MANAGEMENT THEORY

ESTIMATING BULGARIA'S TRADE BORDERS WITH THE EU AN APPLICATION OF THE EMPIRICAL GRAVITY MODEL OF TRADE

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Abstract: We use the empirical gravity model of international trade to evaluate the borders in manufacturing trade between Bulgaria and the European Union (BG-EU). Our results suggest that in 2006 the BG-EU border was quite large and not statistically different from the average border in our sample of 69 countries. As expected, our estimates confirm that the trade border between Bulgaria and the EU members was very large, and much larger than the average sample border, before the collapse of communism. The border fell sharply in the early to mid-90s, but it followed the average sample trend since then. We also document weak asymmetries in the BG-EU border in favor of EU exports to Bulgaria. Our results point to a series of extensions and further analysis.
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Introduction

At the end of the twentieth century the world witnessed a significant shift in the international trade patterns in Europe. The Council for Mutual Economic Assistance (Comecon) slowly dissolved and its individual member-states had to find their new place on the foreign trade map via negotiating bilateral agreements or joining preexisting trade blocks. Bulgaria was one of the founding members of Comecon and its foreign trade was directed predominantly towards the other countries in the Council. In 1989 Bulgaria abolished the communist ideology with hopes for fast transition from central planning to free market economy. International trade was expected to be a key factor in the transition and a driving force for economic growth and the restructuring of the national economy toward an efficient and competitive market system. The rapid liberalization of the Bulgarian foreign trade did not bring the expected results. The European commission recognized Bulgaria as a "functioning market economy" as late as October, 2002. Bulgaria struggled to find new trade partners in the Western Europe, while losing its eastern markets due to political divide former allies, poor trade specialization and misallocated production resources during the communist era and lack of experience in the international markets.

In this study we use the gravity model of trade, which has established itself as the workhorse model for trade analysis[4], in order to evaluate the evolution of the border effect in trade between Bulgaria and European Union member-states. To obtain our estimates and to perform the accompanying analysis, we use a data set covering international manufacturing trade among 69 countries over the period 1986 to 2006. The long time span of our sample covers three different and important periods from the economic history of Bulgaria. Specifically, our sample covers the Communist era – until 1989, the Transition period –1990-2002, and the initial free market economy period – 2002-2006. An important advantage of our dataset, which enables us to robustly identify the key border relationships of interest in our study, is that the sample includes

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[4] cf. **Anderson**, J.E. The Gravity Model. // *Annual Review of Economics*, 2011, Vol. 3, pp. 133–160.

consistently constructed intra-national and international trade data. Availability of gross production data for manufacturing predetermined the sample coverage.

Overall, our results are as expected. However, we also uncover some insightful patterns that point to potential policy failures and to directions, where future policy efforts could be devoted. In sum, we document the following results (in chronological order). First, not surprisingly, we find that in the Comecon era the trade border between Bulgaria and the EU was substantially higher than the sample average, possibly reflecting the influence of the "iron curtain". Second, we find that during the very early stages of the Bulgarian transition toward a market economy, the BG-EU border was still significantly ticker than the average border in the sample. Consistent with Cheng and Wall[5], our explanation for this result is that international trade needed time in order to adjust to policy changes.

Third, we document a sharp drop in the BG-EU border in the mid-90s. The natural explanation for this result is that in 1993 Bulgaria signed with the EU the Europe Agreement and the Provisional Agreement on Trade and Related Matters, establishing a free trade zone between the EU and Bulgaria.[6] Given these developments and trade-liberalization efforts, the large increase in Bulgarian trade with the EU is an expected, but also remarkable (in terms of magnitude) result. An optimistic interpretation of our results so far is that the change in the political regime and the opening of the borders to the west indeed lead to a tremendous increase in trade between Bulgaria and the EU countries. Fourth, our estimates reveal mild (not statistically significant, but always in the same direction) asymmetries in the BG-EU border in favor of EU exports to Bulgarian and against Bulgarian exports to the EU. A possible explanation for this result is that EU producers were more efficient and better adapted to compete in a market economy setting.

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[5] **Cheng,** I-H., Wall, H. Controlling for Heterogeneity in Gravity Models of Trade and Integration. // *Federal Reserve Bank of St. Louis Review*, 2005, Vol. 87(1), pp. 49–63.

[6] These agreements came into force in 1995, and in the same year Bulgaria applied for membership in the Union. In 1996 Bulgaria became a member of the World Trade Organization.

