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Structural Gravity, Panel Data, and Policy Effects: Evidence from Trade in Services

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Abstract: This paper shows that cross-sectional gravity models overstate the effects of services policies on bilateral trade by up to 78% because they do not account for simultaneity bias due to unobserved country pair characteristics. Full exploitation of panel data eliminates the problem, and produces more realistic estimates of policy effects. Coefficients on services trade policies therefore suffer from the same bias in cross-sectional gravity models as those on dummies for membership of a free trade agreement or currency union.

JEL Codes: F14; F16.

Keywords: International trade; Trade policy; Trade in services.

HIGHLIGHTS

The existing literature on services trade policies does not fully exploit panel data.

Cross-sectional gravity models overstate the effects of services policies on bilateral trade.

Fully exploiting panel data reduces estimated policy coefficients by up to 78%.

1 INTRODUCTION

It is well known that policy variables in gravity models suffer from simultaneity bias. One mechanism among many is that country pairs that trade more have an incentive to adopt more liberal trade policies. A particular expression of this dynamic has been analyzed in the literature on trade agreements and currency unions. In the absence of credible instruments, the standard approach in the literature is to use country pair fixed effects to control for observable and unobservable factors that make it more likely that countries will join a trade agreement or currency union. Recent evidence such as Larch et al. (2019) shows that adding country pair fixed effects can greatly reduce the estimated effect size of the variable of interest, with coefficients even becoming statistically insignificant.

Services are in increasingly important part of the international economy. In 2019, services trade as recorded in the balance of payments accounted for nearly one quarter of total world trade (WTO, 2020). The significance of services trade has been reflected in efforts to collect systematic data on policies affecting services trade. The OECD has published annual Services Trade Restrictiveness Indices (STRI) covering 46 countries and 22 sectors since 2014. The World Bank and WTO have published their own STRI for 68 countries and 22 sectors in 2016, building on a previous data collection for policies in 2008-2010. While there are examples of gravity models using STRIs in the literature, none of them has fully exploited the availability of panel data to include country pair fixed effects that could help limit concerns about simultaneity bias affecting the policy variable coefficient.

This paper adds to the literature by providing the first estimates of policy effects for trade in services, showing the difference between cross-sectional estimates and panel estimates with country pair fixed effects. A number of papers use the gravity model to analyze the impact of policy on trade in services, such as van der Marel and Shepherd (2013), and Nordas and Rouzet (2017). They typically find large estimated coefficients. The only example of a paper that uses panel data is Benz (2020), but the gravity model does not include pair fixed effects. Against this background, an important contribution of the present paper is to show that the large estimated coefficients from previous work shrink substantially when panel data are fully exploited to control for simultaneity bias.

Section 2 sets out the standard structural gravity model used for the analysis. Results are in Section 3, while Section 4 concludes.

2 STRUCTURAL GRAVITY MODEL

Considering a single year of data only, the standard structural gravity model takes the following form:

$$(1)\ X_{ij} = F_i F_j t_{ij}^{-\theta} e_{ij}$$

Where: Xij is exports from country i to country j; the F terms are exporter and importer fixed effects; t is bilateral trade costs; θ is a parameter capturing the sensitivity of demand to cost; and e is an error term satisfying standard assumptions. Arkolakis et al. (2012) show that a wide class of trade models have the same macro-level implications for the relationship between trade flows and trade costs, even though their micro-level predictions are quite different. Examples include the Armington model of Anderson and Van Wincoop (2003), the Ricardian model of Eaton and Kortum (2002), and the heterogeneous firms model of Chaney (2008).

A trade costs function using observable proxies completes the gravity model::

$$(2)\ \ln t_{ij} = b_1 STRI_j * intl_{ij} + b_2 \ln dist_{ij} + b_3 contiguous_{ij} + b_4 colony_{ij} + b_5 common\ colonizer_{ij} + b_6 common\ language_{ij} + b_7 international_{ij}$$

Where: STRI is the variable of interest, namely a measure of services trade policies; and the remaining variables are standard gravity model control variables capturing geographical and historical linkages between countries that are known to influence trade costs. Following Heid et al. (Forthcoming), it is possible to identify an effect of the STRI independently of the importer fixed effect by interacting it with a dummy for international trade observations, and including observations on intranational sales in the model as well.

The model defined by (1) and (2) can be estimated straightforwardly by Poisson Pseudo-Maximum Likelihood (PPML), which ensures that estimated fixed effects accord with theory (Fally, 2015), and that zero trade flows are included in the model at the same time as providing consistent estimates under weak assumptions that are robust to heteroskedasticity (Santos Silva and Tenreyro, 2006). However, applying PPML does not deal with the issue of simultaneity bias, as it assumes that the error term is uncorrelated with STRI (and other determinants of trade costs). That assumption is violated if omitted country pair characteristics influence both trade policy and trade flows.

If panel data are available, (1) and (2) can be rewritten using a more rigorous fixed effects specification:

$$(3)\ X_{ijt} = F_{it} F_{jt} t_{ijt}^{-\theta} e_{ijt}$$

$$(4)\ \ln t_{ijt} = b_1 STRI_{jt} * intl_{ij} + D_{ij} * t$$

The exporter and importer fixed effects are replaced by exporter-year and importer-year fixed effects, in line with theory. The gravity controls are replaced by country pair fixed effects interacted with a time trend, building on specifications in Baier et al. (2019) and Larch et al. (2019). The model defined by (3) and (4) deals with the source of bias identified above, as country pair characteristics are fully controlled for.

