On the Measurement of Trade Costs: Direct vs. Indirect Approaches to Quantifying Standards and Technical Regulations*

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Abstract

In this article, we review the literature on the measurement of trade costs in international trade with a special emphasis on nontariff measures and in particular on standards and technical regulations. We distinguish 'direct' from 'indirect' approaches. The direct approach collects observable data or proxy variables on trade cost components which are then typically used as regressors in a gravity equation of trade. Instead, the indirect approach infers the extent of trade impediments from trade flows. It compares actual trade flows to the trade flows predicted by a hypothetical frictionless benchmark scenario based on a micro-founded trade model, attributing the deviation of actual from predicted trade flows to trade frictions. We argue that economists and policymakers can gain useful insights from both approaches.

JEL Classification: F10, F15
Keywords: Trade Costs, Nontariff Measures, Product Standards, Technical Regulations, Technical Barriers to Trade, Measurement, Gravity

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1 Introduction

Despite the long tradition in the international economics profession of investigating the sources and size of trade costs, empirical researchers continue to face a major challenge in measuring trade costs since 'direct measures are remarkably sparse and inaccurate' (Anderson and van Wincoop, 2004, p. 692). Direct measures are available for a few components such as transportation and insurance costs, policy barriers such as tariff or nontariff measures, but not for many other components such as bureaucratic red tape. In addition, data coverage is often limited to a few countries, industries, products or years (Anderson and van Wincoop, 2004).

To overcome those difficulties, an alternative approach to measuring trade costs is to indirectly infer the level of trade impediments from trade flows. A first way of doing this is to use the '*phi*-ness' of trade to estimate 'border effects,' which is in essence a ratio of bilateral over domestic trade flows and mostly reflects border-related costs (Head and Ries, 2001, Baldwin et al., 2003, Head and Mayer, 2004). A second and related approach is to rely on a measure of bilateral trade impediments that is derived by modeling disaggregated trade flows at the industry level in the gravity framework pioneered by Anderson and van Wincoop (2003, 2004), allowing trade costs to be heterogeneous across industries. The resulting measure accounts for heterogeneity across industries by incorporating industry-specific substitution elasticities (Chen and Novy, 2011).

This paper reviews the literature on the measurement of trade costs with a special emphasis on nontariff measures such as product standards and technical regulations which require specific product characteristics or production methods in order to guarantee the health and safety of consumers or the protection of the environment.[1] Differing standards and technical regulations (or Technical Barriers to Trade, TBTs) can indeed be obstacles to trade as they can create additional costs for foreign producers by forcing them to adjust their products to meet national requirements. In order to overcome their trade-distorting effects, policymakers try to harmonize such standards and regulations between countries.[2] A contrasting view considers that standards and regulations may instead encourage trade by raising quality or by promoting scale economies (see Blind, 2004, Swann et al., 1996). Our main aim, however, is to review how standards and regulations are measured for the purpose of empirical analysis, not how they affect international trade (Swann, 2010).

Compared to Anderson and van Wincoop (2004), who provide an extensive review of the measurement of any type of trade costs, the objective of this paper is to extend their review to articles mostly published after their seminal contribution with a special emphasis on standards and technical regulations. We also distinguish between the 'direct' and the 'indirect' approaches to measuring non-

[1] Technical regulations are imposed by governments so that their compliance is *mandatory*, while for standards compliance is only *voluntary*: firms decide to comply with standards, otherwise their products may simply not be demanded by firms or consumers (Baller, 2007).

[2] In the EU policymakers rely on mutual recognition or on technical harmonization. With mutual recognition, each country is obliged to accept on its territory the products lawfully marketed in another member state even if foreign products are manufactured according to technical rules that differ from domestic ones (Brenton et al., 2001). When this is not possible, mutual recognition is replaced by technical harmonization (since 1985 the 'New Approach' to technical harmonization has only defined the essential safety requirements of a product, leaving the producer free to design the rest). Both mutual recognition and harmonization are thus expected to promote trade within the harmonizing region (Baller, 2007, Brenton et al., 2001, Chen and Mattoo, 2008).

tariff measures and illustrate their similarities and differences using some data on private standards at the European Union (EU) level.

