South-North Trade in Ireland: Gravity and Firms from the Good Friday Agreement to Brexit*

Martina Lawless[†] J. Peter Neary[‡] Zuzanna Studnicka[§]

ESRI, Dublin Oxford, CEPR, and CESifo UCD, Dublin

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Abstract

This paper revisits the work of Fitzsimons, Hogan, and Neary (1999) on the level of trade between Ireland and Northern Ireland. In doing so, we reflect on the recent move to prominence of this issue since the referendum decision of the UK to leave the EU and also on the shift within the economics literature to looking at trade issues from a micro rather than a macro perspective as data availability has grown. Our country-level results show the same pattern of limited statistical significance for a border effect as was found in the earlier work still holds but when using firm-level data we find a positive and significant border effect. This effect holds for total trade at firm and product level with the primary determinant coming from the intensive margin, both in terms of average exports per firm and average exports per product within firms.

Keywords: Brexit; Gravity; Multi-Product Firms

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[†]Economic and Social Research Institute, Dublin 2, Ireland; martina.lawless@esri.ie.

[‡]Department of Economics, University of Oxford, Manor Road, Oxford OX1 3UQ, UK; peter.neary@economics.ox.ac.uk.

[§]School of Economics, University College Dublin, Dublin 4, Ireland; zuzanna.studnicka@ucd.ie.

1 Introduction

Fitzsimons, Hogan, and Neary (1999) examined how well the popular "gravity" model of determinants of trade flows explained trade between Ireland and Northern Ireland, with a particular focus on whether the Irish Border tended to reduce South-North trade relative to what would be otherwise predicted by this type of model.[1] Using aggregate data, Fitzsimons, Hogan, and Neary (1999) found no evidence of trade in both directions between 1970 and 1992 being reduced by the border, although the significance level depended on the specification adopted. Looking at sectoral data for a later period from 1988 to 2007, Morgenroth (2009) found some evidence that trade was lower than predicted by a gravity equation for all Irish trade.

The motivation for revisiting this issue comes from the recent shift to policy prominence of the Irish border, which has become central to the negotiations between the European Union and the United Kingdom on how to implement the 2016 Brexit referendum. Evidence on the extent of trade flows across the border and how it relates to the degree of economic integration is central to estimating the degree of disruption that changes in the trade regime might bring. Both parts of the island of Ireland are currently in the EU Single Market and Customs Union, so products can circulate freely between the two. The abolition of intra-EU trade barriers has coincided with a normalization of political relations between Ireland and Northern Ireland and an end to violence, following the so-called "Good Friday Agreement" of 10 April 1998. The current frictionless trade regime would change after a so-called "hard" Brexit, when the two parts of the island would be in different customs regimes. To avoid this situation, the EU and the UK have agreed on a Withdrawal Agreement which includes a Protocol on Ireland and Northern Ireland (also known as the "backstop") whereby Northern Ireland would stay aligned to some of the rules of the EU Single Market.[2] In practice it

[1] This was not the first time the gravity equation was applied to Irish trade flows, with the first appearance being FitzPatrick (1984), who looked at trade levels across all trading partners but did not separately identify a Northern Ireland effect.

[2] These rules include: legislation on VAT and excise in respect of goods, legislation on goods standards, sanitary rules for veterinary controls ("SPS rules"), rules on agricultural production/marketing, state aid

means that no checks or controls would be necessary on goods crossing the border between Northern Ireland and Ireland but there would be some need for checks on goods travelling from the rest of the UK to Northern Ireland. This situation would prevail if another solution cannot be found by the end of the transition period in December 2020. A further aspect of the proposed Withdrawal Agreement is that the whole of the UK would effectively remain in the EU Customs Union – unless and until both the EU and UK agree that it is no longer necessary. This has not been acceptable to many Brexit supporters, and, as of the time of writing (October 8, 2019), the UK's Prime Minister has not managed to secure Parliament's approval of this or any other deal.

From a more academic perspective, revisiting the trade effects of the Irish border also provides an interesting example of how increased data availability at a micro level has broadened the ways in which economists can look at particular questions. We can now use similar aggregate data to re-estimate the results of Fitzsimons, Hogan, and Neary (1999), and then use disaggregated data on firms and their exported products to examine how the aggregate effects found in that approach might mask some underlying heterogeneity. Our disaggregated approach uses a unique transaction-level data set on exports by Irish firms to all destinations. Since 2000, the Irish Central Statistics Office has made data available for exports to Northern Ireland separately from the rest of the United Kingdom. This form of disaggregation by region of a single export destination country is highly unusual and makes it possible to analyse firm-level trade flows to Northern Ireland.