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Fifth, and unfortunately, we obtain insignificant estimates of the change in the effects of the international BG-EU borders for all years during the period 1998-2006. We do note that we observe a small decrease in the magnitude of the BG-EU border over time, however the decrease is not statistically significant. This result applies to all estimates after 1994, including the estimate for 2006, which is the EU pre-accession year for Bulgaria. Our post-1994 estimates suggest that the border between Bulgaria and the EU members has fallen at the average rate for the sample during the period 1998-2006. This result is somewhat unexpected and unfortunate, and it points to a failure of the EU pre-accession efforts in Bulgaria to liberalize trade in the early and mid-2000s, when Bulgaria signed the Treaty for Accession into the EU in 2005.[7] At the same time, on a positive note, this finding implies that Bulgaria's accession to EU in 2007 had a significant potential in terms of liberalizing trade.

The remainder of the paper is organized as follows. In section 1 we review the empirical gravity model of trade.[8] In section 2 we evaluate the average border effect across the sample and the trade border between Bulgaria and European Union for the year 2006, which is the latest year in our sample and, coincidentally, the pre-accession year for Bulgaria's membership in the EU. In section 3 we adopt a panel approach in order to evaluate the evolution of the trade border effect from 1986 to 2006. Finally, the conclusions section offers remarks and points to potentially interesting directions for future work.

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[7] Specifically, actual negotiations for accession in the EU started in 1999 and this allowed Bulgaria to became a member of the Central European Free Trade Agreement, which included only countries that have signed association agreements with the EU. The accession negotiations concluded in 2004 and the Treaty for Accession was signed in 2005 and came into force in January 1, 2007.

[8] Our analysis adopts some of the recommendations of Piermartini and Yotov 2016, who review the challenges with gravity estimations and their solutions, and synthesize best estimation practices. We also refer the interested reader to Baldwin and Taglioni 2006 and Head and Mayer 2014 for excellent surveys of the empirical gravity literature.

1. A Brief Review of the Empirical Gravity Model

This section offers a brief review of the empirical gravity model. It also sets the econometric specification for our analysis and briefly describes the data. The gravity model is the workhorse model in international trade[9]. As summarized in Piermartini and Yotov[10], "Hundreds s of papers have used the gravity equation to study the effects of Geography, Demographics, Preferential Trade Agreements (PTAs), Tariffs, Exports Subsidies, Embargoes, Trade Sanctions, World Trade Organization membership, Currency Unions, Foreign Aid, Immigration, Foreign Direct Investment, Cultural Ties, Trust, Reputation, Mega Sporting Events (Olympic Games and World Cup), Melting Ice Caps, etc. on international trade."

Larch and Yotov[11] attribute the popularity of the gravity model to five key properties. First, the gravity model of trade is very intuitive. We demonstrate this below by comparing the structural gravity model to Newton's Law of Universal Gravitation. Second, the gravity model is a structural model with solid theoretical foundations.[12] Third, the gravity model can simultaneously accommodate multiple countries, multiple sectors, and even firms. Furthermore, it is a general equilibrium framework and, as such, it allows for and can account for the links and ripple effects among the different economic agents in the structural gravity system. Fourth, the gravity framework is a very flexible structure and it can be integrated within a wide class of broader general equilibrium models of the labor markets, investment, the environment, etc. Finally, one of the most attractive properties of the gravity model is its predictive power, which often

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[9] **Anderson,** J.E. 2011. The Gravity Model. // *Annual Review of Economics*, 2011, Vol. 3, pp. 133–160.

[10] **Piermartini**, R., Yotov, Y. Estimating Trade Policy Effects with Structural Gravity. *WTO Working Paper ERSD-2016-10.*, 2016, p. 5.

[11] **Larch, M**., Yotov, Y. General Equilibrium Trade Policy Analysis with Structural Gravity. WTO Working Paper ERSD-2016-08, 2016.

[12] For recent surveys of alternative theoretical foundations of gravity, we refer the reader to Anderson 2011a, Costinot and Rodriguez-Clare 2014, and Larch and Yotov 2016.

varies between 60 and 90 percent with aggregate data[13], as well as with sectoral data for both goods[14] and services[15].

