

Pre-Trends Matter for Estimating the Causal Effect of the WTO on Bilateral Trade

Ben Shepherd, Principal, Developing Trade Consultants, 315 W. 99th St. #7C, New York, NY
10 025, USA (corresponding author)

Ben@Developing-Trade.com

Anirudh Shingal, Professor, S.P. Jain Institute of Management Research, Bharatiya Vidya
Bhavan Campus, Munshi Nagar, Dadabhai Road, Andheri West, Mumbai – 400 058

anirudh.shingal@spjimr.org

October 16th, 2025.

Abstract: This paper reassesses the effects of country WTO membership on trade using a structural gravity model augmented with recent insights from the causal inference literature. The inclusion of time-varying international border dummies is crucial to eliminate the pre-trend in an event studies setting. Resulting estimates of the causal effect of country WTO membership on bilateral trade values are substantially lower than in the previous literature, but are of more certain causal value.

Keywords: International trade; gravity model; trade policy; quantitative model.

JEL Codes: F15; F13; F14.

1 INTRODUCTION

The effect of WTO membership on international trade has been widely examined, with findings ranging from negligible or even negative impacts (Rose, 2004; Roy, 2011; Esteve-Pérez et al. 2020) to clear positive outcomes (Tomz et al. 2007; Liu, 2009; Chang and Lee, 2011; Herz and Wagner, 2011; Cheong et al. 2014; Kohl and Trojanowska 2015; Campos et al. 2024; Felbermayr et al. 2024; Larch et al. 2025). The extent of this impact depends on factors like existing preferential trade agreements (Eicher and Henn, 2011), the duration and intensity of the accession process (Allee and Scalera, 2012), the scope and depth of commitments undertaken at accession (Chemutai and Escaith, 2017), and margins of trade (Felbermayr and Kohler, 2006; Dutt et al. 2013; Bista, 2015).

We revisit these findings in light of Nagengast and Yotov (2024), who combine the structural gravity model (see Capoani, 2024 for a review) and the Extended Two-Way Fixed Effects (ETWFE) estimator of Wooldridge (2023) to provide a rigorous framework for analyzing causal effects in trade settings with potential heterogeneity. Using data from 1948 to 2021, we show that a key factor in analyzing the causal effect of WTO membership on trade is the presence of systematic differences in countries' trade patterns before they join. Eliminating these pre-trends requires inclusion of border-year dummies as in Bergstrand et al. (2015) to account for the impact of globalization on trade, which also substantially reduces the size of the WTO trade effect. We therefore show that including these dummies in structural gravity models is not only important from the point of view of accounting for changes in the national-international economic frontier, but also for achieving credible identification of causal effects of important treatment variables.

The paper, which is the first to combine the above insights and to apply these new techniques from the causal inference literature, proceeds as follows. Introduction introduces the subject and some studies. Section 2 introduces the model and data. Section 3 presents the results. Section 4 is the conclusion.

2 MODEL AND DATA

A standard structural gravity TWFE approach to quantifying the WTO effect in the structural gravity context is:

$$(1) \quad X_{ijt} = \exp \left(S_{it} + M_{jt} + D_{ij} + \int l_{ijt} + b_1^{TWFE} WTO_{ijt} + b_2^{TWFE} RTA_{ijt} + b_3^{TWFE} EU_{ijt} \right) e_{ijt}$$

Where: X_{ijt} is nominal value of exports from country i to country j in time period t . S_{it} is an exporter-time fixed effect. M_{jt} is an importer-time fixed effect. D_{ij} is a dummy variable for each country pair, capturing trade costs that are pair-specific. $\int l_{ijt}$ is a dummy for international observations (exporter and importer are different) by time period, to capture the effect of globalization on trade (Bergstrand et al. 2015). The variable of interest is a dummy equal to one if either the exporter or the importer are members of the WTO in time period t , zero otherwise. The final two terms are controls for joint RTA membership and joint EU membership. The error term e_{ijt} represents unobserved bilateral-time trade costs (Weidner and Zylkin, 2021).