2 The Gravity Equation as a Starting Point

Traditionally, researchers attempt to learn about the effect of trade costs on trade by considering the gravity equation, which has been shown to have broad theoretical foundations (Anderson, 2011). As an illustration, we adopt the popular specification by Anderson and van Wincoop (2004) based on an Armington model:

$$x_{ij}^k = \frac{y_i^k e_j^k}{y^k} \left(\frac{t_{ij}^k}{\Pi_i^k P_j^k} \right)^{1-\sigma_k}, \tag{1}$$

where bilateral trade flows x_{ij}^k in industry k depend on output y_i^k of the exporting country i in industry k and expenditure e_j^k of the importing country j relative to global output y^k in that industry. The interest focuses on bilateral trade costs t_{ij}^k. They reduce trade as governed by the elasticity of substitution $\sigma_k > 1$ amongst the underlying product varieties in that industry. All else being equal, larger average outward trade barriers Π_i^k of country i and larger average inward trade barriers P_j^k of country j lead to more bilateral trade.[3] For estimation purposes, gravity equation (1) is typically log-linearized, and the output and multilateral resistance terms are absorbed by exporter and importer fixed effects, or they are approximated using Baier and Bergstrand's (2009) method.

A researcher who wants to estimate the effect of trade costs on trade needs to specify a trade cost function by relating the unobservable t_{ij}^k variable to observable trade cost proxies. Such proxies typically include geographic data such as distance between countries i and j as well as a range of cultural, historical or political variables. This might also include some measures for standards and technical regulations as we explain in the next section.

3 The 'Direct' Approach

The direct approach to measuring trade costs collects observable data or proxy variables on trade cost components. The literature we review is grouped under two headings according to the way standards and technical regulations are measured: explicit measures assess the existence or the amount of standards and regulations, while implicit measures typically capture the trade effects of standards and regulations without establishing how many are present.

3.1 Explicit Measures

Count of the Number of Standards Perinorm is a subscription-only bibliographic database on national, European and international standards for the industries of 23 countries. The papers that use this rich database to measure standards typically count the total number of standards per industry and country, and distinguish 'national' standards from 'harmonized' standards (defined as being equivalent either to international standards, e.g., Swann et al., 1996, or to the ones of trading

[3] The Π_i^k and P_j^k variables are also known as multilateral resistance variables. They can be interpreted as average trade barriers. See Anderson and van Wincoop (2004) for a formal definition and a more detailed explanation.

partners, e.g., Moenius, 2004, 2006, 2007).[4,5] Unfortunately, such count measures suffer from a 'mixed bag' problem (Swann, 2010, p. 10) as they just add up standards that might differ in importance[6] but also in type (e.g., quality versus compatibility standards). In an attempt to measure the relative stringency and technical complexity of different standards, the number of pages of each standard is sometimes used as a proxy for its complexity (Shepherd, 2006, Czubala et al., 2009).[7]

Notification Data from the WTO The UNCTAD's TRAINS database records notifications on regulations to the WTO from the late 1980s and provides information on the notifying country (the importer), the affected product and the type of barrier. WTO rules require members to notify the WTO whenever a proposed or adopted regulation 1) is not in accordance with an international one, and 2) may affect the trade of other members. The use of such information to measure regulations therefore suffers from three main shortcomings. First, if one country applies an internationally recognized regulation while other countries do not, then this cross-country difference is not accounted for in the data set. Second, only changes to existing measures have to be reported, which means that measures that have existed for a long time but have never been changed are not accounted for either. Third, there is suspicion that some countries systematically notify more frequently than others, raising concerns about data consistency across countries.

Notifications are generally used to compute coverage and frequency ratios to explain trade flows (e.g., Disdier et al., 2008, Essaji, 2008).[8] Even if they are widely used in empirical analysis, it is worth remembering that both suffer from weaknesses: neither is able to capture precisely the relative importance of each nontariff measure in affecting trade flows because the frequency ratio simply adds up the measures as if they were all the same, while the coverage ratio erroneously gives a small weight to the products covered by the most trade-restrictive policies (Nogués et al., 1986, Korinek et al., 2006).