While Fitzsimons, Hogan, and Neary (1999) found no evidence of trade in both directions between 1970 and 1992 being reduced by the border, our findings with firm-level export data from 2000 to 2015 show that the South-North border effect is positive and significant for firm-level trade as a whole. When we decompose this, we find that the positive effect comes primarily from the intensive rather than the extensive margin: that is it comes from larger average exports by firm and by product rather than from larger numbers of exporting firms

rules.

or of products exported by firms. This effect is somewhat different from the effect of the border between the Republic of Ireland and the rest of the UK. This finding suggests that the border with Northern Ireland has less of a depressing effect on trade relative to other international borders faced by the Republic of Ireland. In addition, we find that the effect of the border in expanding South-North trade relative to Irish trade with other destinations has grown over time. In particular, we find that the pattern and extent of cross-border trade changed markedly from about 2008-10, coinciding with the aftermath of the 2008 financial crisis and perhaps reflecting a push towards greater export activity by Irish firms facing the sharp contraction in domestic demand at that time.

The plan of the paper is as follows. Section 2 reviews the literature on the estimation of gravity models, focusing on the estimation of border effects and the use of firm-level data. Section 3 explains our data sources and notes some broad patterns they exhibit. Section 4 presents evidence on the determinants of aggregate exports by Irish-based firms. Section 5 decomposes firm-level exports by within-firm intensive and extensive margins at product level. Section 6 carries out some robustness checks, including showing that export patterns differ relatively little between Irish- and foreign-owned firms. Finally, Section 7 concludes.

2 Literature

The gravity equation is a long-standing empirical technique that links bilateral trade between a pair of countries to their economic masses (usually approximated by GDP) and the distance between them, by analogy with the effects of gravitational forces in physics. These fundamental building blocks have been augmented in many studies to incorporate a wide range of country-level effects that may act as trade barriers or trade facilitators such as international borders and membership of trade agreements. (For a survey, see Head and Mayer (2014)). Initially econometrically successful in terms of fitting patterns in the data, theoretical foundations for the gravity equation were developed later by Anderson (1979),

Anderson and van Wincoop (2003) and others.

Quantifying the impact of a national border in the gravity framework has received a lot of attention since McCallum (1995) estimated that the national border between Canada and the US had a trade-depressing impact as high as -2,200%. However, since then, work by Anderson and van Wincoop (2003) has emphasised the need to consider not only the bilateral trade barriers between two countries, but also how these bilateral barriers vary relative to the average barriers to trade that each country faces when trading with all its partners, which they call "multilateral resistance." When they use this approach to revisit the estimates of McCallum (1995), they find that including multilateral resistance terms reduces the estimated border effect considerably, to a much more plausible -44%.

In practice, multilateral resistance terms are highly non-linear, so in most estimates of the gravity equation they are proxied by using exporter and importer fixed effects (FE). Fixed-effects estimation is easy to implement, but it makes it impossible to estimate quantitative comparative-static effects of time-invariant trade barriers such as the national border. Analysis of border effects is therefore impossible to combine with country-pair fixed effects, which has become the most widely used specification when analysing aggregate country trade flows (see Head and Mayer (2014)).

The literature estimating the gravity equation at the firm level is much scarcer than at the country level. This reflects the greater availability of aggregate trade data and the fact that until relatively recently most trade models have focused on the aggregate value of trade ignoring the role of individual firms and products. The firm-level literature identified considerable heterogeneity in the behaviour of firms, departing from the representative-firm assumption postulated in traditional trade models. In particular, Bernard, Jensen, Redding, and Schott (2007), Mayer and Ottaviano (2008), Crozet and Koenig (2010) and Lawless (2010) are among the first studies to estimate the gravity equation at the firm level and to decompose firm-level trade flows into extensive and intensive margins. Each of these papers, however, defines the margins in different ways and relies on different theoretical models.