Our main focus in this section will be the empirical gravity equation. Therefore, for the current purposes, the two most important features of the five properties listed above are the intuitive appeal of the gravity model and its remarkable predictive power. To demonstrate the former, we start with a simple version of the gravity equation of trade, which can be derived from basic economic foundations:[16]

$$(1) \quad X_{ij,t} = G_t \, \frac{Y_{i,t} E_{j,t}}{T_{ij,t}^{\theta}} \, , \quad \forall i, j.$$

Here $X_{ij,t}$ denotes exports from source *i* to destination *j* at time *t*; $T_{ij,t}^{\theta}$ denotes the trade frictions between *i* and *j*. Gravity theory suggests that the trade cost term $T_{ij,t}^{\theta}$ consists of three interrelated components, which include bilateral trade costs, e.g. distance, contiguity, regional trade agreements, etc.; and two general equilibrium (GE) terms that capture overall remoteness on the importer and on the exporter side.[17] Below we

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[13] **Head**, K., Mayer, T. Gravity Equations: Workhorse, Toolkit, and Cookbook. Chapter 3 in the Handbook of International Economics Vol. 4, eds. Gita Gopinath, Elhanan Helpman, and Kenneth S. Rogoff, Elsevier Ltd., Oxford, 2014; **Larch,** M., Yotov, Y. Op. Cit., 2016.

[14] **Anderson,** J.E., Yotov, Y. Specialization: Pro- and Anti-Globalizing, 1990-2002. *NBER Working Paper No. 16301*, 2010*b*.

[15] **Anderson,** J.E., Borchert, I., Mattoo, A., Yotov, Y. Modeling Services Trade, Trade Costs, Borders and Output. *Manuscript,* 2015; **Aichele,** R., Felbermayr, G.J., Heiland, I. Going Deep: The Trade and Welfare Effects of TTIP. *CESifo Working Paper No. 5150*, 2014.

[16] Anderson 1979 is the 'father' of the gravity theory of trade. Later on Anderson and van Wincoop 2003 popularize the original work of Anderson by presenting an appealing and intuitive structural gravity model of trade. Eaton and Kortum 2002 famously derive gravity on the supply side. We refer the reader to Larch and Yotov 2016 for a derivation of equation 1 and for a demonstration that the same equation can be derived from the demand side, i.e. *a la* Anderson and vanWincoop 2003 and from the supply side, i.e. *a la* Eaton and Kortum 2002.

[17] The intuition for the GE terms is that bilateral trade between two partners depends not only on the trade costs between them, but also on how far away they are

discuss how the frictions $T_{ij,t}^{\theta}$ are modeled in practice; $Y_{i,t}$ denotes the size of the exporter as measured by its value of output. $E_{j,t}$ denotes expenditure in the importer country. Finally, G_t is a gravity constant whose structural interpretation is as the inverse of the value of world output at time *t*.

Note the remarkable similarities between equation (1) and Newton's Law of Universal Gravitation,

$$(2) \qquad F_{ij} = G \; \frac{m_i m_j}{d_{ij}^2} \; , \; \forall i,j$$

which states that the gravitational force between two objects (the trade flow between two countries) is directly proportional to the product of their masses (the product of their sizes) and inversely proportional to the square of distance (a power transform of the trade frictions) between them. We refer the reader to Anderson [18], Costinot and Rodriguez-Clare[19], and Larch and Yotov[20] for derivations and discussions of the theoretical foundations of the structural gravity model. Instead, here we focus on translating specification (1) into an econometric model, which we will use to define our specific estimating equation.

Two simple steps translate equation (1) into an estimating specification: First, log-linearize equation (1) and introduce an additive error term:

$$(3) \qquad lnX_{ij,t} = lnG_t + lnY_{i,t} + lnE_{j,t} - \theta lnT_{ij,t} + \epsilon_{ij,t}$$

from all other potential trading partners. Anderson and van Wincoop 2003 famously label these terms 'multilateral resistances' (MRs). Anderson and Yotov 2010 add to the interpretation of the MRs by demonstrating that they decompose the incidence of trade costs on the consumers and on the producers in each country. Below, we will account for those GE terms econometrically with exporter-time and importer-time fixed effects.

[18] **Anderson,** J.E. The Gravity Model. // Annual Review of Economics, 2011, Vol. 3, pp. 133–160.

[19] **Costinot,** A., Rodríguez-Clare, A. Trade Theory with Numbers: Quantifying the Consequences of Globalization. Chapter 4 in the Handbook of International Economics Vol. 4, eds. Gita Gopinath, Elhanan Helpman, and Kenneth S. Rogoff, Elsevier Ltd., Oxford, 2014.