Identification of Standards and Regulations Based on a literature review, case studies and interviews with national bodies in the 15 EU member states and with EU officials, a study undertaken for the European Commission (European Commission, 1998) assesses the types of measures applying in 130 industries within the EU: technical regulations, standards, both or no barriers. It also assesses, on a five-point scale, the overall effectiveness of EU policies in removing TBTs where the largest value indicates that all TBTs were successfully removed (Chen, 2004, Chen and Novy, 2011). This does not indicate how many standards or regulations are present nor how stringent they are, but this

[4] See also Temple and Urga (1997), Blind and Jungmittag (2005) or Portugal-Perez et al. (2010).

[5] The World Bank compiles two databases on EU standards using Perinorm: the European Standards Database (EUSDB) for textiles, clothing and agricultural products between 1995 and 2003 (Shepherd, 2006) and the EU Electronical Standards Database (EUESDB) for electrotechnical products between 1990 and 2007 (Portugal-Perez et al., 2010).

[6] Indeed, standards are not 'equally important economically: it is likely that using the same voltage in two countries is more important for trade than using the same door handles' (Moenius, 2004, p. 14).

[7] This proxy is far from perfect: the documents may differ in their information content and contain specifications for more than one standard (Korinek et al., 2006). Also, Perinorm records the number of pages of each standard in its original language which may differ between standards (Portugal-Perez et al., 2010).

[8] Frequency ratios provide the proportion of products that are subject to nontariff measures within a given product classification. Coverage ratios calculate the volume or value of trade/imports subject to nontariff measures as a percentage of total trade/imports in a given product category.

information can be used to distinguish industries according to the type of measures that exist and whether they are still affected by TBTs or not.

3.2 Implicit Measures

Regional Agreements This approach consists of counting or identifying (with a dummy variable) the policy instruments that aim to harmonize standards or regulations within a region.[9] The instruments considered in the literature are usually EU-specific (Brenton et al., 2001, Henry de Frahan and Vancauteren, 2006, Baller, 2007, Chen and Mattoo, 2008) while Mutual Recognition Agreements (on conformity assessment procedures) involve both EU and non-EU countries (Baller, 2007, Chen and Mattoo, 2008). The count or identification of instruments is carried out either at the industry level (Baller, 2007, Chen and Mattoo, 2008) or at the disaggregated level of products, in which case coverage or frequency ratios are computed at the industry level (Brenton et al., 2001, Henry de Frahan and Vancauteren, 2006).

Surveys The World Bank Technical Barriers to Trade Survey analyzes how the exports of 689 individual firms in 17 developing countries to 5 developed countries in 2002 are affected by foreign technical requirements. Five specific questions allow the construction of variables capturing the trade effects of standards and technical regulations (binary variables) and of conformity assessment procedures (including the average time in days it takes for conformity assessment inspection to complete). See Maskus et al. (2005) and Chen et al. (2006).[10]

Case Studies Other papers focus on the trade effects of one specific regulation only. For instance, Otsuki et al. (2001) use the maximum aflatoxin levels, a toxic fungus, that are permitted in EU groundnut imports.[11] Wilson and Otsuki (2002) use the maximum residue limit (MRLs) of chlorpyrifos, a pesticide, in affecting banana and plantain imports, while Wilson et al. (2003) use the MRLs of tetracycline, a widely used antibiotic, to explain beef imports. All three papers also use the difference between the domestic regulation and the Codex equivalent to predict the changes in trade flows if regulations were harmonized at the Codex level.[12] This allows researchers to determine the stringency of a national regulation relative to Codex in affecting trade, but not the stringency of the regulation itself.

Other studies measure the *diffusion* or *adoption* of one specific international standard across countries and typically investigate its effect on trade. Although diffusion does not capture the stringency of a standard, it can be expected to promote trade by stimulating the competitiveness of domestic

[9] This is an implicit measure as there is no reason to expect the number of harmonization policies to be correlated with the number of standards and regulations: two countries may share the same number of harmonization policies, but one may have many standards and regulations while the other does not.

[10] Other surveys include the USITC (1998) on standards in the computer hardware, software and telecommunications equipment sectors; OECD (1999) on the role of compliance costs in the telecommunications equipment, dairy products and automotive components industries; or NIST (2004) for the pharmaceuticals and automobile industries in the US.

