Economic Modelling 31 (2013) 684–689

Contents lists available at SciVerse ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

Are distance effects really a puzzle?

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ARTICLE INFO

Article history:
Accepted 10 January 2013

JEL classification:
F10
F40

Keywords:
Distance effect
Year-on-year regression
Trade costs

ABSTRACT

Given the distance proxies for trade costs, the onset of globalization implies that geographical distance would matter less for trade. However, year-on-year regressions of a log-linearized gravity model estimated by the ordinary least squares (OLS) method usually suggest that the negative impact of distance on trade is rising since the 1950s during the late 20th century. These seemingly counter-intuitive results may occur due to the omission of the extensive margin as well as the neglect of the Jensen's inequality. This paper investigates these two potential solutions but that only the second seems to work. After considering Jensen's inequality, the distance effects declined over the period 1950–1999. In addition, this paper proposes a simple theoretical model to identify trade costs. The empirical results also show a declining trend of trade costs over the same time period.

1. Introduction

The negative relationship between bilateral trade and geographical distance is a deep-rooted empirical finding based on the celebrated gravity equation. Distance, which measures trade costs, should matter less for trade over time with the onset of globalization. Owing to the easier transportation of goods and the faster communication of ideas, we should observe the "death of distance" as Cairncross (1997) had proclaimed.

While the death of distance seems sensible in light of globalization, the task of establishing this empirically has proven to be challenging. For instance, Leamer and Levinsohn (1995) first cautioned that contrary to popular notions of globalization, the world was not "getting smaller".[1] Instead, a large body of recent research has documented the existence of the distance puzzle during the late 20th century, where the absolute value of distance coefficients (being negative) in gravity equations are increasing over the period 1950–2000s.[2]

Disdier and Head (2008) employed a meta-analysis to examine 1467 distance effects in 103 papers and found that the negative impact of distance on trade rose around the middle of the 20th century and remained persistently high since then. Mayer (2009) and World Bank (2009) also found that the distance coefficient rose from 1960 to the early 2000s.[3] Against conventional wisdom, Jacks (2009) documented evidence supporting the death of distance in the 19th century, where trade barriers were likely to be prominent. For digital goods, Blum and Goldfarb (2006) found that the large distance effect remained even though these goods were transacted over the Internet. In other words, prima facie evidence suggests that the deepening of globalization is associated with an increasing distance effect.

It should be highlighted that the above studies adopt a similar methodology: they are based on year-on-year cross-country regressions involving the gravity equation, where the slope coefficient on distance is estimated for each year. Though Lin and Nicholas (2012) argued that prima facie evidence from the year-on-year regressions might not be a good indicator of the true impact of distance on trade, the literature overwhelmingly focuses on the year-on-year regressions to explain the puzzle. In this paper, as a complement to the previous work, the author also offers a solution to the puzzle from the perspective of year-on-year regressions.

In the literature, Buch et al. (2004), Brun et al. (2005) and Carrere and Schiff (2005) focus on the measurement issues to explain the puzzle. Buch et al. (2004) argued that if trade costs were a multiple factor of geographical distance, then an increase in trade costs through the multiple would only show up as shifts in the intercept, and not in the distance coefficient, given the logarithmic specification of the regressors in the gravity equation. Brun et al. (2005) included an index of multilateral trade resistance, and added an augmented trade barrier function to correct for the misspecification in using distance to represent transport costs. Carrere and Schiff (2005), on the other hand, developed a

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[1] Coe et al. (2002) argued that the non-declining effect on geographical distance over time should be emphasized as a major puzzle in conjunction with the six major puzzles in international macroeconomics documented by Obstfeld and Rogoff (2000).

[2] In this paper, when we discuss the negative distance coefficients in gravity, we usually refer to the absolute value because the interpretation of the absolute value is consistent with the direction of the negative impact of distance on trade. For instance, when the negative impact of distance on bilateral trade increases, the absolute value of distance coefficient also increases while the value of the distance coefficient (being negative) is decreasing.

[3] See also Berthelon and Freund (2008) and Baier and Bergstrand (2007) for similar findings.

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http://dx.doi.org/10.1016/j.econmod.2013.01.011

new measure of the distance of trade and found that the effect declined over time.

Siliverstovs and Schumacher (2008) and Arribas et al. (2011) offered some insights on the heterogeneity perspective of distance effects. Siliverstovs and Schumacher (2008) found that using disaggregated trade data at the sector level, the distance puzzle largely disappeared. Arribas et al. (2011) also showed that distance varied greatly across countries and, proposed an explanation based on the concept of geographic neutrality. This was used to construct international trade integration indicators under conditions when distance matters and when it does not.

In this paper, our explanation is different from either the measurement perspective done by Buch et al. (2004), Brun et al. (2005) and Carrere and Schiff (2005) or the heterogeneity perspective done by Siliverstovs and Schumacher (2008) and Arribas et al. (2011). The explanation is also different from the perspective of estimating the non log-linearized gravity equation to solve the puzzle, done by Mrquez-Ramos et al. (2007) and Coe et al. (2007). In contrast, the author considers the possible biases in estimating the log-linearized gravity equation by the OLS method and implements new estimation methods to solve the biases.

