Aggregated vs. Disaggregated Trade Flows and the "Missing Globalization" Puzzle

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April 22, 2008

Abstract

This study analyzes the stability of the distance coefficient values over time in the generalized gravity equation of Bergstrand (1989) using both aggregated and disaggregated trade flows among 22 OECD countries recorded for the sample period covering 1970 until 2000. We estimate the gravity equation both in its traditional form as well as by taking into account multilateral resistance as suggested in Baier and Bergstrand (2006). First of all, we find that the missing globalization puzzle, typically observed in empirical gravity models for aggregated trade flows, largely disappears when one estimates a gravity model using disaggregated trade data at the level of individual industries. Secondly, we document that accounting for multilateral resistance alone can provide some evidence against the missing globalization puzzle. At the same time, the results obtained for traditional specification of the gravity equation emphasizing importance of the disaggregated trade flows in explaining the distance puzzle largely remain intact.

Keywords: Gravity model, missing globalization puzzle, distance coefficient, multilateral resistance

JEL code: F12.

§The paper has benefited from comments by K. A. Kholodilin and by the participants at the seminar at KOF, Zürich, Switzerland, at the 9th Annual Conference of the European Trade Study Group (ETSG), Athens, Greece, at the Macroeconometric Workshop, DIW Berlin, Germany, and at the Spring Meeting of Young Economists (SMYE), Lille, France.

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1 Introduction

The "missing globalization puzzle" or "distance puzzle" is well established in the traditional literature on empirical applications of the gravity model. Coe et al. (2002, 2007) argue that the standard gravity models that are usually estimated in the log-linear form are unable to capture the significant decline in the trade costs brought by globalization of the world economy. In particular, they point out that even so these gravity models based on cross-sectional regressions are able to explain the pattern of international trade relatively well, the magnitude of the estimated distance coefficient remains stable over time. Assuming that namely the magnitude of the distance coefficient serves as a proxy for trade-related costs, the reported stability of the distance coefficient remains a puzzling and counterintuitive result. Coe et al. (2002, p. 3) conclude that "globalization is everywhere but in estimated gravity models". This fact prompts the authors to talk about the "missing globalization puzzle". Thus, they confirm Leamer and Levinsohn (1995) who concluded that, contrary to popular notions of globalization, the world is not "getting smaller".

Indeed, Coe et al. (2007) base their argument on numerous studies (Frankel, Stein, and Wei, 1997; Eichengreen and Irwin, 1998; Helliwell, 1998; Frankel and Rose, 2000; Soloaga and Winters, 2001; Brun, Carrère, Guillaumont, and de Melo, 2005, *inter alia*), where results of the estimated gravity models are compared for different time periods with the typical conclusion that the distance coefficient varies in the interval between -0.5 and -1.0 or higher and, what is more important, its value reveals no tendency to decline over time. Hence, this conclusion on the stability of the distance coefficient seems to be robust across different sample sizes and regression specifications.

There are several theories in the literature that explain the apparent stability of the distance coefficient over time. Coe et al. (2002, p. 6) mention the following four types of explanations of the missing globalization puzzle: "the decline in average costs relative to marginal costs of trade over time; the increased dispersion of economic activity; the changing composition of trade; and the importance of relative rather than absolute costs in determining bilateral trade". Coe et al. (2002) also provide in-depth discussion of the proposed explanations for the missing globalization puzzle. Next, Brun et al. (2005) argue that the observed puzzle may be due to misspecification of the transport cost function in the standard gravity models. Finally, Buch et al. (2004, p. 297) argue that stability typically observable over time in the distance coefficient is not that surprising because "interpretation of distance coefficients as indicators of a change in distance costs is misleading".