[11] Xiong and Beghin (2011) question the results by Otsuki et al. (2001) that African exports to the EU are negatively affected by the maximum aflatoxin levels permitted.

[12] The Codex Alimentarius is a collection of internationally recognized standards, guidelines and codes of practice as recommended by the United Nation's Food and Agriculture Organization (FAO) and the World Health Organization (WHO) for the agri-food industry. It offers a benchmark for food standards but there is no obligation for national governments to adopt them.

products by signaling their quality and safety. In the case of ISO 9000, a quality management standard for firms, Clougherty and Grajek (2009) use the ratio between the number of ISO 9000 certificates in a country and its population, while Kim and Reinert (2009) rely on the proportion of firms in each country with ISO 9000 certification. Herzfeld et al. (2011) count the number of issued certificates for GlobalGAP and BRC Food Technical Standard in different countries.

To conclude, the reviewed literature suggests that measuring standards and technical regulations is not an easy task. Explicit measures attempt to capture the presence or the amount of standards and regulations by using dummy or count variables, frequency or coverage ratios, but their stringency remains hard to evaluate. Implicit measures suffer from similar problems. It should be added that the possible endogeneity of standards and regulations – however measured – in explaining trade flows is another concern. Firstly, standards and regulations, as well as the decision to harmonize across countries, could be the result rather than the cause of trade. Secondly, the trade weights that are required for the computation of coverage ratios are usually the same trade flows that appear as a dependent variable, making coverage ratios endogenous by construction (Chen and Mattoo, 2008, Essaji, 2008, or Clougherty and Grajek, 2009, use Instrumental Variables estimation while Czubala et al., 2009, and Portugal-Perez et al., 2010, use the lagged values of standards).

4 The 'Indirect' Approach

We now turn to the 'indirect' approach of measuring trade costs. Indirect trade cost measures capture a wide range of trade cost elements and are therefore hardly suitable to quantify the costs related to standards and regulations only. However, they can be regressed on various trade cost proxies, including measures of standards and regulations as discussed in the previous section, and a variance decomposition can be carried out to determine the contribution of standards and regulations to the variance of the comprehensive trade cost measure.

Returning to gravity equation (1), a problem with specifying the trade cost function is its inherent arbitrariness. Although most researchers opt for a log-linear trade cost function, theory generally gives no guidance as to the appropriate functional form.[13] As a result, the estimated effect of a certain trade cost element depends on the chosen ad hoc form. A second problem is that many trade cost elements are unobservable. Thus, researchers run the risk of omitting potentially important trade cost elements. A third problem is that some proxies such as distance do not vary over time, which makes it difficult to track changes in trade costs.

The indirect approach tries to overcome these problems by indirectly inferring implied trade costs from trade data without specifying a trade cost function. A first step in that direction is taken by the '*phi*-ness' of trade. The idea is to isolate the trade cost variable from the micro-founded gravity equation and express it in terms of observable trade data. But solving equation (1) for t_{ij}^k is problematic as the multilateral resistance variables are unknown. However, they can be eliminated by multiplying the gravity equation by its counterpart for trade flows in the opposite direction, x_{ji}^k, and

[13] See Anderson and van Wincoop (2004, pp. 710 ff.) for a discussion. Eaton and Kortum (2002) allow for a more flexible spline specification that distinguishes between six different distance intervals. Trade cost functions that are linear in levels can also be found in the literature.

then dividing it by the product of gravity equations for domestic trade flows in each country, $x^k_{ii}x^k_{jj}$. Taking the square root results in the expression for the *phi*-ness of trade ϕ^k_{ij}:

$$\phi^k_{ij} \equiv \left(\frac{x^k_{ij}x^k_{ji}}{x^k_{ii}x^k_{jj}}\right)^{\frac{1}{2}} = \left(\frac{t^k_{ij}t^k_{ji}}{t^k_{ii}t^k_{jj}}\right)^{\frac{1-\sigma_k}{2}}. \tag{2}$$

This approach was first adopted by Head and Ries (2001) and followed by a number of other papers (e.g., Baldwin et al., 2003, Head and Mayer, 2004).[14] Expression (2) should be interpreted as an overall trade cost measure at the industry level that captures a comprehensive set of trade cost elements, scaled by the industry-specific elasticity of substitution σ_k. It measures bilateral trade costs relative to domestic trade costs and is by construction symmetric (i.e., $\phi^k_{ij} = \phi^k_{ji}$). Since it is a function of observable trade data, ϕ^k_{ij} can generally be constructed for many countries, industries and years and is thus in principle more broadly available than many direct trade cost data.[15] For example, Head and Mayer (2004) calculate ϕ^k_{ij} for 21 industries for the US-Canada and France-Germany country pairs in 1995.

