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Abstract

Based on an empirical gravity model of sectoral bilateral trade, we uncover three features of bilateral trade balances. First, the difficulty of gravity models in fitting the observed level of bilateral balances is likely due to the presence of unobservable bilateral trade costs. Second, the model fit improves drastically when we focus on changes over time of the balances. Third, using a log linear approximation we show that changes in bilateral trade balances over the past two decades were driven almost entirely by changes in the same macro factors that determine countries' aggregate balances – changes in bilateral trade costs, including tariffs, played therefore only a negligible role. This conclusion provides new support for the view that bilateral balances are, for practical purposes, not relevant to the conduct of macroeconomic policy.

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1. INTRODUCTION

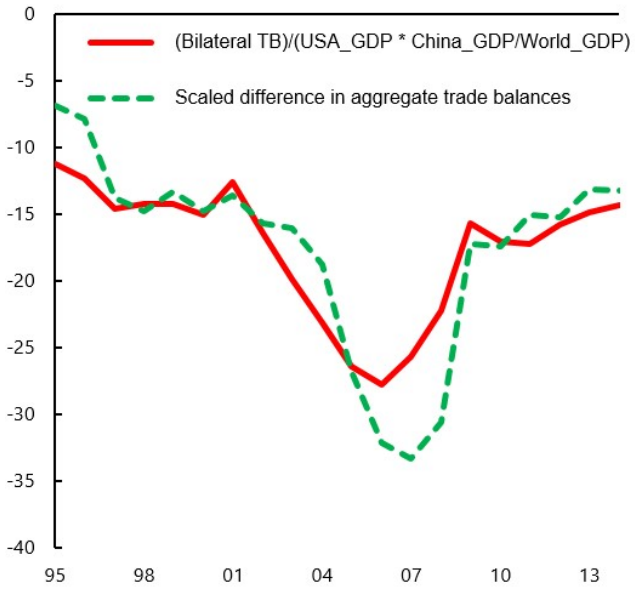
The spectacular growth in international trade in the last three decades was accompanied by rising aggregate and bilateral trade imbalances. China and the United States are major examples of these trends. The US aggregate annual trade deficit increased by about $600 billion between 1991 and 2019, and China's trade surplus increased by about $400 billion. Even more spectacularly, during the same period the bilateral trade balance between the two countries alone grew by about $300 billion. These changes remain large even when numbers are expressed in real terms. Economists have devoted significant efforts to understand the determinants of countries' aggregate external imbalances. Much less attention has instead been given to the detailed exploration of the determinants of bilateral balances.

The "common wisdom" among economists is that aggregate trade balances are linked to the evolution of macroeconomic factors that are relatively independent from a single trade relation and that affect a country's saving-investment balance. From this perspective, the exact way in which aggregate trade balances are divided into all possible bilateral trade relations is considered of little interest for the conduct of macroeconomic policy (see Obstfeld 2012 among others). The idea of "irrelevance" of bilateral trade balances is not as popular among other observers, who instead often suggest that the evolution of aggregate trade balances should be affected by means of policy measures, such as bilateral tariffs, that are targeted at specific bilateral trade relations. These two contrasting policy views provide a first motivation for the investigation of the determinants of bilateral trade balances (Feenstra and others 1998). A second motivation is that the determinants of bilateral trade balances are poorly understood (David and Weinstein 2002).

At a first level of abstraction, bilateral trade balances are influenced by two groups of drivers. The first is represented by the same macroeconomic factors that affect aggregate trade balances and include the level of aggregate demand and supply. The second is given by pairwise trade costs, which include bilateral tariffs, that influence how aggregate balances are split among different bilateral trading relations. Changes in bilateral trade balances could therefore be attributed either to changes in macroeconomic factors or to changes in bilateral trade costs. The main goal of this paper is to provide a quantitative estimation of the role of the two.

As already mentioned, the determinants of bilateral trade balances are not well understood. Our empirical exercise confirms that empirical trade models face difficulties in explaining the *level* of bilateral trade balances even when detailed sectoral data are used in the estimation. A first result of our paper is to trace this difficulty to the existence of unobservable variables that are specific to bilateral trade relations (possibly unobserved components of bilateral trade costs) that are stable over time. This finding leads us to focus our attention on assessing the statistical fit of the gravity model in explaining *changes* over time in bilateral trade balances. The second result of our paper is that the model is successful on this front. The third and main result concerns the quantification of the role played by the different drivers of bilateral trade balances. Based on a sectoral gravity regression, we construct a log-linear approximation that decomposes changes in world bilateral balances between 1995 and 2015 into changes of five types of drivers: countries' aggregate

Figure 1. US-China bilateral trade balance



Note. Actual and Predicted (double-scaled) bilateral trade balance between the US and China for 1995-2015. Predicted values are calculated as the difference between aggregate trade balance-to-GDP ratios of both countries, multiplied by a constant (trade bias) calibrated to minimize the average distance with actual data.

demand/supply, world demand/supply, countries' sectoral composition of spending and output, multilateral trade costs (i.e. "multilateral resistance terms") and bilateral trade costs. Our results indicate that, over the period considered, changes in bilateral trade costs have played a negligible role. Rather, changes in bilateral balances have been predominantly driven by the first four groups of drivers, which are considered macro factors because they are not specific to any bilateral trade relation.

Since bilateral trade balances are driven by the same macro factors that drive aggregate trade balances, the findings of the paper therefore give empirical support to the economists' common wisdom of the irrelevance of bilateral trade balances. A stark example is provided by the evolution of the US-China bilateral trade balance. The solid line in Figure 1 plots the US-China trade balance scaled by the product between the US GDP and the share of China's GDP in the world economy - as we argue in the paper, this is the appropriate way of scaling bilateral trade balances. The dashed line plots the difference between the two countries' aggregate trade balances over GDP, holding constant the influence of a bilateral term, called "trade bias" (see Section 2.2), calibrated to minimize the average distance between the two curves. This term can be thought of as the combination of multilateral and bilateral trade costs between the US and China. The figure makes clear that the evolution of the two countries' aggregate trade balances determines almost entirely the pattern of their scaled bilateral balance.

The literature on the determinants of bilateral trade balances is scant, though there are few notable exceptions, which are closely related to ours. Feenstra et al. (1998) analyze the determinants of the US-China bilateral trade balance and argue that its evolution was mainly driven by macroeconomic forces affecting the saving-investment balances in the two countries. Our paper provides a generalization of this conclusion based on a detailed empirical trade model, which spans two decades and covers a very large set of bilateral trade relations. Davis and Weinstein (2002) study bilateral trade imbalances and find that they are more difficult to predict than bilateral exports. They note that the traditional gravity model fails in two dimensions. First, actual bilateral balances are larger than those predicted, giving rise to the "mystery of excess imbalances". Second, macroeconomic imbalances and idiosyncrasies in the structure and level of demand and supply do not explain the missing imbalances. Our paper confirms the "mystery" puzzle, and attributes it to the existence of time-invariant unobservable bilateral components, possibly capturing the level of bilateral trade costs. However, in contrast to their findings, we show that the "mystery of excess imbalances" does not hold when looking at changes in bilateral trade balances over time. Our paper is also related to some recent and parallel work which, differently from ours, concentrates more on cross-sectional variation than on changes over time. Cunat and Zymek (2019) calibrate a general equilibrium model of international trade at the sectoral level, which gives rise to the type of gravity equation used in our paper. They find, in line with our results, that unobservable asymmetric bilateral "wedges" are needed to explain the cross-sectional level of bilateral trade balances.[2]

The rest of the paper proceeds as follows. Section 2 introduces the gravity framework that represents the backbone of our empirical strategy and presents a special case where the gravity equation is applied to the construction of bilateral trade balances. Section 3 discusses the empirical results from the gravity regression and its empirical fit of the level of bilateral trade balances. Section 4 shows how the gravity equation can be used to approximate the change in bilateral trade balances and to decompose it into its determinants. Section 5 concludes.