Nagengast and Yotov (2024), who use a specification like equation (1) but with a trade agreement dummy in place of the WTO dummy, highlight two major issues with estimates of b_1 . First, it does not allow for heterogeneity in the WTO effect across country groups or time, which could potentially lead to biased estimates that are difficult to interpret. Second, the estimator can

involve “forbidden comparisons” that mistakenly include already treated units in the control group.

To deal with these issues, they adapt the ETWFE estimator of Wooldridge (2023) to the gravity context. The resulting approach is robust to heterogeneity and produces estimates that can be used to easily compute outputs of interest, such as the average effect of the treatment on the treated, either in an overall sense or allowing for heterogeneity in cohort groups and time periods.

The ETWFE estimator is:

$$(2) \quad X_{ijt} = \exp \left(S_{it} + M_{jt} + D_{ij} + \int l_{ijt} + \sum_{g=q}^T \sum_{s=g}^T w_{gs} W_{gs} + b_2^{ETWFE} RT A_{ijt} + b_3^{ETWFE} E U_{ijt} \right) e_{ijt}$$

Equation (2) preserves structural gravity but allows for heterogeneous treatment through the modified WTO dummy term. Instead of a simple dummy, equation (2) includes a time-varying treatment indicator W equal to one for cohort g in post-treatment years and zero otherwise. The w terms capture cohort-year specific treatment effects. A country pair belongs to the treatment cohort g if WTO membership started in year g ; q is used to index the first year of treatment of cohort g .

Identification rests on two assumptions. First, there can be no treatment effect prior to onset as captured by the relevant dummy variable. Second, trade growth of the treated and control groups can depend on the covariates, but not treatment.

An average effect of WTO membership, with standard error calculated by the delta method, is then:

$$(3) \quad \bar{w} = \sum_{g=q}^T \sum_{s=g}^T \frac{N_{gs}}{\sum_{g=q}^T \sum_{s=g}^T N_{gs}} w_{gs}$$

The average effect (average effect of the treatment on the treated) is a weighted average of cohort-time treatment effects, where the weights are the number of observations (N) of cohort g in period s relative to the total number of treated observations.

For computational reasons, we focus here on a version of (2) with heterogeneity by cohort but not year. This approach fits well with the analysis of the WTO effect, because acceding countries have different policy changes depending on when they join.¹

The ETWFE estimator cannot use always treated observations for identification. We therefore use the longest time series possible to allow for as much variation as possible in membership, including treatment times. This is possible using the CEPII gravity dataset, which has trade data from 1948, as well as pre-coded data on GATT/WTO membership, RTA membership, and EU membership. However, this dataset only includes cross-border flows, which makes the gravity estimation theoretically-inconsistent (Yotov et al. 2016). We therefore proxy domestic trade as nominal GDP (included in the dataset) less total exports. The dataset covers the time period 1948-2021. To allow for announcement effects as in Nagengast and Yotov (2025), we code treatment as

¹ Our central finding remains unchanged if we only consider heterogeneity by year.

starting five years before membership. Thus, the last effective estimation year is 2016, which makes our estimates unaffected by the COVID-19 pandemic.

3 RESULTS

Table 1 codes treatment as the exporter or the importer being a member of the WTO (“one in”) using the specification in equation (2) and reporting an average treatment effect per equation (3). The key finding is that while allowing for treatment effect heterogeneity enhances the WTO’s trade impact relative to TWFE estimates (col. 1 vs 3 or 2 vs 4), the largest differential comes from the decision to include or exclude border-year dummies (col. 1 vs 2 or 3 vs 4).