Bernard, Jensen, Redding, and Schott (2007) is one of the first studies using disaggregated data. Their estimates of the gravity equation, however, do not use data on individual firms; instead they decompose the aggregate value of U.S. exports in 2000 into three components: the contribution of the number of firms exporting to a particular destination; the number of products exported to this destination; and the average value of exports per product per firm. They find that, while the number of firms and the number of products are increasing in importer's income and decreasing in distance, the average value per product per firm on the other hand is decreasing in importer's income and increasing in distance. They do not include any other country characteristics such as border effects in their analysis.

Mayer and Ottaviano (2008) consider French and Belgian export flows and decompose trade into firm and product margins. They find that the number of exporters, and to a slightly lesser extent the number of products, are the main drivers of aggregate exports, while average exports per product make a much smaller contribution. Although they do not include border effects, they find that historical links such as colonial ties and common language are important for the extensive margins but have somewhat negative effects on average exports per product.

Lawless (2010) uses a variant of the Melitz (2003) model of firm exports by including firm heterogeneity in productivity and fixed trade costs for each export market. The model predicts that the extensive margin is negatively linked to both fixed and variable trade costs, while the intensive margin is affected by counteracting terms whose overall sign is unclear. Lowering trade costs tends to increase the sales of continuing exporters and leads to the entry of new marginal exporters with lower average sales.

Crozet and Koenig (2010) implement a structural estimation of the Chaney (2008) model in which the response of each margin of trade depends on the elasticity of substitution in a given sector. To do so they decompose the aggregate volume of exports for each industry from France to a given country into the number of shipments and the average value per shipment. In general, they confirm the predictions of the Chaney (2008) model for a large

majority of industries. In addition, their estimates of the border effects are always very small and insignificant with the exception of the extensive margin (number of shipment) for large, single-region firms.

3 The Data

The Irish Central Statistics Office (CSO) collects data on merchandise exports of manufacturing enterprises broken down by product (at the CN 8-digit level) and destination. Since 2000, separate data are given for exports to Northern Ireland and to the rest of the United Kingdom. Distinguishing between different regions of a single export destination country in this way is highly unusual and makes it possible to analyse firm-level trade flows from Ireland to Northern Ireland. In our analysis, we aggregate CN-8 digit products to give a more stable HS 6-digit level classification. Moreover, we account for changes in HS-6 codes over time using the concordance files made available by Eurostat. Our final dataset uses a constant HS 1996 terminology.

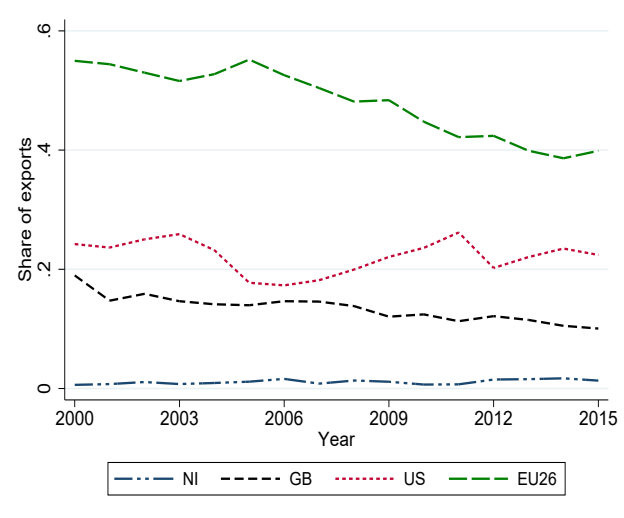
In common with other European countries, the Irish trade data are collected through two different systems. The Extrastat system collects extra-European trade and the Intrastat system gathers data for intra-European trade. One caveat is that the threshold for reporting of exports differs between the two systems. The Extrastat threshold is relatively low: it collects information on all transactions above €254 per annum. By contrast, to reduce the reporting burden on firms, the Intrastat system (i.e., the within-EU export records) requires that a threshold level of exports of €635,000 per annum be reached before the firm is obliged to provide the detailed information on products and destinations (along with other related information) that we utilise in this analysis. This means that a number of small firms that export amounts below the threshold are not included. However, the average export values of these firms are very small so the customs records provide detail on the vast majority of export values, notwithstanding the presence of the recording threshold.