2. THE GRAVITY FRAMEWORK

The gravity model of international trade is the field's workhorse paradigm of empirical analysis. It can be derived from explicit theoretical micro-foundations, as shown in Anderson and van Wincoop (2003), who model the general equilibrium effects of trade costs via an Armington-CES aggregator, and in Eaton and Kortum (2002), who incorporate geographic features of trade into a general equilibrium Ricardian model. We refer the reader to the well-established literature that presents the gravity model and its foundations (among others, see Larch et al. 2016).

Empirical gravity models have been traditionally estimated on country-level data. However, with more detailed datasets becoming available, sector-level gravity models have also become common (Caliendo and Parro 2015). Our baseline framework includes estimations of

[2] Felbemayr and Yotov (2019) suggest instead that, with appropriate adjustments to the estimation strategy, the mystery puzzle disappears. They also argue that the asymmetric component of bilateral trade costs is not an important source of variation in bilateral balances.

both versions of the gravity. We give however more prominence to the sector-level analysis, which allows us to explore the potential role of the sectoral composition of production and demand as a determinant of bilateral trade balances. To reduce notation to the minimum and to simplify the exposition, we start by presenting the gravity equation at the country level, and then briefly discuss how the framework is adjusted to the sector level analysis.

2.1 The country level gravity

At the aggregate level, the gravity representation of gross bilateral exports X_{ijt} from country *i* to country *j* at time *t* can be thought of as the product of a set of *macro factors* (M_{it}, M_{jt}, M_{wt}) that characterize macroeconomic conditions in *i*, in *j* and in the entire world *w*, and of pair-specific *bilateral trade costs* (T_{ijt})

$$X_{ijt} = M_{it} \cdot M_{jt} \cdot M_{wt} \cdot T_{ijt} \cdot \eta_{ijt}$$

with η_{ijt} a measurement error. The empirical implementation of the equation above used throughout the paper takes the following form,

$$\begin{aligned} X_{ijt} = \exp\,[&\alpha + \beta_1\, ln(Y_{it}) + \beta_2 ln(E_{jt}) + \beta_3 \ln(Y_{wt}) + \\ &+(\beta_4\ ln\,(Dist_{ij}) + \beta_5\, Lan_{ij} + \beta_6\, Col_{ij} + \beta_7\, Bord_{ij} + \beta_8\, FTA_{ijt}) \cdot (1 \\ &- SM_{ij}) + \beta_9\, ln\,(Dist_{ij}) \cdot SM_{ij} + \beta_{10}\, SM_{ij} + \beta_{11}\, ln\,(1+\tau_{ijt}) \\ &+ \beta_{12} ln\,(MRT_{it}^{out}) \\ &+ \beta_{13}\, ln\,(MRT_{jt}^{in})\,] \cdot \eta_{ijt} \end{aligned} \qquad (1)$$

In (1), macro factors include the exporter's gross output Y_{it} and the importer's gross expenditure E_{jt} on intermediate and final goods (Baldwin and Taglioni 2011). Multilateral Resistance Terms (MRTs) are also macro factors but deserve a separate discussion below. The world's macro factors are given by gross world output, $Y_{wt} = \sum_i Y_{it}$.

The remaining set of terms in (1) capture *bilateral* trade costs. This is an important distinction from the macro factors described above, which are instead constant across trading partners. Unobservable components of bilateral trade costs are proxied by physical distance ($Dist$), common language (Lan), common colonial history (Col), and contiguous borders ($Bord$). The observable component includes bilateral tariffs (for goods only) τ_{ijt}, and a dummy variable for free, preferential, or regional trade agreements (FTA), which takes the value 1 if the two trading countries have a trade agreement and zero otherwise. A dummy variable SM_{ij} that takes the value of 1 for intra-national trade and zero otherwise is included in the regression to capture home bias in trade (Larch and others 2016). The dummy is interacted with geographical variables to allow for different coefficient estimates on the effect of distance for inter- and intra-national trade, solving the well-known "distance puzzle" that the estimated negative impact of distance on trade has remained persistently high despite declining transportation costs (Disdier and Head 2008).

As we shall see in section 4.2, MRTs are an aggregate version of bilateral trade costs. The "outward" multilateral resistance term (MRT_{it}^{out}) is an average of trade costs faced in the

global market by the exporting country. Instead, the "inward" term (MRT_{jt}^{in}) captures the overall trading costs that the importing country imposes on the rest of the world. Since MRTs are not directly observable, appropriate proxies need to be constructed.

2.2 The sectoral gravity regression

The sectoral gravity model has the same form as the country gravity model proposed in (1), but it now predicts exports X_{ijst} at the sectoral level s. Explanatory variables that are invariant across sectors within a country remain measured as before at the country level. These include proxies for unobservable trade costs (distance, language, colonial history, and contiguous borders) and the free trade agreement dummy. Other variables are instead measured at the sectoral level including tariffs, which are aggregated up from individual goods to the sectoral level using trade-weighted averages. Because tariffs differ across sectors, our estimated inward and outward multilateral resistance terms also differ across sectors. Finally, sectoral (instead of macro) factors are given by sectoral gross output (Y_{is}) and sectoral demand (E_{js}) for final and intermediate goods.

$$\begin{aligned} X_{ijst} = \exp\,[&\alpha + \beta_1\, ln(Y_{ist}) + \beta_2 ln(E_{jst}) + \beta_3 \ln(Y_{wst}) + \\ &+(\beta_4\, ln(Dist_{ij}) + \beta_5\, Lan_{ij} + \beta_6\, Col_{ij} + \beta_7\, Bord_{ij} + \beta_8\, FTA_{ijt}) \cdot (1 - \\ &SM_{ij}) + \beta_9\, ln\,(Dist_{ij}) \cdot SM_{ij} + \beta_{10}\, SM_{ij} + \beta_{11}\, ln\,(1+\tau_{ijst}) + \\ &+ \beta_{12} ln\,(MRT_{ist}^{out}) + \beta_{13}\, ln\,(MRT_{jst}^{in})\,] \cdot \eta_{ijst} \end{aligned} \tag{2}$$

2.3 From the gravity to bilateral trade balances: a simplified decomposition

Since the bilateral trade balance between country i and j is defined as $TB_{ijt} = X_{ijt} - X_{jit}$, we can use expression (1) to decompose bilateral balances into country-specific macro factors and bilateral trade costs. A good starting point is to see how the decomposition looks like under the simplifying assumptions that trade costs, both bilateral and multilateral, are symmetric (a more general decomposition is presented in Section 4.1).

For ease of exposition, we can group the bilateral and multilateral trade costs into a single term σ_{ij}, which is referred to as trade bias since it summarizes the role of trade costs in diverting trade flows between trade partners. If bilateral trade costs are symmetric and aggregate trade balances are small, then multilateral trade costs are also symmetric. Thus, trade biases are symmetric too ($\sigma_{ij} = \sigma_{ji}$) and the standard gravity (1) gives the following relation between bilateral and aggregate trade balances[3]

$$\frac{TB_{ijt}}{Y_{it}Y_{jt}^{W}} = \sigma_{ijt} \cdot \left(\frac{TB_{it}}{Y_{it}} - \frac{TB_{jt}}{Y_{jt}}\right) \tag{3}$$

The variable Y represents here a country's GDP, with the other country's GDP (Y_j^W) expressed as a share of world output. Equation (3) makes clear that, under an appropriate double-scaling, the bilateral trade balance between any two countries depends just on the

[3] See Appendix 1 for a full derivation.

evolution of country-pair specific trade biases and on the aggregate trade balance-to-GDP ratios of each of the two countries.