A drawback of *phi*-ness is that it cannot distinguish between the trade cost variables and the elasticity of substitution σ_k because it is based on a simple trade ratio. When dealing with aggregate data, this might not be a major concern.[16] But when the focus is on measuring trade costs at the industry level, it must be taken into account that substitution elasticities vary substantially across industries (Broda and Weinstein, 2006). Chen and Novy (2011) therefore adopt a related trade cost measure that they denote θ^k_{ij}:

$$\theta^k_{ij} = \left(\frac{x^k_{ii}x^k_{jj}}{x^k_{ij}x^k_{ji}}\right)^{\frac{1}{2(\sigma_k-1)}} = \left(\frac{t^k_{ij}t^k_{ji}}{t^k_{ii}t^k_{jj}}\right)^{\frac{1}{2}}. \tag{3}$$

A high value of θ^k_{ij} corresponds to relatively high implied bilateral trade costs. Since a low σ_k indicates a high degree of differentiation of products and thus a large degree of heterogeneity, θ^k_{ij} is able to separate differences in trade barriers from heterogeneity at the industry level.[17]

Chen and Novy (2011) estimate the substitution elasticities using a methodology adapted from Feenstra (1994) and compute θ^k_{ij} for 163 industries across 11 EU countries between 1999 and 2003. They regress θ^k_{ij} on a number of trade cost proxies and find that, among other factors, TBTs significantly increase implied trade costs. They also find that about 2.7 percent of the variance of θ^k_{ij} is explained by their TBT measure (which captures the effectiveness of EU policies in removing TBTs, European Commission, 1998).

It should be noted that the two expressions in (2) and (3) are not estimated but rather calibrated

[14] Unlike in equation (2), *phi*-ness is sometimes also defined as $(t^k_{ij})^{1-\sigma_k}$, typically in combination with the additional assumptions of bilateral trade cost symmetry (i.e., $t^k_{ij} = t^k_{ji}$) and zero domestic trade costs (i.e., $t^k_{ii} = t^k_{jj} = 1$).

[15] However, domestic trade data, x^k_{ii} and x^k_{jj}, need to be constructed by deducting exports from total domestic production. See Wei (1996) and Novy (2011) for a discussion.

[16] See Jacks et al. (2008) for an application to aggregate trade data in the long run.

[17] Another alternative to measuring overall trade costs would be to construct trade restrictiveness indices (Anderson and Neary, 2005). The difference to the approach underlying expressions (2) and (3) is that direct trade cost data are required to construct trade restrictiveness indices (Kee et al., 2009).

from the data, not unlike the Solow residual in the growth literature or the labor wedge (Shimer, 2009). A disadvantage is that the expressions therefore contain any measurement error that may be part of the trade flow data. Thus, as a matter of caution they should be interpreted as trade cost *measures*, not literally as trade costs.

To conclude, the direct and the indirect approaches provide researchers with different sets of information and thus can be considered as complementary: the first provides measures for standards and regulations that can be used to estimate the sensitivity of trade flows to standards and regulations; the second regresses implied trade costs on standards and regulations, which further allows for a decomposition of the variance of total trade costs into the contribution that is attributable to standards and regulations. Both are equally affected by the problems inherent to the measurement of standards and regulations (use of count variables, frequency and coverage ratios) and by endogeneity. But in contrast to the direct approach, the indirect approach requires domestic trade data which are not always readily available, while at the same time it has an in-built control for multilateral resistance. Finally, with regard to the indirect approach, θ^k_{ij} is theoretically better suited than ϕ^k_{ij} to isolate the trade barrier effect from the heterogeneity effect, but in practice its computation can be difficult as it requires estimates of the substitution elasticities σ_k.