Besides the theoretical considerations, there is a number of studies that argue that the problem of zero observations that is inherent in the log-linear estimation approach of the gravity models and, especially, various ad hoc methods used in the literature to solve this problem may have created "the missing globalization puzzle". For example, Coe et al. (2007) suggest to solve the missing globalization puzzle empirically by reconsidering the estimation method of the parameters of the gravity model. In particular, they propose to dispense with the (historically most popular) log-linear form of the gravity equation and to directly consider the nonlinear specification of the gravity equation. Indeed, using the nonlinear specification of the gravity model the authors show that the distance coefficient value shows trendwise decrease over time. At the same time Coe et al. (2007, p. 36) conclude that their results "also confirm that the standard log-linear specification does not yield evidence of globalization". Similarly, Felbermayr and Kohler (2006) show that applying a Tobit estimation of the gravity equation may resolve the distance puzzle. Dissecting trade growth after World War II into growth of already established trade relations and establishing new trade between countries that have not traded with each other in the past they find that distance plays an ever decreasing role over time. This, however, has to be contrasted with the estimation of the gravity model in the log-linear form where such decline in the value of the distance coefficient was not noticeable.

The contribution of this paper is twofold. First, we suggest another explanation to the missing globalization puzzle in the gravity equation. In this respect we would like to point out that Coe et al. (2007) and the rest of the articles cited above estimate the gravity models using aggregated trade data. On the contrary, in our paper we employ the trade flows at different levels of disaggregation: (i) for all products combined, (ii) for agriculture, mining and quarrying, and manufacturing products as a whole as well as (iii) for manufacturing products broken down by 25 three-digit ISIC Rev.2 industries.

For estimation purposes, we employ the generalized gravity model of Bergstrand (1989) which provides a theoretical foundation for the gravity equation applied to disaggregated trade flows. The parameters of the generalized gravity equation are estimated by the OLS method using the yearly data collected for the 22 OECD countries that encompass the time period from 1970 till 2000.

Thus, our first main finding is that in otherwise standardly specified gravity equations estimated using the disaggregated trade flows we find a substantial decline in the value of the distance elasticity for most of the three-digit level manufacturing industries. Our results show that depending on an industry the (absolute) value of the distance elasticity is up to 45 percent smaller in 2000 than 1970. At the same time, our estimation results obtained for the gravity models estimated for all products combined as well as for all manufacturing goods suggest that the (absolute) magnitude of the distance coefficient remains rather stable over time — a standard finding that gave rise to the missing globalization puzzle in the gravity equations.

Moreover, we acknowledge the fact that our first set of the results is based on estimation of the traditional gravity equation, which for almost half a century was a workhorse of the analysis of trade flows. Nevertheless, the recent strand of the trade literature has questioned the validity of specification of the traditional gravity equation. Earlier, Anderson (1979) and Bergstrand (1985), and, later, Anderson and van Wincoop (2003) emphasized the role of theoretically-motivated multilateral price resistance terms in gravity equations and eventually argued that a gravity equation is misspecified as long as the corresponding multilateral price resistance terms are neglected while estimating parameters of the model. Also note that Bergstrand (1989) introduced the price terms in his reduced-form gravity equation specified for the disaggregated trade flows. Therefore, in response to the mounting criticism of the traditional gravity equation we perform a robustness check of our conclusions by estimating the generalized gravity equation of Bergstrand (1989) which explicitly accounts for the price resistance terms. To this end, we employ the recently suggested "*bonus vetus OLS*" approach (see Baier and Bergstrand, 2006). As Baier and Bergstrand (2006) point out, their approach of introducing the price terms into the gravity equation has a number of important advantages over the approach of Anderson and van Wincoop (2003) and that of Feenstra (2002). First, it is based on the standard OLS procedure in contrast to a more cumbersome nonlinear-least-squares estimation method of Anderson and van Wincoop (2003). Second, the approach of Baier and Bergstrand (2006) allows for explicit estimation of the influence of the region-specific variables, e.g., exporter and importer (per capita) incomes, on bilateral trade that otherwise is subsumed in the fixed-effects approach of Feenstra (2002). As shown in Bergstrand (1989), it is important to allow for differentiated (per capita) income elasticities when estimating gravity equations using disaggregated trade data as these can be tentatively used in order to address relative factor intensity of the manufacturing industries as well as to provide a tentative classification of the industries into those that tend to produce luxury versus necessity goods. In addition, as shown in Schumacher and Siliverstovs (2006), the presence and the magnitude of the home-market effect can also be inferred in such gravity equations.