The double scaling is important and omitting it can lead to serious misinterpretations of the data. For instance, take i as being the United States and j as being China. As noticed in the discussion of Figure 1, the double-scaled trade balance shows no clear trend over the past decades. Instead, if we were to scale the bilateral balance only by the US GDP, then the picture would show a steady deterioration of the US trade deficit vis-a-vis China. This deterioration could be taken as the result of a persistent structural shift, due for instance to a reduction in bilateral tariffs, in the two country's bilateral trade bias σ_{ij}. However, when the double-scaling is applied, a different story emerges. By adding Y_j^W as a second scaling factor, the normalized bilateral balance now takes into consideration China's rapidly growing share of world output. This macro factor naturally leads to an amplification of the absolute level of all bilateral exports, and thus of the bilateral trade balance, of any country trading with China. In the case of the US, the amplification causes a worsening in its bilateral trade deficit with China.

Equation (3) summarizes economists' common wisdom that bilateral balances are a simple by-product of the way in which aggregate trade balances get split according to pair-specific trade biases. Since aggregate trade balances are the difference between domestic production and spending, they are affected by macroeconomic policies (e.g., fiscal and monetary). Instead, bilateral trade policies aimed at specific trade relations influence only the trade bias terms, leading to trade diversion and changing only the bilateral composition of a country's aggregate trade balance, but not its level.[4]

3. GRAVITY ESTIMATION

3.1 Data

The gravity models are estimated using the 2016 and 2018 Trade in Value Added (TiVA) databases from the OECD. The 2016 TiVA reports bilateral export and gross production data at the ISIC 3 level for 34 sectors and 63 countries from 1995-2011, and the 2018 TiVA at the ISIC 4 level for 34 sectors and 63 countries from 2005-2015. The datasets are combined by splicing the 2016 TiVA database forward from 2006 onward using the change in the share of each variable in global GDP in the 2018 TiVA database. In order to match the sectors, two sectors in each database were combined for a total of 33 sectors in the final database. The database does not report intra-national trade, which is instead constructed as the difference between gross production and exports.[5] The OECD input-output tables, on which the TiVA

[4] A different situation is an increase in i's tariffs against *all* its trading partners, a move that is more akin to a macroeconomic policy. This would certainly be expected to impact i's aggregate trade balance, as it would increase the cost for i to trade with the rest of the world relative to the cost of trading with itself (i.e. internal trade). Such aggregate policies are also expected to impact i's output Y_i.

[5] At the sectoral level the constructed value of intra-national trade is negative for a small number of country-sector observations. As it is not clear whether this is a data reporting issue or whether these are sectors in which a portion of exports are in fact goods produced in other domestic sectors, these values are set to zero.

database is built, are used to construct gross expenditure at the country-sector level as the sum of the importing country's expenditure on intermediate and final goods from each of the other exporting country-sectors. Finally, world gross production, used in both the construction of the multilateral resistance terms (Section 3.2) and as a regressor in the model is defined as the sum of all country-sector gross output observations from the TiVA database.

The tariff data is taken from the World Bank's World Integrated Trade Solution (WITS) database, aggregated from the product to sector level using trade-weighted averaging. The tariff data is only available for goods, and so the value of tariffs for all service sectors is set to zero. The other trade cost variables—distance, colonial history, contiguity, common language, and free trade agreements—are from Head, Mayer, and Riess (2010) and Head and Mayer (2014) of the CEPII. In robustness exercises where non-tariff measures (NTMs) are used, data is taken from the UNCTAD TRAINS database. There are many missing values for NTMs at the sector level, which are assumed to be zero.

3.2 PROXYING MULTILATERAL RESISTANCE TERMS (MRTS)

Finding appropriate proxies for the multilateral resistance terms is one of the various econometric issues that arises in empirical implementations of the gravity model (see Larch et al. 2016 for detailed discussion). Much of the literature employs time-varying exporter and importer fixed effects to capture these terms (Feenstra 2004; Redding and Venables 2004). This approach, however, is not appropriate in our case, since the fixed effects would also absorb all country specific characteristics, including the macroeconomic factors that we seek to identify. We present instead an alternative approach, which follows a two-step procedure.

In the first step, the multilateral resistance term is initially proxied through "remoteness" measures, i.e. bilateral GDP-weighted distances between the country-pairs as in Wei (1996), Baldwin and Harrigan (2011) and Martin et al. (2008)

$$MRT_{it}^{out} = MRT_{it}^{in} = \left[\sum_j \left(\frac{Y_{jt}}{Y_{wt}}\right) \cdot Dist_{ij}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \tag{4}$$

where the trade elasticity ε is set to 3, consistent with most empirical and theoretical literature. Since the distance variable is symmetric, then the first-stage outward and inward MRTs equal each other. Equation (1) is then estimated using proxies (4) and predicted bilateral trade costs $\hat{T}_{ijt}$ are obtained as

$$\hat{T}_{ijt} = \exp\{-[(\hat{\beta}_4\, ln\, Dist_{ij} + \hat{\beta}_5\, Lan_{ij} + \hat{\beta}_6\, Col_{ij} + \hat{\beta}_7\, Bord_{ij} + \hat{\beta}_8\, FTA_{ijt}) \cdot (1 - SM_{ij}) + \hat{\beta}_9 ln(Dist_{ij}) \cdot SM_{ij} + \hat{\beta}_{10}\, SM_{ij} + \hat{\beta}_{11} ln(1 + \tau_{ijst})]/(1 - \varepsilon)\}$$

Second stage MRTs are then constructed as GDP-weighted averages of predicted bilateral trade costs

$$MRT_{jt}^{in} = \left[\sum_i \left(\frac{Y_{jt}}{Y_{wt}}\right) \cdot \hat{T}_{ijt}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \quad (5)$$

$$MRT_{jt}^{out} = \left[\sum_i \left(\frac{Y_{jt}}{Y_{wt}}\right) \cdot \hat{T}_{jit}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} \quad (6)$$

In sectoral regressions, multilateral resistance terms are built in the same way, but using gross sectoral outputs in place of aggregate output as weights.

The main limitation of MRTs based on "remoteness" proxies is their only partial consistency with theory (Head and Mayer 2014). However, our focus on changes over time provides a line of defense against potential misspecifications of MRTs. In particular, consider an alternative (outward or inward) unobservable MRT in country i and sector s of the form $\widehat{MRT}_{ist} = u_{is}MRT_{ist}$, where u_{is} is an unobservable scaling factor that is constant over time. Section 4.1 will make clear that all our main conclusions are unaffected by u_{is}.

3.3 Baseline results

The baseline sectoral specification constrains to unity the coefficients on output and expenditure ($\beta_1 = \beta_2 = 1$), while the coefficients on the multilateral resistance terms are constrained to be equal to each other ($\beta_{12} = \beta_{13}$). These assumptions are consistent with typical theoretical foundations of the gravity equation (see Appendix 1 for more details). The coefficients on trade cost proxies are allowed to differ between tradable and non-tradeable sectors. The model is estimated using pseudo Poisson maximum likelihood (PPML) as in Silva and Tenreyro (2006). Our time period *t* is five-year averages over the sample 1995-2015 for a total of five non overlapping cross sections.