We combine the customs data with enterprise accounting variables (collected via the Census of Industrial Production - CIP). This linked data set covers the period from 2000 to 2012 on enterprise characteristics and the period up to 2015 on trade statistics. The level of detail in the CIP survey depends on the size of the firm with a short form sent to firms with three or more employees and a more detailed questionnaire collected from firms with more than 20 employees. Both versions of the questionnaire collect information on firm employment levels, nationality of ownership, investment and costs. Matching the customs data on export values by product and destination to the firm characteristics from the Census of Industrial Production gives us observations on between 1,000 and 1,400 firms per year.

Finally, we use country characteristics as well as gravity data. These come from the World Development Indicators (WDI), Eurostat (for regional GDP), and CEPII. We convert the GDP data from WDI using EUR-US dollars exchange rate for each year taken from Federal Reserve Economic Data (FRED). To obtain real values of GDP and trade we use Euro Area GDP deflator expressed in 2010 €, taken from the International Monetary Fund (IMF). The distance between the Republic of Ireland and Northern Ireland is calculated as the distance between the capital cities and is taken from Google Maps. To give a context to our econometric analysis in subsequent sections, Figure 1 shows the shares of Northern Ireland, mainland UK (Great Britain, henceforward "GB"), the US, and the rest of the EU (henceforward "EU26"), in total exports of the Republic of Ireland from 2000 to 2015. We observe an important decline in the importance of trade with the EU26 (from 56 per cent to 40 per cent) and with mainland Great Britain (from almost 20 per cent to 10.6 per cent). Nevertheless, these two partners continue to constitute about 50 per cent of Irish exports at the end of the period. In contrast, trade with the US has remained approximately constant as a proportion of total exports, at about 20 per cent. Figure 1 also suggests that trade with Northern Ireland is a relatively small proportion of total Irish trade but increased from 0.5 per cent to 1.4 per cent over the period. This increase in the share of Irish exports to Northern Ireland is suggestive of a growing effect of the Good Friday Agreement, though our

data do not allow us to test this explicitly.

Figure 1: Aggregate Export Shares, Ireland 2000-2015



4 Determinants of Aggregate Exports by Irish Firms

In this section we use aggregate firm-level data to explore the determinants of Irish exports. Thanks to the availability of firm-level data, total exports by all firms to a given destination j in a given year t, X_{jt}, can be decomposed into the extensive margin (the number of exporting firms) N_{jt}, and the intensive margin (average exports across all firms) $\overline{X}_{jt}$:

$$X_{jt} = N_{jt}\overline{X}_{jt} \tag{1}$$

We estimate the following equation:

$$\log Q_{jt} = \alpha + \beta' \mathbf{Y}_{jt} + \gamma' \mathbf{Z}_j + \varepsilon_{jt} \tag{2}$$

Where Q_{jt} represents either total exports, number of exporters, or average exports per firm to destination j in year t; $\mathbf{Y}_{jt}$ is a range of time-variant destination characteristics (GDP, GDP per capita, EU dummy); $\mathbf{Z}_j$ is a range of time-invariant destination characteristics (distance,

common language, Britain dummy and South-North dummy); and α is an intercept. Figure 2 illustrates the raw data, while Table 1 presents our results.