The results of our sensitivity check are twofold. First, introduction of the price terms in the gravity equations seems to provide an evidence against the missing globalization puzzle as the reported distance elasticity declines in the absolute value by about 10% and 17% for the aggregated and for the all manufacturing trade flows, respectively. Second, our results obtained for traditional specification of the gravity equation emphasizing importance of the disaggregated trade flows in explaining the distance puzzle largely remain intact. As the measured relative changes in the value of the distance elasticity for the individual manufacturing industries obtained by these two methods appear to be very similar for all but two industries.

The rest of the paper is organized as follows. Section 2 presents the data used in our study. The model specification is discussed in Section 3. Sections 4 presents the estimation results. The final section concludes.

2 Data

In the empirical analysis, for the dependent variable we employ the annual bilateral trade flows measured by imports of the years from 1970 till 2000 (in US $ million) for all products combined, agriculture, mining and quarrying, manufacturing products as a whole and broken down by 25 three-digit ISIC Rev.2 industries among 22 OECD countries.[1] For this purpose the OECD foreign trade figures are appropriately re-coded from the original SITC categories.

The data on GNP (in US $ million) are taken from World Bank publications. The distance D_{ij} (in miles) between the countries i and j is calculated as the shortest line between their economic centres EC_i and EC_j by latitudinal and longitudinal position.[2] The dummy variables cover: adjacency, Adj_{ij}, membership in a preference area: European Union, EU_{ij}, European Free Trade Agreement, $EFTA_{ij}$, the Free Trade Agreement between EU and EFTA, $EU-EFTA_{ij}$, the North-American Free Trade Agreement, $NAFTA_{ij}$, and Asia-Pacific Economic Co-operation, $APEC_{ij}$, in order to capture effects of regional trade liberalisation, ties by language, Lan_{ij}, and colonial-historical ties, Col_{ij}. The value of the dummy variable is 1, if the two countries i and j have a common land border, belong to the respective preference zone considering the

[1] Member countries in 1993, excluding Iceland and taking Belgium/Luxembourg together.

[2] The national capitals were taken as the economic centre (EC) except for Canada (Montreal), the United States (Kansas City as a geographical compromise between the centres of the East and West Coasts), Australia (Sydney), and West Germany (Frankfurt/Main). The formulae are: $cosD_{ij} = \sin\varphi_i * \sin\varphi_j + \cos\varphi_i * \cos\varphi_j * \cos(\lambda_j - \lambda_i)$ and $D_{ij} = \arccos(\cos D_{ij}) * 3962.07$ miles for $EC_i = (\varphi_i; \lambda_i)$ and $EC_j = (\varphi_j; \lambda_j)$ with φ = latitude, λ = longitude.

changes over time according to membership, or have the same language or historical ties.[3] Otherwise the value of the dummy variables is zero.

3 Model Specification

We conduct our first estimation round using the following traditional specification of the gravity equation:

$$\ln(X_{ij}^a) = \beta_0^a + \beta_1^a \ln(Y_i) + \beta_2^a \ln\left(\frac{Y_i}{P_i}\right) + \beta_3^a \ln(Y_j) + \beta_4^a \ln\left(\frac{Y_j}{P_j}\right) + \beta_5^a \ln D_{ij} + \gamma^{a\prime} DUM_{ij} + \eta_{ij}, \quad (1)$$