[20] **Larch**, M., Yotov, Y. General Equilibrium Trade Policy Analysis with Structural Gravity. WTO Working Paper ERSD-2016-08, 2016

The second step, which will complete our econometric specification is to proxy for the bilateral trade cost term $\theta ln T_{ij,t}$. In order to do this, and keeping in mind our goal of estimating the effects of national borders, we adopt the specification of Anderson et. al.[21], which distinguishes between the effects of geography (captured by distance and contiguity) vs. all other impediments to trade (captured by a dummy variable for international borders):

$$(4) \quad \theta ln T_{ij,t} = \beta_1 \, ln DIST_{ij} + \beta_2 \, CNTG_{ij} + \sum_{t=1986}^{2006} \beta_t \, BRDR_{ij,t} + \pi_{i,t} + \chi_{j,t}$$

Here, $ln DIST_{ij}$ is the logarithm of bilateral distance between trading partners i and j, and $CNTG_{ij}$ is an indicator variable, which takes a value of one if i and j share a common border, and it is equal to zero otherwise. Data on our distance and contiguity covariates come from the CEPII distances data base.[22] The next term, $\sum_{t=1986}^{2006} \beta_t \beta BRDR_{ij,t}$, consists of a series of border dummy variables, which take a value of one for international trade and are equal to zero for domestic sales.[23] Following the specification from Anderson et. al 2015, we do not take a specific stand on what is behind the borders in trade. Importantly, (i) our specification distinguishes between geography vs. all other impediments to trade, and (ii) our econometric treatment avoids any endogeneity concerns, since each border variable is just an exogenous indicator variable (by construction). The variation in the estimates of the border variables over time will enable us to capture the effects of globalization on trade, as well

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[21] **Anderson,** J.E., Borchert, I., Mattoo, A., Yotov, Y. Modeling Services Trade, Trade Costs, Borders and Output. Manuscript, 2015.

[22] An advantage of the CEPII data is that distance is constructed as population weighted average, which allows for consistent use and interpretation of the effects of internal vs. international distance. See Mayer and Zignago 2011 for further details.

[23] The inclusion of domestic sales in gravity estimations is theoretically consistent and adds a series of advantages to gravity estimations. See Piermartini and Yotov 2016 for further details.

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as the evolution of the BG-EU border. Finally, the terms $\pi_{i,t}$ and $x_{j,t}$ denote a series of exporter-time and importer-time fixed effects, respectively, which will account for the multilateral remoteness of each trading partner.[24]

To complete the econometric specification, substitute the definition of bilateral trade costs from specification (4) into equation (3):

$$(5)\; lnX_{ij,t} = \; \beta_1 lnDIST_{ij} + \; \beta_2 CNTG_{ij} + \; \sum_{t=1986}^{2006} \beta_t BRDR_{ij,t} + \; \pi_{i,t} + \chi_{j,t} + \epsilon_{ij,t}$$

Note that the exporter-time and the importer-time fixed effects have absorbed exporter output and import expenditure, which are of the same dimensions as the fixed effects, respectively, as well as the gravity constant, which only varies over time.

We address three final econometric concerns before we move to estimation and to presenting our results.[25] Specifically, as demonstrated by Santos Silva and Tenreyro[26], heteroskedasticity renders OLS gravity not only biased but inconsistent. In addition, log-linerazing throws all the information contained in zero trade flows away. In order to account for these issues, we follow the recommendation of Santos Silva and Tenreyro and we estimate the gravity model in multiplicative form with the Poisson Pseudo Maximum Likelihood (PPML):

$$(6)\; X_{ij,t} = \; exp\left[\beta_1 lnDIST_{ij} + \; \beta_2 CNTG_{ij} + \; \sum_{t=1986}^{2006} \beta_t BRDR_{ij,t} + \pi_{i,t} + \chi_{j,t}\right] + \tilde{\epsilon}_{ij,t}$$

Finally, in order to address the critique of Cheng and Wall[27] that panel gravity estimations should not be obtained with data over consecutive years, in order to obtain our results we use data over 4-year intervals, i.e. we employ in our estimations only data for the years 1986,

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[24] We refer the reader to Anderson and vanWincoop 2003 for theoretical motivation of these terms.
[25] Piermartini and Yotov 2016 offer a detailed discussion of all major estimation challenges with gravity equations.
[26] **Santos Silva,** J.M.C., Tenreyro, S. The Log of Gravity. // *Review of Economics and Statistics*, 2006, Vol. 88(4), pp. 641–658.
[27] **Cheng,** I-H., Wall, H.J. Controlling for Heterogeneity in Gravity Models of Trade and Integration. // *Federal Reserve Bank of St. Louis Review*, 2005, Vol. 87(1), pp. 49–63.

1990, 1994, 1998, 2002, and 2006. In the following section, we estimate various versions of specification (6) with bilateral trade data covering internal and international manufacturing flows over the period 1986-2006.[28] Availability of intra-national trade flows, constructed as the difference between gross manufacturing output (from UNIDO's *IndStat* database) and total exports (from UN's COMTRADE database) predetermined the coverage of our sample.