Figure 2: Total Exports by Destination 2015

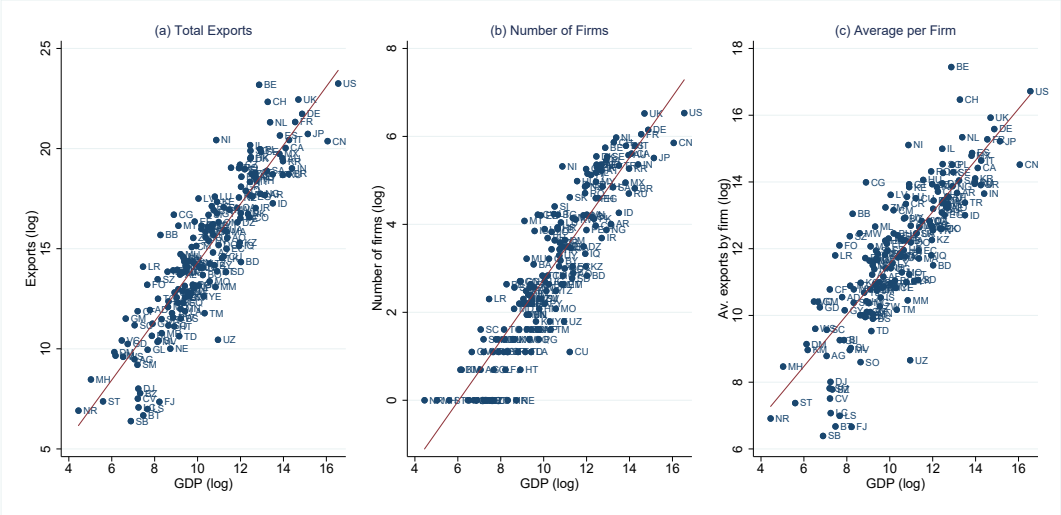


Figure 2 shows clearly that Northern Ireland (NI) is a positive outlier in Irish exports in every dimension. Ireland exports more to Northern Ireland at both intensive and extensive margins relative to the average of all other export destinations.

Following Fitzsimons, Hogan, and Neary (1999) we estimate two sets of specifications - first using pooled OLS and second a random effects model.[3] Our main interest is in the dummy variable for South-North trade on the island of Ireland, which we call the "border dummy". Both the random effects and pooled OLS specifications yield coefficients for the effect of the border dummy on total exports that are positive but insignificant, essentially the same pattern as that found in the earlier work. Given our access to more detailed data, we can split this overall effect into the component parts of the number of firms exporting to a destination and the average exports per firm. Doing this, the border effect in both specifications remains consistently insignificant but with the main source of the moderate positive effect coming from average exports per firm. By contrast, the coefficients on the

[3]Fitzsimons, Hogan, and Neary (1999) also present findings for a fixed effects estimator but, as the border effect drops out in this specification, we do not include it here.

Table 1: Estimated Gravity Equations for Aggregate Irish Exports, 2000-2015

	Pooled OLS			Random Effects		
	(1) Total exports	(2) No. of firms	(3) Av. exports per firm	(4) Total exports	(5) No. of firms	(6) Av. exports per firm
Distance	-0.752***	-0.628***	-0.217**	-0.536***	-0.330***	-0.206*
	(0.156)	(0.087)	(0.106)	(0.162)	(0.083)	(0.113)
GDP	1.171***	0.555***	0.596***	1.231***	0.612***	0.619***
	(0.045)	(0.024)	(0.028)	(0.038)	(0.020)	(0.027)
GDP per capita	0.075	-0.019	0.033	0.157**	0.115***	0.043
	(0.068)	(0.035)	(0.046)	(0.066)	(0.032)	(0.046)
Common Language	0.734***	0.388***	0.336**	0.833***	0.434***	0.400***
	(0.210)	(0.120)	(0.144)	(0.191)	(0.105)	(0.136)
EU	0.685***	-0.077*	0.654***	1.141***	0.503***	0.638***
	(0.151)	(0.045)	(0.141)	(0.263)	(0.143)	(0.189)
Northern Ireland	0.360	-0.141	0.419	0.393	0.024	0.369
	(0.536)	(0.306)	(0.370)	(0.492)	(0.263)	(0.362)
Britain	-0.772*	-0.619***	-0.048	-1.209***	-1.012***	-0.197
	(0.425)	(0.232)	(0.303)	(0.383)	(0.204)	(0.293)
Constant	9.623***	3.001***	8.116***	6.512***	-1.228	7.740***
	(1.571)	(0.891)	(1.046)	(1.546)	(0.810)	(1.070)
Observations	2,832	2,832	2,832	2,832	2,832	2,832
R-squared	0.8029	0.8255	0.61	0.806	0.850	0.610
Number of destinations	192	192	192	192	192	192
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Destination RE	No	No	No	Yes	Yes	Yes

Dependent variables: Exports/Number of firms exporting/Average exports by firm between the Republic of Ireland and a sample of 192 countries, 2000-2015.
All variables except for Common border, Common language, South-North and EU dummies are in logs.
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

dummy for mainland Britain imply significant negative effects on total exports, driven by the effect on the extensive margin. The other explanatory variables follow the expected pattern with partner GDP attracting trade as does having a common language and being an EU member state. Distance is consistently negative in its overall effect, which works most strongly through reductions in the number of firms exporting.