where X_{ij}^a denotes the trade flows in the respective ISIC category from a country i to a country j, the variables Y_i and Y_j denote the GNP of the corresponding countries, P_i and P_j are the population of the exporting and importing countries, respectively, and $DUM_{ij} = (Adj_{ij}, EU_{ij}, EFTA_{ij}, EU-EFTA_{ij}, NAFTA_{ij}, APEC_{ij}, Lan_{ij}, Col_{ij})'$ is the vector of dummy variables as defined above in Section 2. Observe that (apart from the omitted price terms) equation (1) could be considered as the reduced form of the generalized gravity equation suggested in Bergstrand (1989), which remains one of the most important studies in the literature that provides a solid theoretical foundation for estimating the gravity equation for trade flows disaggregated by industries. Hence, the per capita income of country i could be considered as a proxy of the capital-labor endowment ratio of the exporting country, whereas the per capita income of country j represents the import demand conditions of the importing country.

In our second estimation round, we reestimate the parameters of the gravity equation by explicitly accounting for the presence of the multilateral (and world) resistance terms as suggested in Baier and Bergstrand (2006). The corresponding specification is as follows:

$$\ln(X_{ij}^a) = \beta_0^a + \beta_1^a \ln(Y_i) + \beta_2^a \ln\left(\frac{Y_i}{P_i}\right) + \beta_3^a \ln(Y_j) + \beta_4^a \ln\left(\frac{Y_j}{P_j}\right) + \beta_5^a \ln D_{ij}^{MWR} + \gamma^{a\prime} DUM_{ij}^{MWR} + \eta_{ij}, \quad (2)$$

where the distance and each of the dummy variables were adjusted for the presence of price terms as suggested in Baier and Bergstrand (2006). For example, the adjusted distance variable looks as follows:

$$\ln D_{ij}^{MWR} = \ln D_{ij} - MWRD_{ij} \quad (3)$$

with

$$MWRD_{ij} = \left[\frac{1}{N}\left(\sum_{j=1}^{N} \ln D_{ij}\right) + \frac{1}{N}\left(\sum_{j=1}^{N} \ln D_{ij}\right) - \frac{1}{N^2}\left(\sum_{i=1}^{N}\sum_{j=1}^{N} \ln D_{ij}\right)\right], \quad (4)$$

where the first term represents the average (log-)distance of an exporting country to all its trading partners, the second term represents the average (log-)distance of an importing country to all its trading partners, and the last term represents the world resistance, i.e., the average (log-)distance among all the trading partners. Similarly, we adjust each of the dummy variables collected in vector DUM_{ij}^{MWR}, e.g., the transformed EU_{ij}

[3] 0.5 for second languages and 0.5 for historical ties until 1914.

dummy is

$$EU_{ij}^{MWR} = EU_{ij} - MWREU_{ij} \tag{5}$$

with

$$MWREU_{ij} = \left[\frac{1}{N} \left(\sum_{j=1}^{N} EU_{ij} \right) + \frac{1}{N} \left(\sum_{j=1}^{N} EU_{ij} \right) - \frac{1}{N^2} \left(\sum_{i=1}^{N} \sum_{j=1}^{N} EU_{ij} \right) \right]. \tag{6}$$

Given the available sample of yearly data that covers the period from 1970 till 2000, we estimate equations (1) and (2) – where for simplicity the time index is omitted – for every year $t = 1970, 1971, ..., 2000$ using the OLS procedure. This gives us a time series of 31 cross-sectional estimates of each coefficient. However, since our main concern is investigation of the missing globalization puzzle, we will focus only on the analysis of the time pattern of the values of the estimated distance coefficient $\widehat{\beta}_5^{a,t}$ for $t = 1970, 1971, ..., 2000$. In sequel, we will refer to the estimation results from equation (1) as "OLS" and from equation (2) as "BV-OLS". The next section presents the estimation results.