2. On the Pre-accession BG-EU Borders in Trade

In this section we evaluate the effects of the Bulgarian trade borders with the European Union in 2006, which is the year prior to the accession of Bulgaria to the EU. Our results are reported in Table 1. Column (1) of the table reproduces the results from Anderson, Larch and Yotov[29], which are based on the following cross-section version of specification (6):

$$(7) \quad X_{ij} = exp\left[\beta_1 lnDIST_{ij} + \beta_2 CNTG_{ij} + \beta_3 BRDR_{ij} + \pi_i + \chi_j\right] + \tilde{\epsilon}_{ij,t}$$

Two main findings stand out from the estimates in this column. First, the estimates of the coefficients on the standard gravity variables in our model are readily comparable to those from the literature. See Head and Mayer[30] for representative gravity estimates obtained from a meta-analysis based on 159 papers. Specifically, we obtain a large, negative and significant effect of distance on bilateral trade, which suggests that distance is a strong impediment to international trade. The estimate of the coefficient on *ln_DIST*, which is a continuous variable, should be interpreted as

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[28] These data were constructed and kindly provided by Tom Zylkin.

[29] **Anderson**, J., Larch, M., Yotov, Y. Estimating General Equilibrium Trade Policy Effects: GE PPML. *CESifo Working Paper No. 5592*, 2015

[30] **Head,** K., Mayer, T. Gravity Equations: Workhorse, Toolkit, and Cookbook. Chapter 3 in the Handbook of International Economics Vol. 4, eds. Gita Gopinath, Elhanan Helpman, and Kenneth S. Rogoff, Elsevier Ltd., Oxford, 2014; Larch, M., Yotov, Y. Op. Cit., 2016.

elasticity. Thus, according to our estimates, a 10 percent increase in distance should be associated with about 8 percent decrease in international trade. Countries that share a common border trade more with each other. This is captured by the large, positive and significant estimate of the effect of *CNTG*. All else equal, two countries that share a common border trade almost 100 percent more with each other. Specifically, $96.2=(e^{0.674}-1)*100$. Second, and more important for the purposes of this study, we obtain a very large estimate of the effect of international borders, which suggests that, even after accounting for the effects of geography, international trade is about 10 times smaller than intra-national trade.

Column (2) of Table 1 introduces an indicator variable that takes a value of one for trade between Bulgaria and the countries in the European Union, and it is equal to zero otherwise.

$$(8) \quad X_{ij} = exp\left[\beta_1 lnDIST_{ij} + \beta_2 CNTG_{ij} + \beta_3 BRDR_{ij} + \beta_4 BG\_EU_{ij} + \pi_i + \chi_j\right] + \tilde{\epsilon}_{ij,t}$$

By construction, the estimate of the new regressor, *BG_EU,* should be interpreted as deviation from the estimate of the effect of the average border, *INTL_BRDR*.[31] The treatment and interpretation of the estimate of *BG_EU* as deviation is also convenient for another reason. Specifically, because we can use the standard error of the estimate to judge whether the trade border between Bulgaria and the EU members is significantly different from the average border across all countries in our sample. The estimate on *BG_EU*, -0.306 (std. err. 0.364) suggests that in 2006 the trade border between Bulgaria and the EU countries was not statistically different from the average border in the sample. Pushing inference to the limit, one may interpret the negative estimate of *BG_EU* as an indicator that the border between Bulgaria and the EU members was actually thicker than the average border in our sample. This is a somewhat alarming result

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[31] This should be the case because *INTL_BRDR* still takes a value of one for trade between Bulgaria and the EU members. Alternatively, we could have set *INTL_BRDR* to be equal to zero for BG-EU trade, and then introduce the new border *BG_EU*. In that case, the estimate of the effect of *BG_EU* would have been -2.779, which is exactly the sum of the two border estimates from column (2) of Table 1.

because, due to various efforts and liberalization measures taken in preparation for the EU accession, e.g. the 1999-2004 negotiations for accession in the EU and the CEFTA membership, by 2006 Bulgaria should have been relatively integrated with the EU already.