5 Decomposing Gravity within Firms

In this section we discuss the estimation of gravity equations at firm level. Total exports by each firm f to a given destination j in a given year t, x_{fjt}, can be decomposed into the *within-firm* extensive margin (the number of products exported) n_{fjt}, and the *within-firm*

Table 2: Estimated Gravity Equations for Irish Exports by Firm, 2000-2015

	Firm fixed effects			Firm random effects		
	(1) Total exports by firm	(2) No. of products	(3) Av. exports by product	(4) Total exports by firm	(5) No. of products	(6) Av. exports by product
Employment	0.367***	0.068***	0.298***	0.538***	0.110***	0.425***
	(0.047)	(0.024)	(0.046)	(0.029)	(0.009)	(0.030)
Productivity	0.091***	0.007	0.085***	0.141***	0.020**	0.121***
	(0.021)	(0.013)	(0.022)	(0.021)	(0.010)	(0.021)
Distance	-0.297***	-0.078***	-0.218***	-0.293***	-0.075***	-0.217***
	(0.029)	(0.008)	(0.026)	(0.029)	(0.007)	(0.026)
GDP	0.467***	0.122***	0.345***	0.458***	0.119***	0.339***
	(0.014)	(0.004)	(0.012)	(0.014)	(0.004)	(0.012)
GDP per capita	0.143***	0.059***	0.083***	0.139***	0.057***	0.081***
	(0.019)	(0.005)	(0.016)	(0.019)	(0.004)	(0.016)
Common Language	0.382***	0.210***	0.172***	0.360***	0.199***	0.158***
	(0.041)	(0.011)	(0.035)	(0.040)	(0.010)	(0.035)
EU	0.915***	-0.048**	0.964***	0.938***	-0.044**	0.981***
	(0.057)	(0.021)	(0.055)	(0.056)	(0.021)	(0.054)
Northern Ireland	1.194***	0.194***	1.000***	1.217***	0.191***	1.020***
	(0.150)	(0.041)	(0.130)	(0.146)	(0.041)	(0.128)
Britain	0.946***	-0.021	0.967***	0.991***	-0.016	1.003***
	(0.085)	(0.024)	(0.075)	(0.084)	(0.024)	(0.075)
Constant	5.142***	-0.692***	5.836***	2.084***	-1.998***	4.110***
	(0.856)	(0.158)	(0.793)	(0.452)	(0.117)	(0.413)
Observations	196,941	196,997	196,941	196,941	196,997	196,941
R-squared	0.213	0.156	0.182	0.2585	0.155	0.237
Number of firms	2,872	2,872	2,872	2,872	2,872	2,872
Firm RE/RE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes

Dependent variables: Exports by firm/Number of products by firm/Average exports by product between the Republic of Ireland and a sample of 192 countries, 2000-2015.
All variables except for Common border, Common language, South-North and EU dummies are in logs.
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
All regressions include year and 4-digit NACE dummies.

intensive margin (average exports per product for each firm) $\overline{x}_{fjt}$:[4]

$$x_{ft} = n_{fjt}\overline{x}_{fjt} \tag{3}$$

We use these three variables to estimate the following model:

$$\log q_{fjt} = \alpha + \beta' \mathbf{Y}_{jt} + \gamma' \mathbf{Z}_j + \delta' \mathbf{W}_{ft} + \varepsilon_{fjt} \tag{4}$$

where q_{fjt} represents alternatively total exports by each firm to a given destination, number of products per firm to each destination, or average exports per product by firm. In addition to the time-varying and fixed destination characteristics ($\mathbf{Y}_{jt}$ and $\mathbf{Z}_j$) used in the aggregate estimation, the specifications in this section also include firm characteristics ($\mathbf{W}_{ft}$). The error term ε_{fjt} is modelled as fixed or random effects at the firm level.

We show the results in Table 2. Our key results from this table are twofold. For trade overall, and for both specifications, firm data yield quite different results compared to the national data with significantly positive coefficients for the Irish border dummy. This is true for total exports per firm and also for its two components.

The second result is that, quantitatively, the contribution of the intensive margin is considerably greater. Thus, relative to other international borders faced by Ireland, the border with Northern Ireland encourages significantly higher exports by individual firms, with most of the difference accounted for by a higher average value of exports per firm whereas a higher number of products accounts for only a small part of the difference. This contrasts with the mainland GB dummies: these are also consistently significant for total exports per firm and for average exports per product, but in this case there is an offsetting effect of fewer products per firm although this latter effect is not statistically significant.