4 Results

4.1 Estimated distance coefficient

Table 1 presents the estimated values of the distance coefficients obtained from equations (1) and (2) using the cross-sectional data in the beginning and in the end of the available time period. The columns *initial* and *last* contain the estimate of the distance elasticity in the beginning and in the end of our sample period calculated as an average of the corresponding values obtained for years 1970, 1971, and 1972 and for years 1998, 1999, and 2000, respectively. This is done in order to smooth the year-to-year variation of our estimates. The values reported in columns *absolute change* are the simple difference between values reported in columns *initial* and *last*. Similarly, the values reported in columns *relative change* are the relative difference between the respective columns that was calculated as the ratio of values in column *absolute change* to modulus values (in order to preserve the sign) reported in column *initial*. Hence, if the "missing globalization" phenomenon were present then there would be no noticeable and/or systematic changes in the values of the distance coefficient observed over time and, correspondingly, values reported in columns *absolute change* and *relative change* would be close to zero. At the same time, changes with a positive sign indicate a decreasing trade deterrent role of distance, and changes with a negative sign — an increasing one.

Our discussion of the estimated results unveils as follows. First, we present the results obtained from the traditional gravity equation specification given in equation (1). These results are of its own interest, as they allow us to single out the difference in estimated distance coefficient values that solely can be attributed to the use of the disaggregated vs aggregated trade flows. Second, we investigate the robustness of our results by estimating distance coefficients using the *bonus vetus* OLS approach of Baier and Bergstrand (2006), see Equation (2).

4.2 Aggregated and one-digit level trade flows

First, we present our results obtained for the gravity equation (1) estimated for the aggregated trade flows as well as for the trade flows broken down by one-digit ISIC Rev.2 classification, see the upper-left panel of Table 1.

The first noticeable finding is that when we look at the aggregated trade flows the distance elasticity does not show any sign to decline. On the opposite, our estimation results indicate that its (absolute) values has increased by about 13 % during the period in question. This observation is consistent with the previous literature that gave rise to the missing globalization puzzle. Nevertheless, when we compare the estimates of the distance elasticity in the beginning and in the end of our sample for the trade flows disaggregated at the one-digit level, we observe substantial heterogeneity. As seen, in case of both agriculture and mining and quarrying the estimated distance elasticity tends to increase in absolute value and this increase is much more pronounced than that observed in case of aggregate trade flows. At the same time, for manufacturing products as a whole the value of distance elasticity appears to be rather stable over the period in question. Since the most trade between the OECD countries consists of manufacturing products, this result is also consistent with outcomes of the earlier studies cited above.

From this exercise, it follows that by estimating a gravity equation using only aggregated trade flows one may well overlook the heterogeneous development in the underlying disaggregated trade flows. In the next subsection, we compare estimation results obtained for all manufacturing products and for the manufacturing products broken down by three-digit ISIC Rev.2 industries.

4.3 Manufacturing as a whole and three-digit level trade flows

The lower-left panel of Table 1 presents estimates of the distance elasticity obtained for each manufacturing industry in the beginning and in the end of our sample. The comparison of those values produces a striking contrast to what we observe for all manufacturing products. Only for two industries – textiles (321) and petroleum refineries and products(353-4), we find that the distance elasticity has substantially increased in the absolute value. Next, for seven industries including food, beverages, and tobacco (31), wearing apparel (322), wood and wood products (331), furniture (332), pottery, china, and earthware (361), glass and glass products (362), and iron and steel (371), we find that the estimated distance elasticity does not exhibit strong evidence of change in either direction and hence we conclude that for these industries it remains more or less the same over the observation period.

Finally, for the remaining 16 out of 25 manufacturing industries we find that the reported distance coefficient declined in the range of about 10%–45% when we compare its value in late 1990s-2000 with that in the early 1970s, depending on a particular industry. This finding suggests that the substantial decline of the deterring role of distance observed at the disaggregate level is masked by aggregation. Recall that according to our estimation results obtained for the manufacturing products as a whole, the distance elasticity remained constant.