Finally, in column (3) of Table 1, we look for asymmetries between the trade border that Bulgaria faces as an exporter to the EU countries and the border that the EU members face as exporters to Bulgaria. To capture such effects, we introduce the dummy variables *BG_EXP_EU*, which takes a value of one for Bulgarian exports to EU, and it is equal to zero otherwise, and *BG_IMP_EU*, which takes a value of one for Bulgarian imports form the EU (or equivalently, EU exports to Bulgaria), and it is equal to zero otherwise. Our econometric specification becomes:

$$(9)\ X_{ij} = exp\left[\beta_1 lnDIST_{ij} + \beta_2 CNTG_{ij} + \beta_3 BRDR_{ij}\right] \times$$
$$exp\left[\beta_4 BG\_EXP\_EU_{ij} + \beta_4 BG\_IMP\_EU_{ij} + \pi_i + \chi_j\right] + \check{\epsilon}_{ij,t}$$

Three main findings stand out from the estimates in column (3) of Table 1. First, we find that neither of the two new regressors in column (3) are statistically significant. This means that the borders that Bulgaria faces for exports to and for imports from the EU countries are not statistically different from the average border in our sample. Second, even though the estimates of the export and of the import borders are not statistically different form each other, we see that the estimate on *BG_EXP_EU* is larger in magnitude as compared to the estimate *BG_IMP_EU*. This suggests that Bulgaria faces a higher border for exports to EU as compared to the border that the EU countries face for exports to Bulgaria. It should be emphasized, however, that the two estimates are not statistically different from each other.

Finally, once again, we note that both of the border estimates for Bulgaria's trade with EU in column (3) of Table 1 are negative. This suggests that Bulgaria's borders on trade with EU are larger than the average for the sample, even though not significantly so. The fact that, on the verge of its accession to the EU, Bulgaria's borders with the European Union member countries were about the same as the average borders in

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our sample points to two interesting questions. Did the BG-EU borders fall after the collapse of communism? And, did the borders fall further after Bulgaria became an EU member? Our sample, which covers the period 1986-2006 does not allow us to study and answer the second question. However, it is well suited to answer the first question. We do so in the next section.

3. On the Evolution of Bulgaria's Trade Borders with EU

In this section we study the evolution of the trade borders between Bulgaria and the European Union over the period 1986-2006. Our experiments follow the format of the specifications from Table 1. However, this time, we use panel data and we allow for time-varying border effects. We impose constancy of the effects of geography, as captured here by distance and contiguity.[32] However, we do allow for the effects of all international borders to vary over time, and this variation is the main object of interest in this section. Results for the evolution of borders are reported in Table 2.

We start, in column (1), with a specification that obtains estimates of the evolution of the average border effects in our sample, after controlling for the effects of geography.

$$(10) \quad X_{ij,t} = exp\left[\beta_1 lnDIST_{ij} + \beta_2 CNTG_{ij} + \sum_{t=1986}^{2006}\beta_t BRDR_{ij,t} + \pi_{i,t} + \chi_{j,t}\right] + \tilde{\epsilon}_{ij,t}$$

We note first, that the effects of distance and contiguity are very similar to the estimates that we obtained and reported in Table 1. This suggests that imposing constancy on the effects of geography may not be

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[32] Estimates available upon request reveal that the results presented here remain valid even when we allow for the effects of distance and contiguity to vary over time. This is consistent with the results from Bergstrand, Larch and Yotov 2015.

such a strong restriction after all.[33] More importantly, we note that the estimates of the effects of international borders have fallen significantly over the period of investigation. Globalization forces, i.e. improvements in communication and technology, are natural candidates to explain this result. Consistent with the estimates from Yotov[34], this result reveals that the empirical gravity model can indeed capture the effects of globalization.[35]

In column (2) of Table 2 we introduce a series of indicator variables that capture the evolution of the border between Bulgaria and the EU in each year of our sample.

$$(11) \quad X_{ij,t} = exp\left[\beta_1 lnDIST_{ij} + \beta_2 CNTG_{ij} + \sum_{t=1986}^{2006}\beta_t BRDR_{ij,t}\right] \times$$
$$exp\left[\sum_{t=1986}^{2006}\tilde{\beta}_t BG\_EU_{ij,t} + \pi_{i,t} + \chi_{j,t}\right] + \tilde{\epsilon}_{ij,t}$$

The results are interesting and intuitive. First, we note that the estimates of the border between Bulgaria and the EU countries was very large in 1986. The estimate on *BG_EU_*1986 is almost two-thirds larger than the average international border among the countries in our sample, *INTL_BRDR_*1986, in the same year. Communism and the presence of the "iron curtain" are natural candidates to explain this result. Second, we find that during very early stages of the transition toward a market economy in Bulgaria, the BG-EU border was still significantly ticker than the average

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[33] We do note that the effect of contiguity is a bit larger in Table 2. However, the estimates on *CNTG* in the corresponding specifications from tables 1 and 2 are not significantly different from each other.