5 Illustration

We now compare the direct and the indirect approaches to measuring standards. We use the data from Chen and Novy (2011) to measure bilateral trade frictions as captured by $\theta^k_{ij,t}$ and $\phi^k_{ij,t}$ (the indirect approach) between 11 EU countries at the 4-digit NACE industry level between 1999 and 2003, and we also use the corresponding trade flows $x^k_{ij,t}x^k_{ji,t}$ (as an illustration of the direct approach).[18] We regress the three variables on the number of private standards at the EU level taken from the World Bank's EU Standards database (Shepherd, 2006) at the HS2002 level for the agriculture, textiles and clothing industries which results in a sample of 35 NACE industries.[19] To reduce endogeneity issues standards are lagged by one period. Given that these standards are shared by EU countries, we would expect them to correlate positively with trade flows and negatively with $\theta^k_{ij,t}$ and $\phi^k_{ij,t}$.

Table 1 reports the results of regressing $\theta^k_{ij,t}$, $\phi^k_{ij,t}$ and $x^k_{ij,t}x^k_{ji,t}$ on standards $Standards^k_{t-1}$ in addition to other typical gravity variables.[20] Column (1) indicates that standards lower $\theta^k_{ij,t}$. In contrast, they are insignificant in explaining $\phi^k_{ij,t}$ (column 2) or trade flows (column 3). Table 2 shows that standards explain 14 percent of the variance of $\theta^k_{ij,t}$ and nothing of the variance of $\phi^k_{ij,t}$ or bilateral trade $x^k_{ij,t}x^k_{ji,t}$. This exercise illustrates that the different approaches, as well as the use of different indirect trade cost measures (i.e., $\theta^k_{ij,t}$ versus $\phi^k_{ij,t}$), can lead to contrasting predictions regarding the economic importance of standards. Technically, such differences arise because in contrast to $\phi^k_{ij,t}$ and $x^k_{ij}x^k_{ji,t}$, the $\theta^k_{ij,t}$ measure has an in-built control for the elasticity of substitution σ_k. But

[18] See Chen and Novy (2011) for data sources.

[19] The HS2002 is more disaggregated than the NACE Rev.1 level classification. We match each NACE industry with the HS code that reports the largest number of standards.

[20] These variables are bilateral and domestic distances, dummies for sharing a common border, a common language, for Finland and Austria that joined the EU last in the sample and for remaining outside the Eurozone. Chen and Novy (2011) also consider other explanatory variables which we exclude here for simplicity. For $\theta^k_{ij,t}$ and $\phi^k_{ij,t}$, year and 3-digit industry fixed effects are included while for trade flows controls for multilateral resistance are used.

from an economic point of view, further research should investigate the reasons why controlling for heterogeneity leads to such differences and what the interaction between heterogeneity and standards is.

6 Concluding Remarks

Standards and technical regulations are a predominant concern in today's global trade negotiations, and as claimed by Pascal Lamy, the WTO Director-General, they can even be considered as 'the real 21st century trade issues.'[21] For the purpose of empirical analysis it is therefore crucial to better measure standards and regulations, and we hope that additional and more precise measures will become available in the future. For instance, the availability of a data set similar to Perinorm but for mandatory technical regulations would be welcome. Also, although some unofficial concordance exists between the International Classification of Standards (as used by Perinorm) and the SITC trade classification (Blind, 2004), future research would further benefit from a better matching between standards and trade classifications.

As far as the indirect approach of inferring trade costs is concerned, future research needs to examine the robustness of this approach to recent theoretical innovations. For example, Fieler (2011) introduces nonhomotheticity such that rich countries produce and demand a different bundle of goods than poor countries. Nonhomotheticity would be a problem for the trade cost measures (2) and (3) if it applied differentially to bilateral and domestic trade. Also, few frameworks exist for gravity with different stages of intermediate production (Baldwin and Taglioni, 2011). In addition, Chen and Novy (2011) show that the exponent of the trade cost measure (3) is not necessarily a function of the CES substitution elasticity and could depend on technology parameters including the Fréchet parameter of the Ricardian model by Eaton and Kortum (2002) or the Pareto parameter of heterogeneous firms models by Melitz (2003) or Chaney (2008). Finally, we show that the different approaches, as well as the use of different indirect trade cost measures, can lead to contrasting predictions regarding the economic importance of standards. Understanding the reasons for such differences is an additional avenue for future research.