4.4 Evidence from BV-OLS approach

The right panel of Table 1 presents the estimation results obtained for equation (2). The first and, for our purposes, most important result to be mentioned is that the deterring role of distance appear to decline both for the aggregated trade flows as well as for all manufacturing trade flows. The corresponding absolute values of the distance elasticity is reported to decline by about 10% and 17%, respectively. This contrasts our findings reported earlier for the traditional gravity model specification that omits the multilateral resistance terms and points out to the fact that the persistance of the distance puzzle in the empirical literature, at least partially, could be explained by omission of the multirateral resistance from the estimated models.

The second finding is that the introduction of the multilateral (and world) resistance terms in the gravity equation results in higher values of the estimated distance elasticities. This holds true both for the parameter estimates in the beginning and in the end of our sample. Nevertheless, the relative changes in the values of the distance elasticity estimated for the individual manufacturing industries between the beginning and the end of our sample period is very similar for all but two (323 and 324) industries according to the both estimation methods.

Figure 1 contains the cross plot of relative changes in the values of the distance elasticities obtained by the OLS and the BV-OLS procedures. Apart from two outlying cross points — for leather and leather products (323) and for footwear (324), where discrepancy is largest — the remaining 27 cross points lie rather close to the 45 degrees line. Indeed, the Pearson's correlation coefficient between the two groups of observations is 0.87 (when industries (323) and (324) were excluded) and 0.63 (when all industries were included). In either case, the null hypothesis that the corresponding correlation coefficient is zero could be decisively rejected at the 1% significance level[4].

According to the BV-OLS approach, in the following four industries: textiles (321), footwear (324), petroleum refineries and products(353-4), and pottery, china, and earthware (361), the distance elasticity increased by more than 10% in the absolute value. At the same time for five industries including food, beverages, and tobacco (31), wearing apparel (322), leather and leather products (323), wood and wood products (331), and furniture (332), we find that the estimated distance elasticity does not exhibit strong evidence of change in either direction. For the remaining 16 out of 25 manufacturing industries we find that the reported distance coefficient declined in the range of about 10%–45% when we compare its value in late 1990s-2000 with that in the early 1970s, depending on a particular industry. It is worthwhile emphasizing that out of 16 industries where we observed a substantial decrease in the (absolute) value of the distance elasticity by either method, the *same* 14 industries were selected by both OLS and BV-OLS approaches.

5 Conclusion

In this paper, we suggested an alternative explanation of the missing globalization puzzle typically observable in the gravity equations estimated using aggregated trade flows. First of all we showed, that in when

[4]The Pearson's correlation coefficient and the corresponding p-value of the null hypothesis of zero correlation coefficient were calculated using the routine *cor.test* available in the **R** programming language, see http://cran.r-project.org/

estimating the traditional specification of the gravity equation using aggregated trade flows the estimated values of the distance coefficient show no signs to decline, i.e., the missing globalization puzzle could be also detected in our dataset.

Second, we showed that in the otherwise standard specification of the gravity equation the missing globalization puzzle largely dissolves when one uses disaggregated data. Thus, our first set of results points out that information contained in the disaggregated trade flows can well be lost at the aggregated level.

Third, following the recent trend in the theoretical literature on the gravity equations, we estimated the gravity model by accounting for the presence of the multilateral resistance. To this end, we use the *bonus vetus* OLS approach of Baier and Bergstrand (2006). We find that accounting for the presence of the price terms in the gravity equation alone can provide, at least, some evidence against the missing globalization puzzle. At the same time, our results reported for the disaggregated manufacturing flows on the declining role of distance seems to be largely unaffected by including such multilateral resistance terms in the gravity equation.