Table 1 reports results for the sectoral model that estimates equation (2) on the 5-year average panel. Column (1) uses the first stage MRTs defined in (4). Column (2) is our baseline specification, which uses second stage MRTs of equations (5)-(6). Estimates of critical coefficients, such as the elasticities of exports to bilateral tariffs, distance and MRTs, are in line with the literature (see Bacchetta et al. 2012 and Larch et al. 2016).[6] Note that, as expected, trade costs are notably larger for trade in services than trade in goods.

The remaining columns provide various robustness exercises. In column (3) we estimate the model with no constrains on the coefficients on the MRTs. While the coefficient on the outward multilateral resistance term is about one and a half times the magnitude of that on the inward term, all the other coefficients in the regression are largely unchanged. In column (4) we estimate a completely unconstrained version of the model. In this case, the magnitude of the coefficients on some of the bilateral trade cost variables differs significantly from the

[6] The estimated elasticity of exports to tariffs, which according to theoretical models should equal to $1 - \varepsilon$ (see Larch et al. 2016 and Caliendo and Parro 2015), is approximately consistent with the assumption that $\varepsilon = 3$ used in the construction of MRTs.

baseline, but the results are qualitatively consistent. Finally, in column (5) we estimate our baseline model but include non-tariff measures as an additional explanatory variable.[7]

For comparison, Table 2 reports estimates for the country-level model as specified in equation (1). Results are generally consistent with those at the sector level. The last column of the table presents a specification with country-pair fixed effects, which absorb all our time-invariant bilateral proxies in addition to any bilateral characteristics that were previously omitted. This approach addresses the potential presence of omitted variables and concerns of endogeneity of trade policy variables (Baier and Bergstrand 2007). Again, all (remaining) coefficients are broadly stable. Finally, the results for the different specifications are robust to estimating the gravity model over repeated cross-sections, suggesting that structural changes in the global economy over the period considered did not alter significantly the empirical validity of our estimated parameters.[8]

3.4 Levels of bilateral trade balances: evaluating the fit

Tables 1 and 2 show that our baseline gravity models fit observed bilateral export flows quite well. But does the model also fit the observed level of bilateral trade balances well? To answer this question, we regress actual bilateral balances TB_{ijt} against their corresponding baseline predicted values $\widehat{TB}_{ijt} = \hat{X}_{ijt} - \hat{X}_{jit}$.

The results obtained using predicted value from the aggregate baseline gravity of Table 2 are reported in Table 3 and are consistent with the results obtained from the sectoral gravity regression (see Appendix 3).[9] The gravity model explains the levels of trade balances less well than it explains unidirectional export flows. The R-squared falls from 99 percent in column (2) of Table 2 to only 31 percent in column (2) of Table 3. This is consistent with the long-established observation that bilateral trade balances are more difficult to predict than bilateral exports (see Davis and Weinstein, 2002).

However, as shown in columns (3) and (5), a high fit for the bilateral trade balances is achieved when the gravity estimation includes country-pair fixed effects, with the R-squared increasing again to around 95 percent. This indicates that our gravity variables do not capture completely all the bilateral factors that are constant over time and that contribute to shaping trade costs. This is the crucial observation that motivates our decision to focus on a decomposition of *changes* in bilateral trade balances.

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[7] Appendix 2 provides additional robustness exercises for the baseline model estimated in the cross-section at 5-year intervals. Results are broadly consistent with those in Table 1. Except for the estimated coefficient on tariffs becoming insignificant in the first period, the coefficient estimates are very stable in the cross-section, suggesting that estimating the model in a panel should not bias the results in any particular direction.

[8] Results are available upon request.

9 We show the goodness of fit with the country-level results because in this specification we are able to include country-pair fixed effects. Appendix 3 reports the goodness of fit for the sectoral specification.

Table 1. Gravity Model: Sector Level, 5-year Average Panel

	(1)	(2)	(3)	(4)	(5)
Dependent Variable			*Gross bilateral exports*		
Model	Constrained, MRT-distance	Constrained, MRT-cost	Partially constrained	Unconstrained	Constrained, NTM
Non-Service					
$LN(Distance_{ij})\cdot(1-SM_{ij})$	-1.08***	-0.93***	-0.93***	-0.50***	-0.93***
	(0.06)	(0.05)	(0.05)	(0.07)	(0.05)
$Border_{ij}\cdot(1-SM_{ij})$	-0.35**	-0.35**	-0.33**	0.64***	-0.36**
	(0.15)	(0.16)	(0.16)	(0.17)	(0.16)
$Language_{ij}\cdot(1-SM_{ij})$	0.05	-0.11	-0.10	0.32***	-0.11
	(0.17)	(0.21)	(0.20)	(0.12)	(0.21)
$Colony_{ij}\cdot(1-SM_{ij})$	0.91**	1.08***	1.09***	0.08	1.08***
	(0.39)	(0.42)	(0.40)	(0.17)	(0.42)
$FTA_{ijst}\cdot(1-SM_{ij})$	0.55***	0.60***	0.58***	0.14	0.60***
	(0.11)	(0.10)	(0.10)	(0.13)	(0.10)
$LN(Distance_{ij})\cdot SM_{ij}$	-1.83***	-1.75***	-1.75***	-0.40***	-1.75***
	(0.09)	(0.06)	(0.06)	(0.08)	(0.06)
Service	-1.18***	-1.04***	-1.05***	-0.61***	-1.05***
$LN(Distance_{ij})\cdot(1-SM_{ij})$	(0.06)	(0.05)	(0.05)	(0.07)	(0.05)
	-0.83***	-1.07***	-1.06***	0.14	-1.07***
$Border_{ij}\cdot(1-SM_{ij})$	(0.21)	(0.27)	(0.28)	(0.15)	(0.27)
	0.37**	0.26	0.26	0.61***	0.26
$Language_{ij}\cdot(1-SM_{ij})$	(0.17)	(0.20)	(0.21)	(0.10)	(0.20)
	1.95***	2.22***	2.18***	0.71***	2.22***
$Colony_{ij}\cdot(1-SM_{ij})$	(0.30)	(0.33)	(0.32)	(0.19)	(0.33)
	0.15	0.18*	0.19*	-0.21*	0.18*
$FTA_{ijst}\cdot(1-SM_{ij})$	(0.11)	(0.10)	(0.10)	(0.12)	(0.10)
	-1.82***	-1.74***	-1.74***	-0.39***	-1.74***
$LN(Distance_{ij})\cdot SM_{ij}$	(0.09)	(0.06)	(0.06)	(0.08)	(0.06)
	-1.92***	-1.77***	-2.26***	-1.86***	-1.83***
All sectors	(0.41)	(0.40)	(0.41)	(0.41)	(0.41)
$LN(1+Tariff_{ijst})$	-0.95***	-1.00***	-1.01***	-0.26***	-1.01***
	(0.06)	(0.03)	(0.03)	(0.05)	(0.03)
$LN(World\ Gross\ Output_{T})$	1	1	1	0.68***	1
	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)
$LN(Gross\ Output_{ist})$	1	1	1	0.58***	1
	(0.00)	(0.00)	(0.00)	(0.03)	(0.00)
$LN(Gross\ Expenditure\_{jst})$	6.67***	7.47***	7.47***	3.15***	7.47***
	(0.62)	(0.53)	(0.51)	(0.68)	(0.53)
SM_{ij}	0.93***				
	(0.04)				
$LN(MRT_{ist}^{Distance})$	0.93***				
	(0.04)				
$LN(MRTj_{st}^{Distance})$		1.02***	0.75***	0.07	1.02***
		(0.02)	(0.06)	(0.06)	(0.02)
$LN(MRT_{ist})$		1.02***	1.29***	0.41***	1.02***
		(0.02)	(0.06)	(0.07)	(0.02)
$LN(MRT_{jst})$					-0.02
					(0.02)
Constant	-6.79***	-1.44***	-1.43***	-1.80***	-1.36**
	(0.92)	(0.54)	(0.53)	(0.57)	(0.53)
Observations	475,567	474,933	474,933	474,933	474,933
R-squared	0.947	0.962	0.962	0.984	0.963

*** p<0.01, ** p<0.05, * p<0.1

Note: Clustered (country-pair) standard errors in parenthese. Coefficients are interacted with dummy variables for services/non-services if they are within those sections, coefficients under *all sectors* are not interacted.