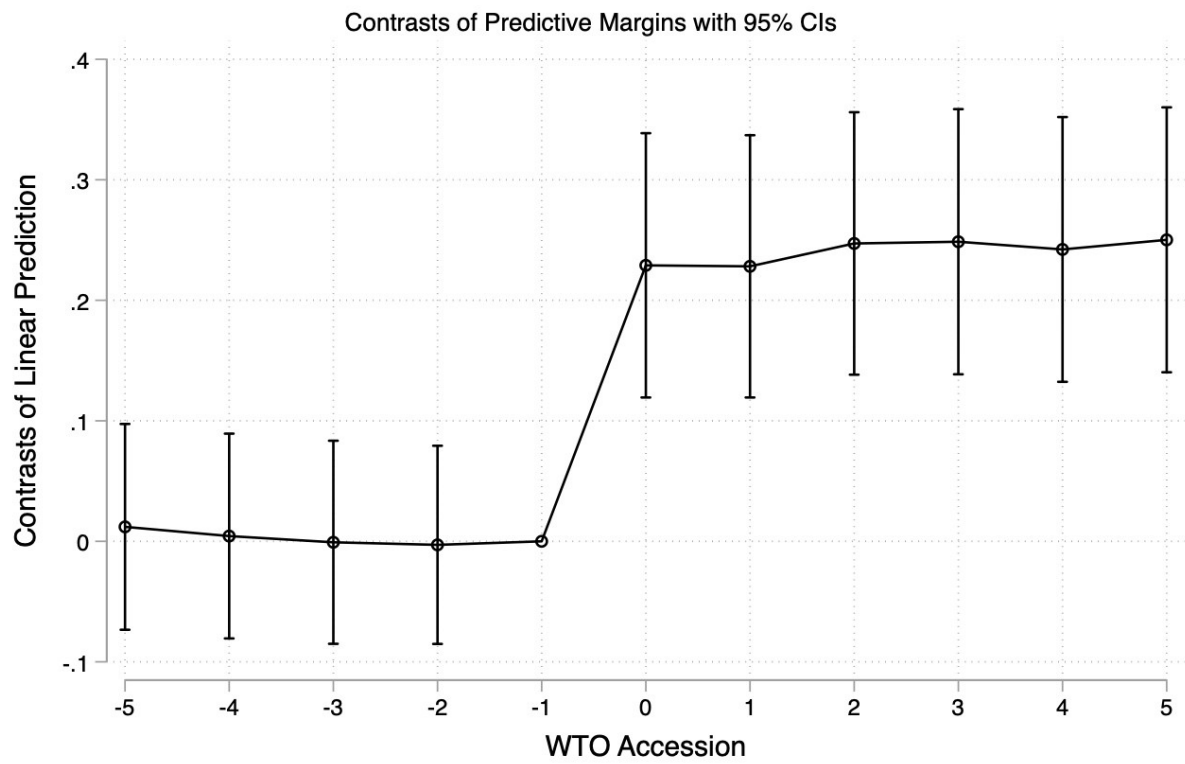
Figure 1 provides event study evidence. When border-year dummies are not included (lower panel), there is slight evidence of a pre-trend in the data. Statistically speaking, a test of the null hypothesis that there is no pre-trend in the data is rejected at the 5% level (Table 1, column 2). Thus the model does not satisfy the assumptions of the ETWFE estimator, and causal identification is suspect. Results for the model including border-year dummies (upper panel) show that there is now no pre-trend in the data, and a statistical test of that assumption fails to reject the null hypothesis of no pre-trend (Column 1). Thus, inclusion of border-year dummies is vital for causal identification in an event studies framework. It has a larger (downward) impact on estimated coefficients, and their interpretation, than the decision to allow for heterogeneity.