[34] **Yotov,** Y. A Simple Solution to the Distance Puzzle in International Trade. // *Economics Letters*, 2012, Vol. 117(3), pp. 794–798

[35] Coe et. Al. 2002 describe the inability of empirical gravity models to capture the effects of globalization as the "missing globalization puzzle". Disdier and Head 2008 use meta-analysis to document steady estimates of the distance effects over a long period of time. This result is known as "the distance puzzle in trade". Yotov 2012 demonstrates that the distance puzzle disappears once gravity is estimated with intra-national trade flows. Bergstrand, Larch and Yotov 2015 generalize Yotov's idea to also resolve the "missing globalization puzzle".

border in the sample. The interpretation of this finding is that international trade needed time in order to just to the changes.[36]

This result changes in 1994, when the estimate on *BG_EU_*1994 loses statistical significance and drops significantly in magnitude. Trade between Bulgaria and the EU in the first few years after the collapse of communism increase significantly, by more than 300 percent. A natural explanation for this finding is that in 1993 Bulgaria signed with the EU the Europe Agreement and the Provisional Agreement on Trade and Related Matters, establishing a free trade zone between the EU and Bulgaria.[37] Given these efforts, the large increase in Bulgarian trade with the EU is an expected, but also remarkable (in terms of magnitude) result. The change in the political regime and the opening of the borders to the west lead to a tremendous increase in trade between Bulgaria and the EU countries.

Finally, and unfortunately, we obtain insignificant estimates of the effects of the international BG-EU borders for all years after 1994. It is true that the estimates decrease in magnitude, i.e. the borders seem to become smaller, however these decreases are not statistically significant. This result suggests that the border between Bulgaria and the EU members has fallen at the average rate for the sample during the period 1994-2006, which is unexpected given the developments in Bulgaria's foreign policy during this period. Specifically, actual negotiations for accession in the EU started in 1999 and this allowed Bulgaria to became a member of the Central European Free Trade Agreement, which included only countries that have signed association agreements with the EU. The accession negotiations concluded in 2004 and the Treaty for Accession was signed in 2005 and came into force in January 1, 2007. Our results imply that these efforts have not paid off in terms of decreasing the BG-EU borders and opening to trade.

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[36] Bulgaria started its trade liberalization with the political reforms of 1989–1991, which abolished the communist rule with the adoption of the new Bulgarian Constitution of 1991. In 1991 The Council for Mutual Economic Assistance was disbanded and its members were forced to search for new export destinations in the free market.

[37] These agreements came into force in 1995, and in the same year Bulgaria applied for membership in the Union. In 1996 Bulgaria became a member of the World Trade Organization.

Finally, in column (3) of Table 2, we look for asymmetries in the evolution of the border effects for Bulgarian exports to and imports from the EU countries.

$$(12) \quad X_{ij,t} = exp\Big[\beta_1 \, lnDIST_{ij} + \beta_2 \, CNTG_{ij} + \sum_{t=1986}^{2006} \beta_t BRDR_{ij,t} + \sum_{t=1986}^{2006} \breve{\beta}_t BG_{EXP_{EU_{ij,t}}}\Big] \times exp\Big[\sum_{t=1986}^{2006} \breve{\breve{\beta}}_t BG\_IMP\_EU_{ij,t} + \pi_{i,t} + \chi_{j,t}\Big] + \breve{\epsilon}_{ij,t}$$

We find the following. First, both Bulgarian imports from the EU and Bulgarian exports to the EU have been subject to significantly larger borders than the average borders in the sample before the collapse of communism. Second, we find that the border effects at that time were significantly asymmetric. Specifically, our estimates suggest that Bulgarian exports to the EU countries faced much larger resistance as compared to Bulgarian imports from the EU members. Third, the border effects remained strong in 1990. Fourth, the borders drop significantly in 1994, possibly reflecting the effects of the Europe Agreement and the Provisional Agreement on Trade and Related Matters. Finally, similar to our estimates of the evolution of the average Bulgarian-EU border from column (2) of Table 2, we find that the directional border estimates (i.e. on exports and on imports) are not statistically significant after 1994. This suggests that after the initial boost following the collapse of communism, the trend in the border effects on Bulgarian exports to and imports from the European Union has followed the average trend for the sample. Pushing inference to the limit, the fact that all BG-EU estimates that we obtain are negative suggests that the BG-EU border has remained larger than the average in the sample throughout the period of investigation.