Table 2. Gravity Model: Country Level, 5-year Average Panel

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	Gross bilateral exports				
	Constrained Model			Unconstrained Model	
Model	MRT-Distance	MRT-Cost	Country-Pair FE	MRT-Cost	Country-Pair FE
$LN(Distance_{ij})\cdot(1-SM_{ij})$	-1.08***	-0.96***		-0.52***	
	(0.07)	(0.06)		(0.07)	
$Border_{ij}\cdot(1-SM_{ij})$	-0.45***	-0.54***		0.49***	
	(0.15)	(0.18)		(0.16)	
$Language_{ij}\cdot(1-SM_{ij})$	0.09	-0.08		0.34***	
	(0.17)	(0.22)		(0.09)	
$Colony_{ij}\cdot(1-SM_{ij})$	1.50***	1.71***		0.41***	
	(0.33)	(0.38)		(0.15)	
$FTA_{ijst}\cdot(1-SM_{ij})$	0.27***	0.29***	0.13***	-0.08	0.04
	(0.11)	(0.11)	(0.04)	(0.13)	(0.04)
$LN(Distance_{ij})\cdot SM_{ij}$	-1.80***	-1.75***		-0.42***	
	(0.11)	(0.07)		(0.09)	
$LN(1+Tariff_{ijst})$	-5.40***	-5.36***	-4.21***	-4.56***	-4.20***
	(1.19)	(1.14)	(0.54)	(1.05)	(0.29)
$LN(World\ Gross\ Output_{T})$	-0.96***	-1.03***	-1.07***	-0.29***	-0.08**
	(0.07)	(0.02)	(0.03)	(0.05)	(0.04)
$LN(Gross\ Output_{ist})$	1.00	1.00	1.00	0.62***	0.90***
	(0.00)	(0.00)	(0.00)	(0.03)	(0.05)
$LN(Gross\ Expenditure_{jst})$	1.00	1.00	1.00	0.66***	0.16***
	(0.00)	(0.00)	(0.00)	(0.03)	(0.03)
SM_{ij}	6.72***	7.55***		3.40***	0.04
	(0.63)	(0.57)		(0.68)	(0.24)
$LN(MRT_{ist}^{Distance})$	0.92***				
	(0.07)				
$LN(MRTj_{st}^{Distance})$	0.92***				
	(0.07)				
$LN(MRT_{ist})$		1.07***	1.08***	0.18***	0.81***
		(0.03)	(0.10)	(0.06)	(0.12)
$LN(MRT_{jst})$		1.07***	1.21***	0.35***	-0.76***
		(0.03)	(0.12)	(0.07)	(0.09)
Constant	-6.86***	-1.25**		-1.90***	
	(1.01)	(0.56)		(0.57)	
Observations	15,560	15,560	15,552	15,560	15,554
R-squared	0.969	0.986	0.999	0.996	1.000
Country -pair FE	NO	NO	YES	NO	YES

*** p<0.01, ** p<0.05, * p<0.1

Note: Clustered (country-pair) standard errors in parenthese

TABLE 3. TRADE BALANCE FIT: COUNTRY LEVEL, 5-YEAR AVERAGE PANEL

	(1)	(2)	(3)	(4)	(5)
Dependent variable	*Actual Trade Balance*				
Predicted trade balance, constrained model with distance-MRT	0.80***				
	(0.21)				
Predicted trade balance, constrained model with cost-MRT		0.97***			
		(0.19)			
Predicted trade balance, constrained model with country-pair FE			1.00***		
			(0.029)		
Predicted trade balance, unconstrained model with cost-MRT				2.29***	
				(0.30)	
Predicted trade balance, unconstrained model with country-pair FE					0.99***
					(0.034)
Constant	0	0	0	0	0
	(0.04)	(0.04)	(0.01)	(0.04)	(0.01)
Observations	15,282	15,282	15,282	15,282	15,282
R-squared	0.260	0.314	0.931	0.286	0.921
R-squared, subsample of largest bilateral balances	0.429	0.449	0.953	0.454	0.939

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4. CHANGES IN BILATERAL TRADE BALANCES: FIT AND DECOMPOSITION

4.1 Analytical decomposition

In this section we generalize the characterization of bilateral trade balances and show how their change over time can be decomposed using a log linear approximation. To achieve this, we abandon the additional assumptions behind the derivation of (3) and we allow for a general environment where bilateral trade costs and MRTs may be asymmetric. We also move away from the aggregate gravity equation (1) and concentrate on the more detailed sectoral model (2). The sectoral model allows us to investigate the importance of the sectoral composition of supply and demand in driving bilateral trade balances.

To approximate the change in bilateral balances we first note that the predicted sectoral bilateral trade balance can be written as $\widehat{TB}_{ijst} = \hat{X}_{ijst} - \hat{X}_{jist}$, where $\widehat{X_s}$ represents bilateral exports in sector s predicted by the sectoral gravity regression. Then, we consider the following approximation,

$$\Delta\widehat{TB}_{ijst} \approx \Delta \ln\left(\hat{X}_{ijst}\right) \cdot X_{ijst-1} - \Delta \ln\left(\hat{X}_{jist}\right) \cdot X_{jist-1} \tag{7}$$

Changes in predicted aggregate bilateral trade balances are then calculated as

$$\Delta\widehat{TB}_{ijt} = \sum_s \Delta\widehat{TB}_{ijst} \quad (8)$$

The choice of focusing on *changes* rather than *levels* of bilateral trade balances was discussed at length in Section 3.4 and is motivated by the fact that the likely presence of time-invariant unobserved trade cost makes it difficult to use the gravity equation to predict levels of bilateral trade balances. This issue is however inconsequential when we focus on trade balances changes over tome.[10] Equation (7) is an approximate relation because growth rates of bilateral exports are replaced by changes in log bilateral exports. While this choice produces an approximation error, it is nonetheless convenient because it leads to a linearization of the exponential form of the gravity equation.[11]

Using the estimated coefficients from the gravity regression, equation (7) can be further specified in terms of the drivers of bilateral exports,

$$\Delta\widehat{TB}_{ijst} \approx \Delta\widehat{NS}_{ist} + \Delta\widehat{ND}_{jst} + \Delta\widehat{W}_{st} + \Delta\widehat{SC}_{ist} - \Delta\widehat{SC}_{jst} + \Delta\widehat{MC}_{ist} - \Delta\widehat{MC}_{jst} + \Delta\widehat{BC}_{ijst} \quad (9)$$