[21] 'EU and Asean to pave way for trade pact talks', *The Financial Times*, September 7, 2004.

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Table 1: 'Direct' vs. 'Indirect' Approaches to Measuring Standards

	(1)	(2)	(3)
Dependent variable	$\ln \theta^k_{ij,t}$	$\ln \phi^k_{ij,t}$	$\ln \left(x^k_{ij,t} x^k_{ji,t} \right)$
Geography/Transport Costs			
$\ln D_{ij}$	0.388^a (7.926)	3.765^a (15.219)	-2.931^a (−9.285)
$\ln (D_{ii} \times D_{jj})$	−0.231 (−1.640)	-2.825^a (−3.255)	–
Adj_{ij}	−0.033 (−0.770)	−0.300 (−1.386)	0.465^b (2.078)
$Lang_{ij}$	-0.255^a (−3.052)	-2.031^a (−4.160)	2.093^a (4.048)
Policy Variables			
$\ln Standard^k_{t-1}$	-0.267^a (−7.439)	−0.099 (−0.742)	−0.136 (−0.308)
FI, AT_{ij}	0.136^a (3.500)	1.649^a (8.007)	-8.366^a (−25.524)
$noEURO_{ij,t}$	0.037 (1.308)	0.407^b (2.518)	-0.426^c (−1.963)
N	2,364	2,364	2,364
Adj-R^2	0.578	0.649	0.962

Notes: Year and 3-digit industry fixed effects are included in (1) and (2), industry times year fixed effects, separately for the exporting and the importing country, are included in (3). Robust standard errors are adjusted for clustering at the 4-digit NACE Rev.1 level in each country pair. The sample period is 1999-2003. t-statistics in parentheses. Constant terms are included but not reported. ^{a}, ^{b} and ^{c} indicate significance at 1, 5 and 10 percent levels, respectively. Explanatory variables include bilateral distance D_{ij} and domestic distances $D_{ii} \times D_{jj}$, dummies for sharing a common border Adj_{ij} and a common language $Lang_{ij}$, lagged standards $Standard^k_{t-1}$, and dummies for Finland and Austria who joined the EU last in the sample FI, AT_{ij} and for remaining outside the Eurozone $noEURO_{ij,t}$. For a description of the variables, see Chen and Novy (2011).

Table 2: Variance Decompositions

	(1)	(2)	(3)
Dependent variable	$\ln \theta^k_{ij,t}$	$\ln \phi^k_{ij,t}$	$\ln \left(x^k_{ij,t} x^k_{ji,t} \right)$
Geography/Transport Costs	**2.27%**	**22.85%**	**21.84%**
$\ln D_{ij}$	1.72%	19.06%	18.85%
$\ln \left(D_{ii} \times D_{jj} \right)$	0.18%	1.31%	–
Adj_{ij}	0.15%	1.16%	1.92%
$Lang_{ij}$	0.22%	1.32%	1.07%
Policy Variables	**14.65%**	**6.17%**	**46.28%**
$\ln Standard^k_{t-1}$	14.19%	0.79%	0.37%
FI, AT_{ij}	0.46%	5.38%	45.91%
$noEURO_{ij,t}$	0.00%	0.00%	0.00%
3-digit industry fixed effects	40.89%	35.77%	–
Year fixed effects	0.01%	0.12%	–
Multilateral resistance fixed effects	–	–	28.08%
Variation explained	57.82%	64.91%	96.20%
Residual	42.18%	35.09%	3.80%
Sum	100%	100%	100%
N	2,364	2,364	2,364

Notes: The variance decompositions are calculated according to Fields (2003). The contribution of each explanatory variable x_m to the total variance of a dependent variable Y is given by $c_m = \beta_m cov \left(x_m, Y \right) / var \left(Y \right)$ where β_m is the partial regression coefficient of Y on the explanatory variable x_m (holding all other explanatory variables constant). The decompositions in columns (1) to (3) correspond to regressions (1) to (3) in Table 1. The contributions sum to 100 percent.