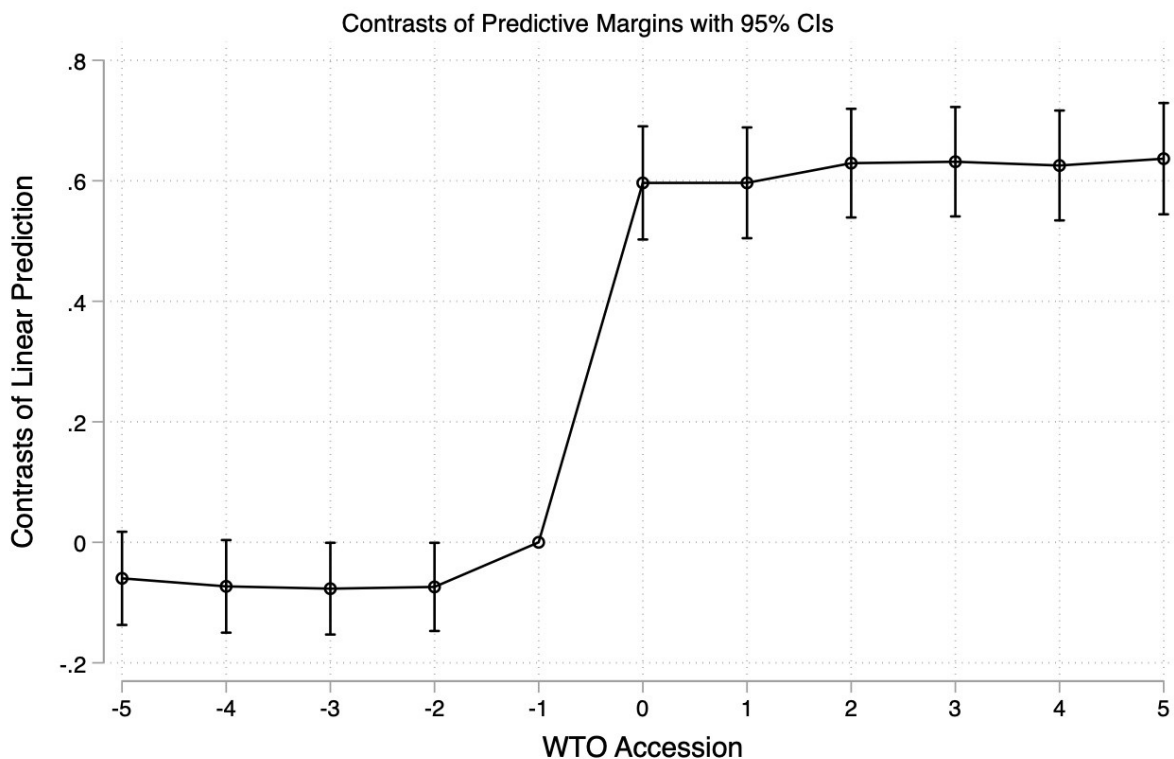
Table 1: PPML estimation results (equations (2) and (3)).

	(1)	(2)	(3)	(4)
	ETWFE		TWFE	
WTO	0.315*** (0.0747)	0.738*** (0.0551)	0.189* (0.103)	0.653*** (0.107)
Obs.	198 494	198 494	193 96 4	193 964
R ²	0.999	0.999	0.999	0.998
Pretrend	3.007	9.752**		
Prob. (Pretrend)	0.557	0.0448		

Note: Standard errors in parentheses, corrected for clustering by pair. * p<0.1, ** p<0.05, *** p<0.01.

Figure 1: Event study figures for ETWFE models in Table 1, with (upper panel) and without (lower panel) border-year dummies.





Note: Results are qualitatively identical with ten lags and leads.

4 CONCLUSION

This paper has provided new evidence on the WTO effect in international trade, for the first time using a structural gravity model combined with causal inference insights. Whereas Nagengast and Yotov (2025) highlight the importance of allowing for heterogeneity when estimating the causal impact of RTA membership, this paper shows that including border-year dummies is crucial for causal identification in a WTO effect context, because it eliminates the pre-trend in the data. This also results in much smaller trade effects than in the existing literature.

The authors have no competing financial or non-financial interest.

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The data underlying this research are available upon request from the authors.

REFERENCES

- Allee, T.L. and J.E. Scalera. 2012. "The Divergent Effects of Joining International Organizations: Trade Gains and the Rigors of WTO Accession." *International Organization*, 66(2): 243-276.
- Bergstrand, J., M. Larch, and Y.V. Yotov. 2015. "Economic integration agreements, border effects, and distance elasticities in the gravity equation." *European Economic Review*, 78: 307-327.