Conclusions

The objective of this study was to evaluate the effects of the borders between Bulgaria and the EU members on international trade prior to Bulgaria's accession to the union. Our findings suggest that in 2006 the

borders between Bulgaria and the EU were large, but not larger than the average borders in our sample. We also study the evolution of the border effects over time and our main findings are that the borders between Bulgaria and the EU countries were very large before the collapse of communism. Then, they fell sharply in the early 90s. However, after that the borders on trade between Bulgaria and the EU followed the average trend for the sample.

Our results and analysis pose a series of questions for future work. Did the borders between Bulgaria and the former Soviet republic increase after the collapse of communism? If so, by how much? Was the increase in the obstacles to trade between Bulgaria and the former Soviet Union offset by the initial surge in trade with the EU? Have the borders fallen after Bulgaria joined the EU in 2007? Do the effects of borders and their evolution over time vary across sectors? Do the borders vary across the different EU members? What are the implications of the changes in the BG-EU trade borders for the consumers and for the producers in Bulgaria? Where did the additional trade with EU countries come after the collapse of communism? If these trade flows were diverted from trade with the former Soviet Union republics, then is the net effect on Bulgarian trade and welfare positive? We view these questions as valuable directions for further research.

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Tables

Table 1.
Bulgaria's Borders on Trade with EU prior to Entrance, 2006

	(1) BRDR_ALL	(2) BG_EU	(3) EXP_IMP
ln_DIST	-0.791	-0.792	-0.792
	$(0.050)^{**}$	$(0.050)^{**}$	$(0.050)^{**}$
CNTG	0.674	0.672	0.672
	$(0.107)^{**}$	$(0.107)^{**}$	$(0.107)^{**}$
INTL_BRDR	-2.474	-2.473	-2.473
	$(0.119)^{**}$	$(0.119)^{**}$	$(0.119)^{**}$
BG_EU		-0.306	
		(0.364)	
BG_EXP_EU			-0.419
			(0.423)
BG_IMP_EU			-0.213
			(0.378)
N	4761	4761	4761

errors in parentheses

$^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$

Table 2.

On the Evolution of Bulgaria's Trade Borders with the EU,1986-2006

	(1) BRDR_ALL	(2) BG_EU	(3) EXP_IMP
ln_DIST	-0.734	-0.735	-0.735
	$(0.026)^{**}$	$(0.026)^{**}$	$(0.026)^{**}$
CNTG	0.790	0.787	0.787
	$(0.054)^{**}$	$(0.054)^{**}$	$(0.054)^{**}$
INTL_BRDR_1986	-3.409	-3.397	-3.397
	$(0.084)^{**}$	$(0.084)^{**}$	$(0.084)^{**}$
INTL_BRDR_1990	-3.115	-3.109	-3.109
	$(0.082)^{**}$	$(0.082)^{**}$	$(0.082)^{**}$
INTL_BRDR_1994	-2.956	-2.952	-2.952
	$(0.079)^{**}$	$(0.079)^{**}$	$(0.079)^{**}$
INTL_BRDR_1998	-2.748	-2.745	-2.745
	$(0.080)^{**}$	$(0.080)^{**}$	$(0.080)^{**}$
INTL_BRDR_2002	-2.721	-2.718	-2.718
	$(0.079)^{**}$	$(0.078)^{**}$	$(0.078)^{**}$
INTL_BRDR_2006	-2.617	-2.614	-2.614
	$(0.076)^{**}$	$(0.076)^{**}$	$(0.076)^{**}$
BG_EU_1986		-2.026	
		$(0.292)^{**}$	
BG_EU_1990		-2.047	
		$(0.299)^{**}$	
BG_EU_1994		-0.637	
		(0.423)	
BG_EU_1998		-0.622	
		(0.489)	
BG_EU_2002		-0.277	
		(0.459)	
BG_EU_2006		-0.272	
		(0.372)	
BG_EXP_EU_1986			-2.596
			$(0.288)^{**}$
BG_EXP_EU_1990			-2.382
			$(0.327)^{**}$
BG_EXP_EU_1994			-0.740
			$(0.437)^{+}$

BG_EXP_EU_1998			-0.650
			(0.524)
BG_EXP_EU_2002			-0.384
			(0.502)
BG_EXP_EU_2006			-0.387
			(0.431)
BG_IMP_EU_1986			-1.717
			(0.372) **
BG_IMP_EU_1990			-1.802
			(0.375) **
BG_IMP_EU_1994			-0.545
			(0.488)
BG_IMP_EU_1998			-0.597
			(0.531)
BG_IMP_EU_2002			-0.186
			(0.481)
BG_IMP_EU_2006			-0.177
			(0.386)
N	285666	28566	28566

Standard errors in parentheses

$+p < 0.10$, $*$ $p < .05$, $**$ $p < .01$

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