Changes in net supply ($\Delta\widehat{NS}$), net demand ($\Delta\widehat{ND}$), world output ($\Delta\widehat{W}$), sectoral composition ($\Delta\widehat{SC}$), multilateral cost ($\Delta\widehat{MC}$), and bilateral cost ($\Delta\widehat{BC}$) terms are defined by[12]

$$\Delta\widehat{NS}_{ist} = \hat{\beta}_1 X_{ijst-1} \Delta \ln(Y_{it}) - \hat{\beta}_2 X_{jist-1} \Delta \ln(E_{it})$$

$$\Delta\widehat{ND}_{jst} = \hat{\beta}_2 X_{ijst} \quad \Delta \ln(E_{jt}) - \hat{\beta}_1 X_{jist-1} \Delta \ln(Y_{jt})$$

$$\Delta\widehat{W}_{ijst} = \hat{\beta}_3 TB_{ijst-1} \Delta \ln(Y_{wt})$$

$$\Delta\widehat{SC}_{ist} = \left[\hat{\beta}_2 \Delta \ln(\alpha^E_{ist}) - \hat{\beta}_1 \Delta \ln(\alpha^Y_{ist})\right] X_{jist-}$$

$$\Delta\widehat{SC}_{jst} = \left[\hat{\beta}_2 \Delta \ln(\alpha^E_{jst}) - \hat{\beta}_1 \Delta \ln(\alpha^Y_{jst})\right] X_{ijst-1}$$

$$\Delta\widehat{MC}_{ist} = \hat{\beta}_{12}\left[X_{ijst-1} \Delta\ln\left(MRT^{out}_{ist}\right) - X_{jist-1} \Delta\ln\left(MRT^{in}_{ist}\right)\right]$$

$$\Delta\widehat{MC}_{jst} = \hat{\beta}_{13}\left[X_{jis} \quad \Delta\ln\left(MRT^{out}_{jst}\right) - X_{ijst} \quad \Delta\ln\left(MRT^{in}_{jst}\right)\right]$$

[10] Notice that once $\hat{X}_{ijst}$ is broken down into its multiplicative components, then any (multiplicative) bilateral fixed effect in the representation of $\hat{X}_{ijst}$ would cancel out in the calculation of the $\Delta \ln(\hat{X}_{ijst})$ in (7). It follows that the only remaining way for a missing bilateral fixed effect to influence the decompositions (7)-(8) is through its impact on the *level* of lagged bilateral exports, which operate as initial weights for all time-differenced variables in (7). We address this potential issue is by calculating (7) using actual (instead of predicted) lagged bilateral exports X_{ijs} .

[11] The log-difference is approximately equal to the growth rate for relatively small changes - less than 10 percent, as a rule-of-thumb. About 90 percent of the observed changes in the sample variables are within this threshold.

[12] Notice that the construction of $\Delta\widehat{MC}_{ist}$ in (5) would be unaffected by any constant (multiplicative) u_{is} scaling factor in the construction of the MRTs (see Section 3.2).

$$\Delta\widehat{BC}_{ijst} = \hat{\beta}_{11}\left[X_{ijst-1}\,\Delta\ln\left(1+\tau_{ijst}\right) - X_{jist-}\;\Delta\ln\left(1+\tau_{jist}\right)\right] + \hat{\beta}_{8}TB_{ijst-}\;\Delta\mathrm{FTA}_{\mathrm{ijt}}$$

where sectoral gross spending and output shares are defined, respectively, as $\alpha_{is}^{E} = \frac{E_{is}}{E_i}$ and $\alpha_{is}^{Y} = \frac{Y_{is}}{Y_i}$ and the interpretation of the estimated coefficients $\hat{\beta}$ was provided in equation (2).

Finally, summing (9) across sectors as in (8), we obtain an approximate decomposition of the predicted change of bilateral trade balances into changes in macro factors and in bilateral trade costs:

$$\Delta\widehat{TB}_{ijt} \approx \underbrace{\Delta\widehat{NS}_{it} + \Delta\widehat{ND}_{jt} + \Delta\widehat{W}_{st} + \Delta\widehat{SC}_{it} - \Delta\widehat{SC}_{jt} + \Delta\widehat{MC}_{it} - \Delta\widehat{MC}_{jt}}_{change\ in\ macro\ factors\ M_i,\ M_j,\ M_w} + \underbrace{\Delta\widehat{BC}_{ijt}}_{change\ in\ T_{ij}} \qquad (10)$$

Two points are worth noting. The first is that the construction of bilateral trade balances starting from sectoral data allows us to build a macro index $\Delta SC_{it} = \sum_s \Delta SC_{ist}$ of sectoral change, whose contribution to changes in trade balances is quantified separately. Second, if we disregard the sectoral composition index, equation (10) is a linearized version of (3) expressed in changes over time, where changes in "trade biases" are represented by the last three terms of the equation.

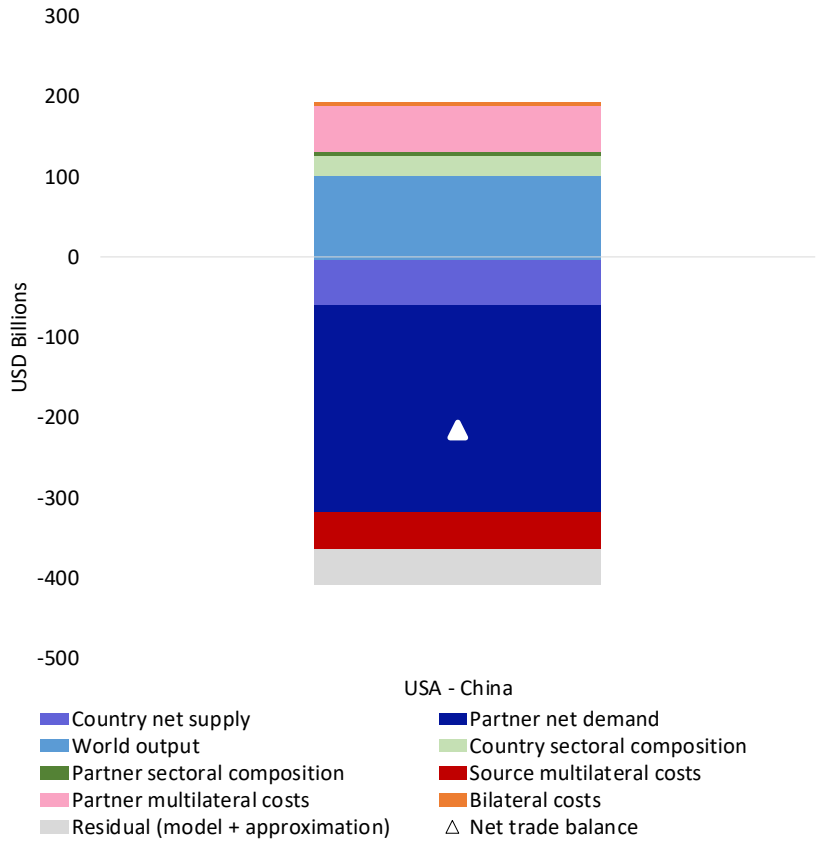
4.2 Empirical results

If the reason the gravity model cannot fit well the *level* of bilateral balances (Section 3.4) is because of the existence of time invariant unobserved trade biases, then a regression of *changes* in actual trade balances on the predicted change (10) should yield a high fit. We run such regression separately, and we find that this is indeed the case. Specifically, the R-squared of actual versus predicted changes in bilateral balances is 82 percent, with a point estimate of 0.82 (standard deviation 0.003) for the regression slope.[13]

After establishing the good fit of our predicted changes in bilateral balances, we are ready to discuss their determinants. Based on equation (10), Figure 2 and 3 present a decomposition of the largest (negative) changes in bilateral trade balances since 1995. Figure 2 focuses on the US-China relation, while Figure 3 present the remaining 30 largest changes in bilateral trade balances. The figures also include the combined size of the statistical and the log-linear approximation error. The contributions are calculated using the estimated $\hat{\beta}$ from the baseline sectoral specification in column (2) of Table 1. The main takeaway from Figures 2 and 3 is that macro factors have been by far the most important drivers of bilateral trade balances. Changes in bilateral trade costs, which include tariffs, have played only a very minor role. This reflects in part the fact that tariffs were already low in the mid-1990s in many countries

[13] At the sectoral level, there are two potential sources of discrepancy between actual and predicted changes in trade balances in (7). The first is a statistical error in the prediction of $\Delta\ln\hat{X}_{ijst}$ and $\Delta\ln X_{ijst}$. The second is the approximation error stemming from the fact that $\Delta\widehat{TB}_{ijst}$ is derived as a log-linear approximation. To correctly quantify the statistical fitness of our model we thus need to neutralize the influence of the approximation error. To this end, for each sector we construct an approximate log-linear change in the actual trade balance obtained by plugging into (7) the actual value $\Delta\ln X_{ijst}$ in place of the predicted $\Delta\ln\hat{X}_{ijst}$. Approximated actual and predicted changes in sectoral trade balances are then aggregated up across sectors. A regression is then run between the two resulting variables.