- Bista, R. 2015. "Reconciling the WTO effects on trade at the extensive and intensive margins." *International Economic Journal*, 29, 231-257.
- Campos, R., J. Timini, and E. Vidal. 2021. "Structural Gravity and Trade Agreements: Does the Measurement of Domestic Trade Matter?" *Economics Letters*, 208: 110 080.
- Campos, R., M. Larch, J. Timini, E. Vidal and Y. Yotov. 2024. "Does the WTO Promote Trade? A Meta-Analysis." Working Paper, Drexel University.
- Capoani, L. 2024. "The Gravity Equation in International Trade: An Overview of the Introduction of Gravity to the Study of Economics and its Systemic Barriers." *European Journal of the History of Economic Thought*, 31(3): 487-520.
- Chang, P.-L. and M.-J. Lee. 2011. "The WTO Trade Effect." *Journal of International Economics*, 85(1): 53-71.
- Chemutai, V. and H. Escaith. 2017. An empirical assessment of the economic effects of WTO accession and its commitments. WTO Staff Working Paper, ERSD-2017-05.
- Cheong, J., D.W. Kwak, and K.K. Tang. 2014. "The WTO puzzle, multilateral resistance terms and multicollinearity." *Applied Economics Letters*, 21, 928-933.
- Dutt, P., I. Miho and T. Van Zandt. 2013. "The effect of WTO on the extensive and the intensive margins of trade." *Journal of International Economics*, 91, 204-219.
- Eicher, T.S. and C. Henn. 2011. "In search of WTO trade effects: Preferential trade agreements promote trade strongly, but unevenly." *Journal of International Economics*, 83(2): 137-153.
- Esteve-Pérez, S., S. Gil-Pareja, and R. Llorca-Vivero. 2020. "Does the GATT/WTO Promote Trade? After All, Rose Was Right." *Review of World Economics*, 156(2): 377-405.
- Felbermayr, G. and W. Kohler. 2006. "Exploring the intensive and extensive margins of world trade." *Review of World Economics*, 142(4): 642-674.
- Felbermayr, G., M. Larch, E. Yalcin, and Y.V. Yotov. 2024. "On the heterogeneous trade and welfare effects of GATT/WTO membership." *Review of World Economics*, 160(3): 983-1008.
- Herz, B. and M. Wagner. 2011. "The real impact of GATT/WTO - a generalised approach." *The World Economy*, 34, 1014-1041.
- Kohl, T. and S. Trojanowska. 2015. "Heterogeneous trade agreements, WTO membership and international trade: An analysis using matching econometrics." *Applied Economics*, 47, 3499-3509.
- Larch, M., J.A. Monteiro, R. Piermartini, and Y.V. Yotov. 2025. "On the trade effects of GATT/WTO membership: They are positive and large after all." *Canadian Journal of Economics*, 58(1): 281-328.
- Liu, X. 2009. "GATT/WTO promotes trade strongly. Sample selection and model specification." *Review of International Economics*, 17, 428-446.
- Nagengast, A., and Y. Yotov. 2025. "Staggered Difference-in-Differences in Gravity Settings: Revisiting the Effect of Trade Agreements." *American Economic Journal: Applied Economics*, 17(1): 271-296.

Rose, A.K. 2004. "Do We Really Know That the WTO Increases Trade?" *American Economic Review*, 94(1): 98-114.

Roy, J. 2011. "Is the WTO mystery really solved?" *Economics Letters*, 113, 127-130.

Tomz, M., J. Goldstein, and D. Rivers. 2007. "Do We Really Know That the WTO Increases Trade? Comment." *American Economic Review*, 97(5): 2005-2018.

Wooldridge, J. 2023. "Simple Approaches to Nonlinear Difference-in-Differences with Panel Data." *Econometrics Journal*, 26(3): C31-C66.