We can re-estimate these equations for each year, to explore how the border and GB

[4]Note that this is not the same definition of the product margin used by Bernard, Jensen, Redding, and Schott (2007) or Mayer and Ottaviano (2008) as we are using a within-firm measure rather than the aggregate number of products traded between countries.

Figure 3: South-North Dummy for Firm Exports by Year

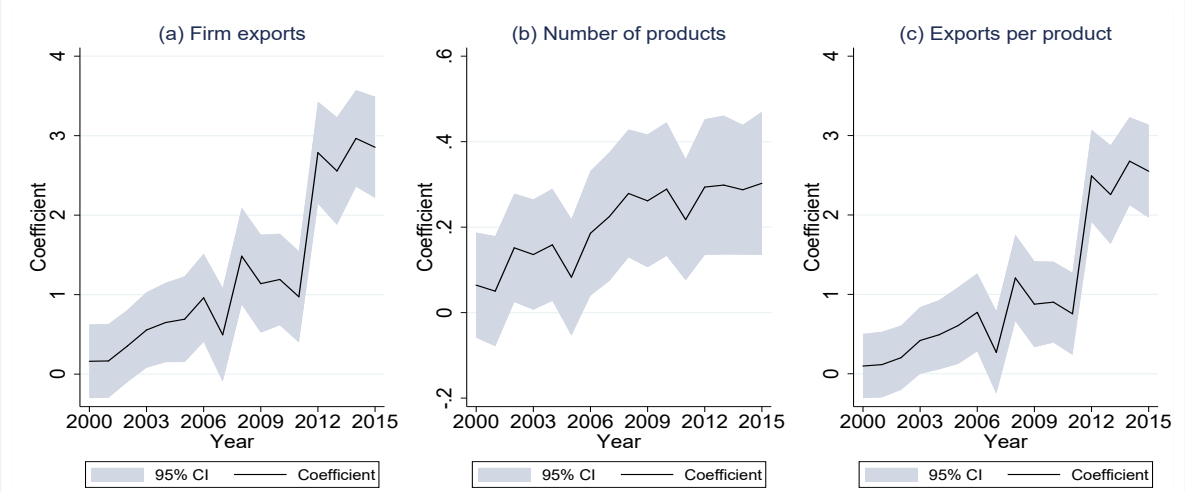
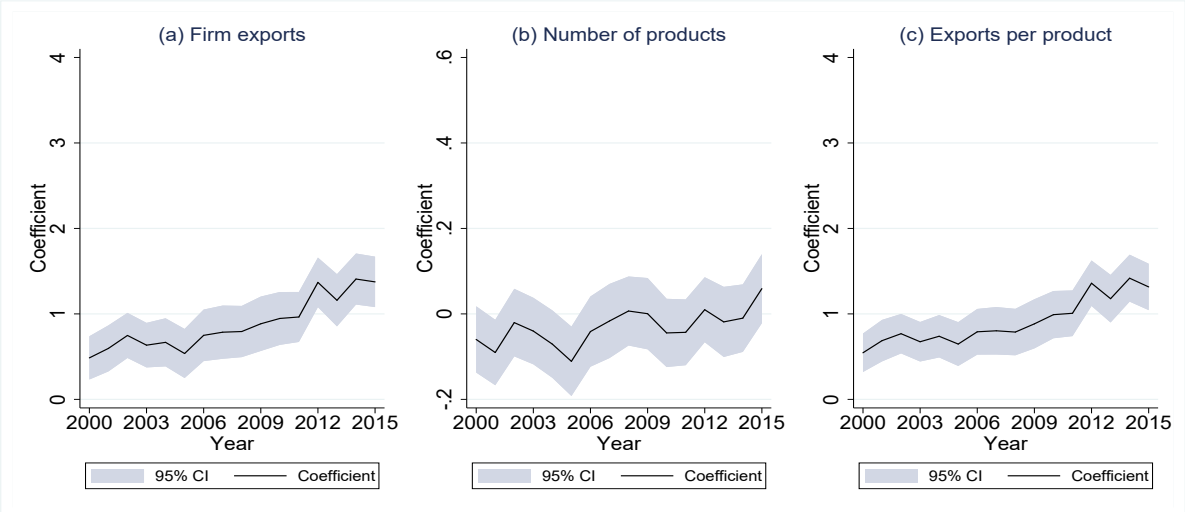