The first bias is due to the omission of the extensive margin in gravity equation.[4] Helpman, Melitz and Rubinstein (later HMR) (2008) addressed this bias by developing a two-stage procedure to estimate the gravity that used an equation for selection into trade partners in the first stage and an augmented gravity equation in the second. The second bias comes from the neglect of the Jensen's inequality, that is, the expected value of the logarithm is different from the logarithm of its expected value. One important implication of Jensen's inequality is that the standard practice of interpreting the parameters of log-linearized gravities estimated by OLS as elasticity can be highly misleading in the presence of heteroskedasticity, which is more severe under conditions when zero trade flows are common.

Santos Silva and Tenreyro (later SST) (2006) considered this property and proposed a Poisson pseudo-maximum-likelihood (PPML) method which could address the issues in the estimation of log-linearized gravity equations. While HMR (2008) and SST (2006) used cross-section data to show that when using their methods the parameters in gravity largely decreased, they did not study the trend of distance coefficients over time.

Using the HMR and SST approaches, the author shows that the absolute values of the distance coefficients estimated by HMR method, which are also biased because of heteroskedasticity, have been stable (around one) over the period 1950–1999, while the (negative) distance impact estimated by SST method shows a significant declining trend over time, from 0.372 in 1950 to 0.144 in 1999, decreasing by 61.3%. Bosquet and Boulhol (2009) also used the SST approach to investigate the distance effect, and using fewer controls than the current paper, they found that the absolute values of the elasticity had been stable at around 0.65–0.70 since the 1960s.[5]

In order to prove the statement that trade costs lessen over the period 1950–1999, the author proposes a simple theoretical model to identify trade costs. Empirically, the results show that trade costs also abate over the period 1950–1999, decreasing by about 64.1% from 1950 to 1999 quantitatively, which is very similar with the declining distance effect estimated by SST method. Therefore, when zero trade flows are common, the SST approach is a reliable method to solve the distance puzzle.

[4] HMR (2008) showed that using traditional method, the sample selection was also omitted and most of the bias was due not to selection but rather due to the omission of the extensive margin.

[5] In the cross-section case, besides distance, only contiguity, language, one colony relationship and country fixed effects are controlled in the gravity, which is presented in Table 1 of their paper. The other determinants besides distance in the gravity model in this paper will be introduced in more detail in Section 2.

The remainder of the paper is structured as follows. In Section 2, we replicate the pseudo distance effect puzzle. Section 3 discusses the bias and uses HMR and SST methods to re-estimate the distance effect over the period 1950–1999. In Section 4, the author presents a simple theoretical model to identify trade costs. Section 5 concludes the paper.

2. The pseudo distance effect puzzle

The author first replicates the distance puzzle in the estimation of the log-linearized gravity equation by the OLS method year-on-year. The gravity equation models bilateral trade flows on the exporting and importing countries' characteristics and the symmetric variables such as distance, border, language and others between country pairs. Generally, it is expressed as:

$$\log\left(trade_{ij}\right) = \gamma \log\left(Distance_{ij}\right) + \beta' z_{ij} + \delta_i + \delta_j + v_{ij}. \quad (1)$$

The dependent variable is the log of bilateral trade flows between countries i and j, which are obtained by averaging all four possible measures of flows, namely exports from country i to j, imports into j to i, exports from j to i, and imports into i from j. z_{ij} are other control variables which include symmetric variables such as GDP of partners, GDP per capita of partners, language, border, landlocked countries dummy, island, colony related effects, currency union, and an indicator for regional trade agreements (RTA) and WTO accessions. The two sets of country fixed effects are given by δ_i and δ_j, and the idiosyncratic unobservable term v_{ij} is a white noise process.[6] The main variable of interest is the log of geographical distance.

The data is taken from Rose (2004), which covers bilateral trade for more than 175 countries spanning from 1950 to 1999. Trade volume is dominated in millions of US dollars. The standard gravity equation does not contain a time index as it is estimated using cross-sectional information. By estimating the gravity equation year-on-year using the OLS method over the period 1950–1999, but with 5-year intervals, the trend in the distance coefficient can be obtained.

Before we discuss the coefficient of greatest interest to us in more detail, the author briefly discusses the other determinants of trade flows, which are included in the regressions as appropriate but not reported (to economize on the space in the paper). The gravity model seems to work well. It delivers precisely estimated coefficients that are sensible and similar to those estimated by others. Results significantly show that the size of the economy, having the same language, with the same border, RTA, currency union and colony relations will positively affect bilateral trade. Landlocked and island characteristics seem to negatively affect bilateral trade. WTO accession variables mostly lose their significance, some get negative estimators and only a small proportion of estimators are statistically positive.[7] While these results are not of direct interest to us, they do reassure us that our estimates are grounded in a statistical conditioning model that delivers sensible and significant results.

The left of Fig. 1 shows the evolution of the distance coefficient estimated by Eq. (1) using bi-directional positive trade flows. The distance coefficient was initially stable from the 1950s to 1960s, but the absolute value increased precipitously in late 1960s and continued on this upward trajectory into the 1990s (negative coefficient actually decreased). Because bilateral trade variable are obtained by averaging all four possible measures of flows, the skeptical readers may argue

[6] Anderson and van Wincoop (2003) and Feenstra (2004) suggested that the theory-motivated gravity equation should include the “multilateral (price) resistance terms” in typical gravity equation and such price terms could be generated by using countries' fixed effects.

[7] Rose (2004) found that the WTO had no effect on promoting bilateral trade. This paper uses Rose (2004) data, and the findings are consistent with his findings.