Figure 2. Contributions to Changes in Bilateral Trade Balance Since 1995, US-China

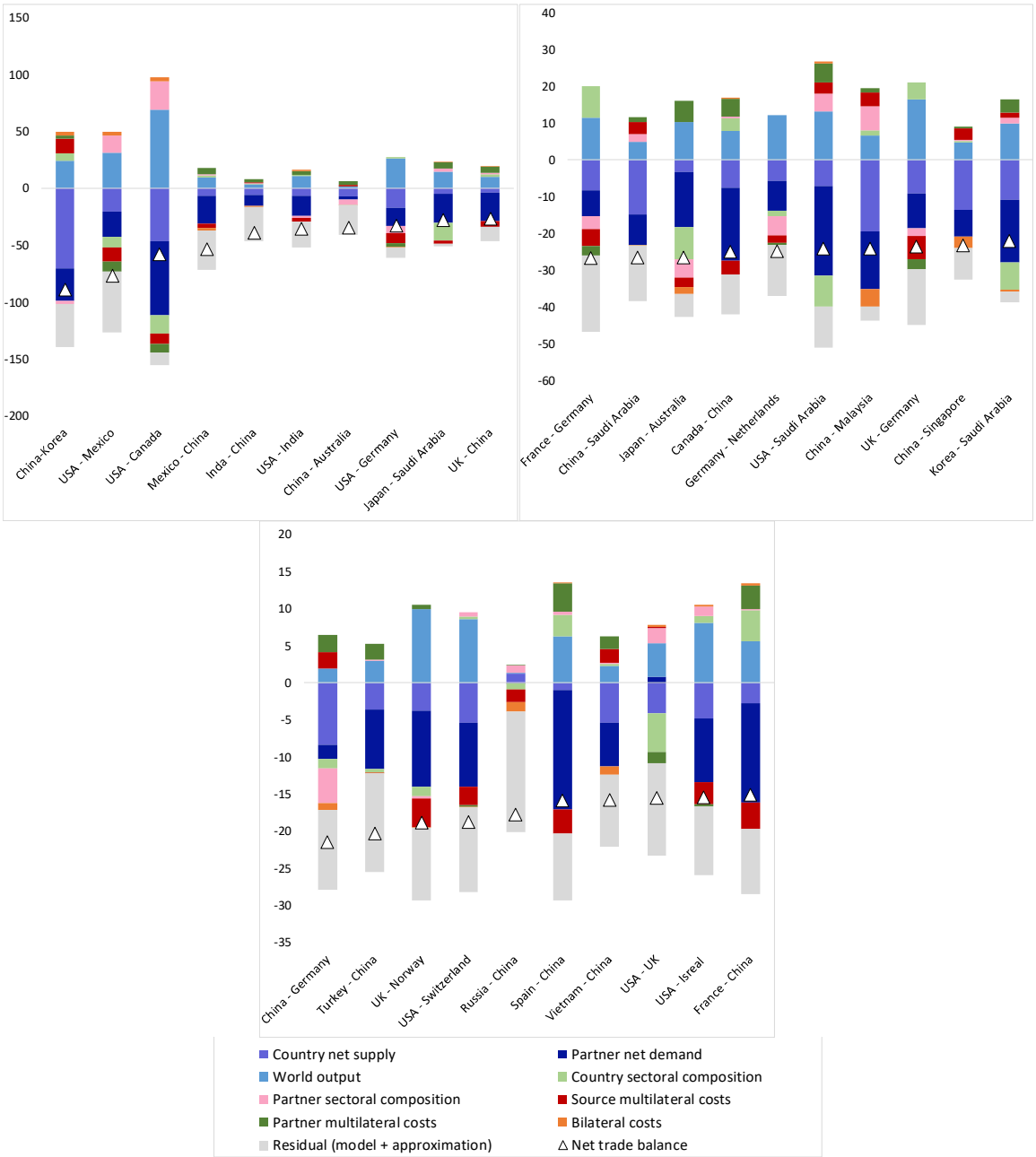


Note: the figures report the average value 2010-15 minus the average value 1995-99. The residual is the sum of the model's statistical error plus the log-linearization approximation error. The "source" is the exporting country (USA) and the "partner" is the importing country (China).

and that tariff reductions were often reciprocal, with offsetting effects on bilateral trade balances.

Within the group of macro factors, changes in countries' net demand and supply played the lion's share. These drivers are in turn affected by the structural characteristics of the economies, such as productivity growth or demography, but they are also influenced directly by macroeconomic policies. Returning to the US-China example, we can see changes in the US net supply contributed negatively to the US trade balance with China, reflecting the fact that during the period considered the US demand for goods from the rest of the world grew more than its supply. In addition, changes to China's net demand also contributed negatively to the bilateral balance, since during the period China's exports to the rest of the world grew more than its imports.

Figure 3. Contributions to Changes in Bilateral Trade Balance Since 1995,
Next Largest Bilateral Trade Balances



Note: the figures report the average value 2010-15 minus the average value 1995-99 The residual is the sum of the model residuals plus the approximation error. The "source" is the exporting country (first in the label) and the "partner" is the importing country (second in the label).

The contribution of changes in the sectoral composition of countries' demand and supply are generally moderate but significant in various cases. A positive contribution of the change in sectoral composition indicates that the output share of sectors where a country featured initial large exports rose more than its corresponding spending share. Alternatively, the spending share of sectors where the country initially featured high imports fell more than the corresponding output share.[14]

Finally, the contribution of changes in multilateral resistance factors are non-negligible but not very large in general. In the case of the US-China trade balance, the two contributions cancel out in the net. This, together with a negligible contribution from the change in bilateral trade costs, implies that changes in the two countries' bilateral trade bias had essentially no impact on the change of their bilateral trade balance. This explains why, even when constructed with a constant trade bias, the predicted bilateral trade balance in Figure 1 closely tracks the actual one.

5. CONCLUSIONS

This paper re-examines the argument behind the irrelevance of bilateral trade balances for the conduct of macroeconomic policy. The common wisdom among economists is that aggregate trade balances are the variable of interest for the conduct of macroeconomic policy. Bilateral balances are merely a by-product, the way in which aggregate imbalances are divided across trading partners according to bilateral trading costs.