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Table 1: Estimated distance coefficient

ISIC	Sector	OLS				BV-OLS			
		initial	last	absolute change	relative change	initial	last	absolute change	relative change
	All products	-0.657	-0.742	-0.085	-0.130	-0.934	-0.844	0.090	0.096
1	Agriculture	-0.538	-0.682	-0.144	-0.267	-1.022	-1.116	-0.094	-0.092
2	Mining, quarrying	-1.142	-1.490	-0.348	-0.305	-1.493	-2.144	-0.651	-0.436
3	Manufacturing	-0.757	-0.754	0.003	0.004	-0.998	-0.824	0.174	0.174
31	Food, beverages, tobacco	-0.460	-0.484	-0.024	-0.052	-0.721	-0.767	-0.046	-0.064
321	Textiles	-0.527	-0.641	-0.114	-0.216	-0.759	-0.881	-0.122	-0.161
322	Wearing apparel	-1.133	-1.164	-0.031	-0.027	-1.382	-1.515	-0.133	-0.096
323	Leather, leather products	-0.970	-0.527	0.444	0.457	-1.137	-1.227	-0.090	-0.079
324	Footwear	-0.901	-0.669	0.232	0.258	-0.966	-1.365	-0.399	-0.413
331	Wood, wood products	-0.973	-1.048	-0.075	-0.077	-1.580	-1.619	-0.039	-0.025
332	Furniture	-1.333	-1.230	0.104	0.078	-1.596	-1.516	0.080	0.050
341	Paper, paper products	-1.445	-1.199	0.246	0.170	-2.069	-1.523	0.545	0.264
342	Printing, publishing	-1.137	-0.968	0.169	0.149	-1.296	-1.161	0.135	0.104
351	Industrial chemicals	-1.382	-1.028	0.354	0.256	-1.598	-0.977	0.621	0.388
352	Other chemical products	-1.301	-0.860	0.442	0.339	-1.308	-0.802	0.505	0.387
353	Petroleum refineries and products	-1.737	-1.916	-0.180	-0.104	-2.156	-2.399	-0.243	-0.113
355	Rubber products	-1.214	-1.063	0.151	0.124	-1.308	-1.161	0.147	0.112
356	Plastic products	-1.144	-0.962	0.183	0.159	-1.509	-1.115	0.394	0.261
361	Pottery, china, earthware	-0.825	-0.779	0.046	0.056	-1.050	-1.304	-0.253	-0.241
362	Glass, glass products	-1.156	-1.119	0.037	0.032	-1.417	-1.226	0.191	0.135
369	Structural clay products	-1.398	-0.949	0.449	0.321	-1.674	-1.388	0.285	0.170
371	Iron and steel basic industries	-1.394	-1.400	-0.006	-0.004	-1.734	-1.508	0.226	0.130
372	Basic non-ferrous metals	-1.316	-1.114	0.202	0.154	-1.564	-1.198	0.366	0.234
381	Fabricated metal products	-1.215	-1.020	0.195	0.161	-1.433	-1.137	0.296	0.206
382	Machinery	-1.232	-1.037	0.195	0.159	-1.241	-0.966	0.275	0.222
383	Electrical machinery	-1.286	-0.991	0.295	0.230	-1.351	-0.761	0.590	0.437
384	Transport equipment	-1.409	-0.918	0.490	0.348	-1.589	-1.001	0.588	0.370
385	Measuring, photo, optical equipment	-1.088	-0.756	0.332	0.305	-1.087	-0.706	0.381	0.351
390	Other manufacturing	-0.938	-0.835	0.103	0.110	-1.065	-0.907	0.158	0.149

Columns *initial* and *last* contain estimated values of the distance coefficient $\widehat{\beta}_5^a$ in Equations (1)[left panel] and (2)[right panel] computed as the simple average of cross-sectional estimates for years 1970-1972 and 1998-2000, respectively.
Column *absolute change* contains the difference between values reported in columns *initial* and *last*. Column *relative change* reports the relative difference between values recorded in columns *initial* and *last*. It is calculated as the ratio of values in column *absolute change* to modulus values (in order to preserve the sign) reported in column *initial*.