Trade data to estimate these gravity models are taken from the Asian Development Bank's multi-region input-output table. This source gives the most up-to-date coverage of services trade (2019) and includes data on intranational trade flows. The OECD STRI is used for policy data, retaining only those sectors that can easily be mapped to trade data: banking (financial intermediation), road freight transport (inland transport), logistics storage and warehousing (auxiliary transport services), telecommunications (post and telecom), maritime transport (water transport), and distribution (wholesale and retail), where sector correspondences with the trade data are in parentheses. Historical and geographical controls come from CEPII.

3 Estimation Results

Tables 1 and 2 present estimation results. Both the cross-sectional models and the panel models fit the data well: gravity models characteristically have high pseudo-R2s due to the high number of fixed effects. With cross-sectional data, five of the six sectors have a negative and statistically significant coefficient at the 1% level. That number falls to four out of six for the panel data models.

The key point for the present paper's purposes is the comparison between the STRI coefficients in the two tables, focusing only on the four that are statistically significant at the 1% level in both. For banking, the estimated coefficient falls by nearly 65% when panel data are fully exploited. For other sectors, the differences are of varying size, but of major economic significance in all cases: 10% for

logistics, 78% for telecommunications, and 64% for maritime transport. Clearly, estimates of policy impacts based on cross-sectional data could be highly misleading, and would lead to severe overstatements of the impacts of policy changes.

Table 1: Cross-section estimation results.

	Banking	Road Transport	Logistics	Telecommunications	Maritime Transport	Distribution
STRI*Intl	-15.519 ***	0.623	-4.305 ***	-6.519 ***	-14.171 ***	-12.329 ***
	(3.584)	(4.974)	(1.234)	(1.471)	(2.470)	(4.408)
Ln(Distance)	-0.231	0.030	-0.314 *	-0.138	-0.559 ***	-0.247
	(0.256)	(0.250)	(0.166)	(0.280)	(0.174)	(0.315)
Contiguous	-0.644	0.228	0.325	-0.337	-0.134	-0.012
	(0.725)	(0.635)	(0.419)	(0.775)	(0.455)	(0.769)
Colony	-0.662	0.107	-0.498	-0.241	-0.355	-0.754
	(0.664)	(0.788)	(0.342)	(0.706)	(0.405)	(0.715)
Common Colonizer	-1.254	-1.644 **	-0.370	-1.186	0.423	-0.647
	(1.324)	(0.816)	(0.564)	(0.939)	(0.509)	(1.348)
Common Language	-0.344	-1.065	-0.327	-0.415	-0.087	-0.773
	(0.525)	(0.765)	(0.343)	(0.555)	(0.295)	(0.563)
International	-1.113	-5.356 ***	-3.456 ***	-3.126 **	1.480	-1.323
	(1.289)	(1.595)	(0.668)	(1.215)	(0.945)	(1.443)
Constant	14.057 ***	11.878 ***	12.653 ***	12.326 ***	13.111 ***	14.293 ***
	(1.301)	(1.238)	(0.806)	(1.386)	(0.890)	(1.513)
Observations	2418	2379	2340	2418	1980	2379
Pseudo-R2	0.910	0.833	0.934	0.874	0.926	0.780
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes	Yes	Yes	Yes

Note: Estimation is by PPML. Robust standard errors adjusted for clustering by country pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%).

Table 2: Panel estimation results.

	Banking	Road Transport	Logistics	Telecommunications	Maritime Transport	Distribution
STRI*Intl	-5.479 ***	-0.062	-3.869 ***	-1.417 ***	-5.083 ***	0.248
	(1.456)	(0.864)	(1.117)	(0.383)	(1.645)	(0.452)
Constant	12.490 ***	11.221 ***	10.602 ***	11.104 ***	9.718 ***	12.044 ***
	(0.052)	(0.052)	(0.037)	(0.017)	(0.120)	(0.036)
Observations	7254	7137	7020	7254	5940	7110
Pseudo-R2	1.000	0.999	0.999	0.999	0.997	1.000
Exporter-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country Pair FE * Time	Yes	Yes	Yes	Yes	Yes	Yes

Note: Estimation is by PPML. Robust standard errors adjusted for clustering by country pair are beneath the parameter estimates. Statistical significance is indicated by: * (10%), ** (5%), and *** (1%).

4 CONCLUSION

This paper has shown that estimates of policy effects from gravity models can be severely biased in the absence of panel data. The reason is that omitted country pair characteristics simultaneously affect trade flows and trade policies. The mechanism is well known and has been investigated in depth in the literature dealing with trade agreements and currency unions. But it has not previously been demonstrated in relation to a country-level policy variable, like services trade restrictiveness.

This finding has important implications both for research and practice. Clearly, it is important to fully exploit available panel data to obtain estimates of policy effects that are robust to this kind of simultaneity bias. While there is an understandable interest in policy circles in obtaining estimates rapidly when policy data first become available, this paper's findings counsel caution: the effect of the bias seen here is to overstate the sensitivity of trade flows with respect to policy, which has significant practical implications in the policy sphere.

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