
Common Colony	-0.123* (0.076)	0.108 (0.090)	0.014 (0.108)	0.517** (0.295)	-0.115 (0.075)	0.188*** (0.092)	-0.072 (0.109)	0.357 (0.292)
Log of distance	0.034*** (0.015)	0.004 (0.018)	-0.028 (0.022)	-0.017 (0.061)	0.030*** (0.015)	0.006 (0.018)	0.001 (0.022)	-0.010 (0.062)
Constant	1.380** (0.758)	-7.686*** (0.602)	-13.467*** (1.080)	39.585*** (3.429)	-1.221* (0.757)	2.256*** (0.291)	19.760*** (1.098)	95.256*** (4.102)
Multilateral Resistance Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	9312	9312	9312	9312	9312	9312	9312	9312
Pearson's Chi-square stat	7079.018	1200000000	14000		7049.161	1100000000	15000	
Pseudo R2				0.6152				0.6215

Note: * = significance at the 15% level; * * = significance at the 10% level; *** = significance at the 5% level

Appendix E.

First stage regressions without imputed values.

Dependent Variable	Exporter Marketing regulation index	Exporter Age regulation index	Exporter smoking location regulation index	Exporter Counter-advertising regulation index	Importer Marketing regulation index	Importer Age regulation index	Importer smoking location regulation index	Importer Counter-advertising regulation index
Model	Fractional logit	Fractional logit	Fractional logit	Logit	Fractional logit	Fractional logit	Fractional logit	Logit
Exporter Corruption Control	-0.780*** (0.269)	-0.719*** (0.077)	1.782*** (0.415)	2.806*** (0.892)	-0.447** (0.269)	-0.254*** (0.065)	1.754*** (0.415)	17.835*** (2.447)
Importer Corruption Control	-0.433* (0.269)	-0.493*** (0.077)	1.636*** (0.415)	1.633** (0.889)	-0.794*** (0.269)	-0.526*** (0.066)	1.900*** (0.415)	19.061*** (2.457)
Exporter Asbestos production per capita	307.708*** (83.999)	232.463*** (23.292)	-655.29*** (129.471)	-986.963*** (275.607)	321.506*** (84.000)	208.382*** (26.517)	-753.67*** (129.474)	-6678.40*** (886.377)
Importer Asbestos production per capita	309.558*** (83.996)	282.662*** (23.264)	-653.60*** (129.467)	-990.655*** (275.611)	319.659*** (83.998)	160.726*** (26.491)	-755.33*** (129.470)	-6675.39*** (886.265)
Log of exporter per capita GDP	0.332*** (0.100)	0.211*** (0.032)	-0.600*** (0.155)	-0.718*** (0.339)	0.365*** (0.100)	0.213*** (0.034)	-0.677*** (0.155)	-5.686*** (0.806)
Log of importer per capita GDP	0.364*** (0.100)	0.210*** (0.033)	-0.670*** (0.155)	-0.240 (0.337)	0.333*** (0.100)	0.105*** (0.034)	-0.608*** (0.155)	-6.208*** (0.806)
Log of trade	-0.277***	1.065***	2.281***	3.721***	0.277***	-0.509***	-2.281***	-3.655***

freedom index	(0.075)	(0.111)	(0.116)	(0.368)	(0.075)	(0.114)	(0.116)	(0.362)
Contiguous	0.011 (0.092)	-0.134 (0.123)	0.023 (0.142)	-0.222 (0.382)	0.008 (0.092)	-0.128 (0.151)	0.030 (0.142)	-0.026 (0.389)
Common language	-0.003 (0.052)	-0.108* (0.067)	0.019 (0.080)	-0.064 (0.223)	-0.005 (0.052)	-0.150** (0.083)	0.023 (0.080)	-0.018 (0.236)
Common Colony	0.007 (0.094)	0.132 (0.107)	-0.143 (0.145)	0.216 (0.374)	0.008 (0.094)	0.197 (0.154)	-0.146 (0.145)	0.012 (0.392)
Log of distance	0.003 (0.022)	-0.076*** (0.027)	0.016 (0.034)	0.016 (0.088)	0.001 (0.022)	-0.091*** (0.035)	0.020 (0.034)	-0.019 (0.093)
Constant	0.727 (0.957)	-2.392*** (0.618)	-17.033*** (1.474)	-26.602*** (3.553)	-1.547* (0.957)	3.250*** (0.586)	1.812 (1.475)	-48.951*** (8.116)
Multilateral Resistance Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	3192	3192	3192	3192	3192	3192	3192	3192
Pearson's Chi-square stat	1857.221	290000000	4412.267		1857.282	5083.938	4412.427	
Pseudo R2				0.5324				0.5856

Note: * = significance at the 15% level; * * = significance at the 10% level; *** = significance at the 5% level