We presented a study of the determinants of bilateral trade balances based on the gravity model of international trade. In doing so, we first established that the well-known difficulty of the gravity model in providing a fit for bilateral trade balances is likely due to the omission of unobservable, time invariant components of bilateral trade costs. Consequently, we showed that our gravity estimates are successful in fitting the change over time in bilateral balances. We therefore constructed a log-linear approximation that allowed us to decompose changes in bilateral trade balances into underlying changes in macro factors, i.e. variables not specific to a given trade relation, and in bilateral trade costs. We found that macroeconomic factors, and especially the evolution of countries' aggregate demand and supply, are by far the main determinants of changes in bilateral trade balances. In contrast, changes in bilateral trade cost play a very minor role. The finding that bilateral trade balances are by and large driven by the same macro factors that determine aggregate trade balances provides new evidence of the practical irrelevance of bilateral trade balances in the conduct of macroeconomic policy.

[14] For a discussion of the relationship between sectoral specialization, asymmetric trade costs across sectors, and external balances, see Barattieri (2014), Joy et al. (2018), and Boz et al. (2019).

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APPENDIX 1

This appendix derives the relation between bilateral and aggregate trade balances presented in equation (3). A typical theoretical gravity model with empirical specification (1) takes the following form (see Larch and others 2016):

$$X_{ij} = \frac{Y_i E_j}{Y_w}\left(\frac{\tau_{ij}}{\Pi_i P_j}\right)^{1-\varepsilon}$$

where τ_{ij} represents bilateral trade costs and Π_i and P_j are the theoretical MRTs. Note that this specification motivates the coefficient restrictions imposed in the baseline regressions in Table 1 and Table 2. The outward MRT (Π_i) is an average of all the tariffs faced in the global market by the exporting country. The inward MRT (P_j) captures instead the overall tariff that the importing country imposes on the rest of the world. More precisely,

$$\Pi_i = \left[\sum\nolimits_j \theta_j \left(\frac{\tau_{ij}}{P_j}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$$

$$\mathrm{P}_j = \left[\sum\nolimits_i \theta_i \left(\frac{\tau_{ij}}{\Pi_i}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$$

The coefficient $\theta_i = y_i/y_w$ represents the share of country i's nominal output in world's output. This representation employs the approximations that countries' output shares in world output are close to the countries' spending shares in world spending, which implies that countries' aggregate trade balances are close zero.

If Y is taken to be GDP and spending E is domestic absorption, then $E_j = Y_j - TB_j$. In addition, if we assume that $\tau_{ij} = \tau_{ji}$, i.e. trade costs are symmetric, it follows that $\Pi_i = \mathrm{P}_i$. The gravity equation can then be rewritten as,

$$\frac{X_{ij}}{Y_i Y_j / Y_W} = \sigma_{ij}\left(1 - \frac{TB_j}{\mathrm{Y}_j}\right)$$

The trade bias σ between i and j is a function of bilateral trade costs and the multilateral resistance terms. It is straightforward to verify that under the assumption of symmetric trade costs, trade biases are symmetric as well, i.e. $\sigma_{ij} = \sigma_{ji}$. Computing the quantity above also for X_{ji} and taking differences yields equation (3).

APPENDIX 2

Table A2.1. Gravity Model: Cross-Section Robustness

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	*Gross bilateral exports*				
Model:	Constrained, MRT Cost				
Cross section year:	1995	2000	2005	2010	2015
Non-Service					
$LN(Distance_{ij})\cdot(1-SM_{ij})$	-0.85***	-0.78***	-0.92***	-0.93***	-0.86***
	(0.07)	(0.07)	(0.06)	(0.06)	(0.07)
$Border_{ij}\cdot(1-SM_{ij})$	-0.28**	-0.33**	-0.29*	-0.37**	-0.56**
	(0.12)	(0.15)	(0.16)	(0.18)	(0.26)
$Language_{ij}\cdot(1-SM_{ij})$	-0.10	-0.12	-0.28	-0.08	-0.02
	(0.22)	(0.19)	(0.22)	(0.22)	(0.23)
$Colony_{ij}\cdot(1-SM_{ij})$	1.64***	1.45**	1.42***	1.02**	1.02**
	(0.48)	(0.57)	(0.41)	(0.48)	(0.41)
$FTA_{ijst}\cdot(1-SM_{ij})$	0.78***	0.67***	0.38***	0.50***	0.54***
	(0.12)	(0.15)	(0.12)	(0.11)	(0.14)
$LN(Distance_{ij})\cdot SM_{ij}$	-1.74***	-1.76***	-1.77***	-1.70***	-1.79***
	(0.07)	(0.07)	(0.07)	(0.06)	(0.04)
Service					
$LN(Distance_{ij})\cdot(1-SM_{ij})$	-0.94***	-0.90***	-1.04***	-1.05***	-0.95***
	(0.07)	(0.07)	(0.06)	(0.06)	(0.07)
$Border_{ij}\cdot(1-SM_{ij})$	-0.72***	-0.88***	-1.01***	-1.18***	-1.14***
	(0.23)	(0.26)	(0.28)	(0.29)	(0.30)
$Language_{ij}\cdot(1-SM_{ij})$	0.01	0.08	0.11	0.29	0.27
	(0.23)	(0.20)	(0.21)	(0.20)	(0.21)
$Colony_{ij}\cdot(1-SM_{ij})$	2.07***	2.39***	2.23***	2.38***	2.24***
	(0.38)	(0.36)	(0.33)	(0.35)	(0.42)
$FTA_{ijst}\cdot(1-SM_{ij})$	0.12	0.18	0.01	0.17	0.46***
	(0.14)	(0.16)	(0.13)	(0.11)	(0.12)
$LN(Distance_{ij})\cdot SM_{ij}$	-1.74***	-1.76***	-1.77***	-1.69***	-1.77***
	(0.07)	(0.06)	(0.07)	(0.06)	(0.04)
All sectors					
$LN(1+Tariff_{ijst})$	-0.02	-2.90***	-3.79***	-1.95***	-1.44***
	(0.41)	(0.67)	(0.54)	(0.60)	(0.48)
$LN(Gross\ Output_{ist})$	1.00	1.00	1.00	1.00	1.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LN(Gross Expenditure_$_{jst}$)	1.00	1.00	1.00	1.00	1.00
	(0.00)	(0.02)	(0.02)	(0.02)	(0.02)
SM_{ij}	1.01***	1.01***	1.03***	1.01***	1.01***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
$LN(MRT_{ist})$	1.01***	1.01***	1.03***	1.01***	1.01***
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
$LN(MRT_{jst})$	8.23***	8.53***	7.45***	7.12***	8.43***
	(0.65)	(0.71)	(0.62)	(0.56)	(0.62)
Constant	-12.57***	-12.68***	-13.01***	-13.12***	-13.21***
	(0.56)	(0.65)	(0.54)	(0.51)	(0.60)
R-Squared	0.964	0.964	0.967	0.959	0.969
Observations	87,436	58,414	68,353	81,076	62,373

*** p<0.01, ** p<0.05, * p<0.1

Note: Clustered (country-pair) standard errors in parenthese. Coefficients are interacted with dummy variables for services/non-services if they are within those sections, coefficients under *all sectors* are not interacted.

APPENDIX 3

Table A3.1. Trade Balance Fit: Sector Level, 5-year Average Panel

	(1)	(2)	(3)	(4)	(5)
Dependent variable			*Actual Trade Balance*		
Predicted trade balance, constrained model with dista	0.94***				
	(0.24)				
Predicted trade balance, constrained model with cost-MRT		1.05***			
		(0.21)			
Predicted trade balance, partially constrained model			1.07***		
			(0.22)		
Predicted trade balance, unconstrained model				-0.09	
				(0.24)	
Predicted trade balance, constrained model with NTMs					1.06***
					(0.22)
Observations	15,876	15,876	15,876	15,876	15,876
R-squared	0.235	0.288	0.269	0.001	0.295
R-squared, subsample of largest bilateral balances	0.330	0.357	0.424	0.003	0.376

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1