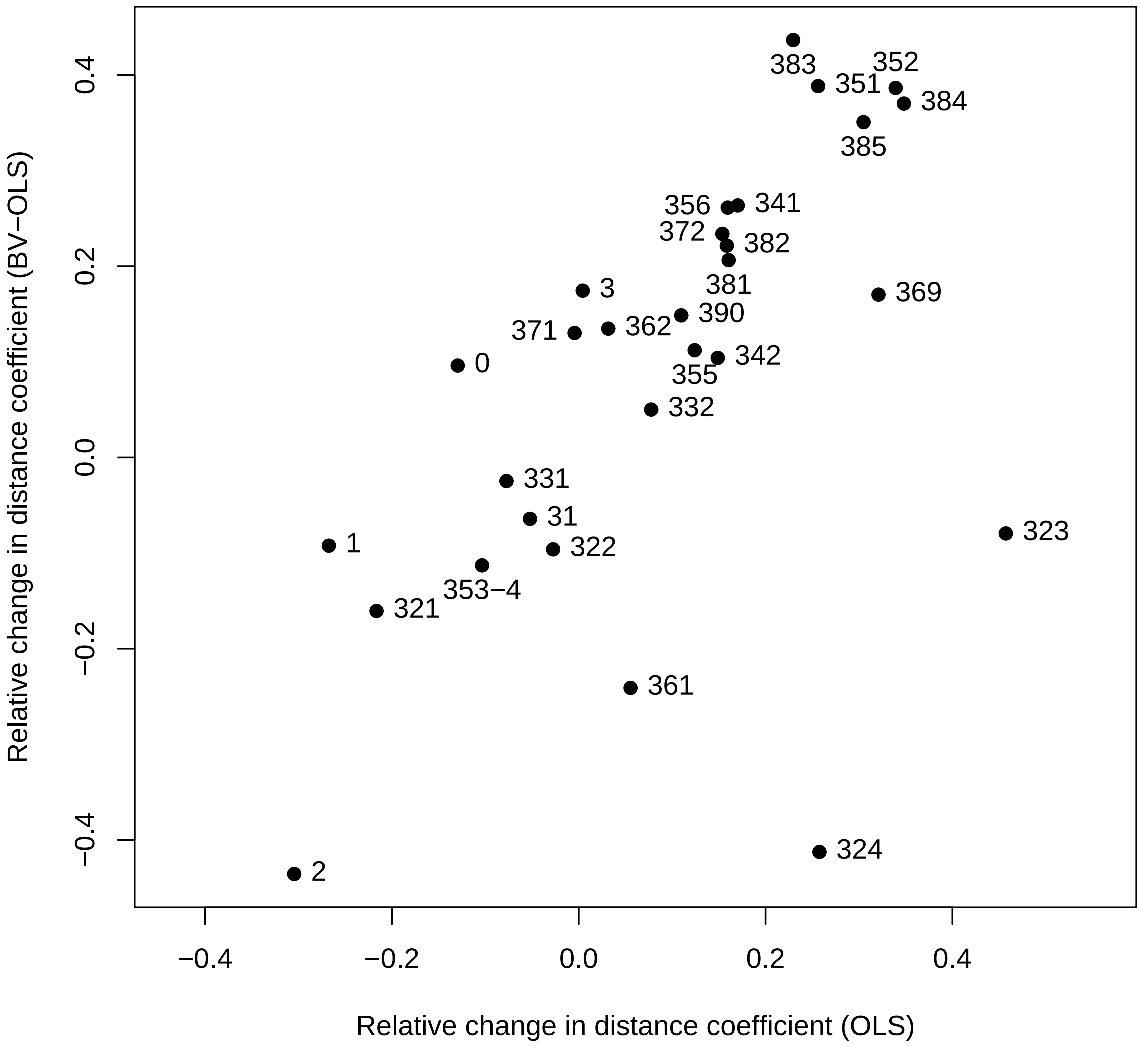

Figure 1: Cross plot of relative changes in the values of the estimated distance coefficients using equation (1) (x-axis) and equation (2) (y-axis)