Figure 4: Ireland-GB Dummy for Firm Exports by Year



dummies vary over time. Figure 3 illustrates the border dummy in each year, estimated using the disaggregated data across all 192 destinations with the shaded regions denoting 95% confidence regions for the estimated coefficient in each year. Figure 4 does the same for the GB dummy. Two trends are apparent from Figures 3 and 4. First, the effects of the border dummy on total trade and on the average trade per product increase fairly substantially in 2007 and 2008 and then remain at this new higher level for a few years, whereas the effects of the GB dummy increase relatively moderately over the same time period. Bearing in mind that these trends reflect not absolute changes but rather changes relative to exports to other destinations, it seems likely that this reflects the recovery from the financial crisis. This would be consistent with Irish firms looking for additional markets given the sharp contraction in domestic demand at that time. It is also consistent with the evidence in Bricongne, Fontagné, Gaulier, Taglioni, and Vicard (2012) that most of the adjustment of French exports to the crisis occurred at the intensive rather than at the extensive margin. Second, there is a clear jump in total trade from 2012 onwards. This can be decomposed into a very strong jump at the intensive margin, coupled with a less pronounced but still suggestive jump at the extensive margin. The changes in the extensive margin over time are not statistically significant, suggesting that firms were concentrating on their "core competence" products. The timing of the second increase and the sustained higher level seem less likely to be effects of the financial crisis, and suggest instead a growing economic integration between the different parts of the two islands.

By comparison with the GB dummy, the border dummy exhibits a clear upward trend over the whole period, interrupted by the financial crisis and its aftermath. It seems plausible to attribute this to increased integration of the Irish and Northern Irish economies as they adapted to the new environment made possible by the Good Friday Agreement, though we cannot test this hypothesis directly.

6 Robustness Checks

Table 3: Estimated Gravity Equations for Irish Exports by Firm, Irish vs. Foreign Firms, 2000-2015

	Irish firms			Foreign firms		
	(1) Total exports by firm	(2) No. of products	(3) Av. exports by product	(4) Total exports by firm	(5) No. of products	(6) Av. exports by product
Employment	0.299***	0.056***	0.243***	0.378***	0.078*	0.299***
	(0.061)	(0.016)	(0.057)	(0.076)	(0.047)	(0.068)
Productivity	0.102***	0.027***	0.075***	0.076**	-0.013	0.089***
	(0.024)	(0.008)	(0.022)	(0.032)	(0.019)	(0.029)
Distance	-0.306***	-0.070***	-0.236***	-0.316***	-0.088***	-0.228***
	(0.034)	(0.010)	(0.029)	(0.044)	(0.011)	(0.039)
GDP	0.334***	0.095***	0.239***	0.575***	0.145***	0.430***
	(0.018)	(0.004)	(0.015)	(0.020)	(0.006)	(0.016)
GDP per capita	0.064**	0.046***	0.018	0.181***	0.067***	0.114***
	(0.026)	(0.006)	(0.022)	(0.023)	(0.006)	(0.020)
Common Language	0.410***	0.178***	0.232***	0.380***	0.238***	0.142***
	(0.054)	(0.015)	(0.046)	(0.056)	(0.015)	(0.048)
EU	0.755***	0.015	0.739***	0.986***	-0.098***	1.084***
	(0.071)	(0.028)	(0.070)	(0.080)	(0.029)	(0.076)
Northern Ireland	1.103***	0.201***	0.901***	0.964***	0.120	0.844***
	(0.165)	(0.048)	(0.143)	(0.281)	(0.083)	(0.239)
Britain	1.471***	0.140***	1.331***	0.378***	-0.200***	0.578***
	(0.108)	(0.033)	(0.096)	(0.122)	(0.033)	(0.110)
Constant	7.268***	-0.408**	7.675***	2.957***	-1.355***	4.313***
	(0.721)	(0.198)	(0.615)	(0.813)	(0.410)	(0.696)
Observations	88,238	88,252	88,238	108,703	108,745	108,703
R-squared	0.193	0.140	0.159	0.243	0.182	0.212
Number of firms	2,299	2,299	2,299	770	770	770
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes

Dependent variables: Exports by firm/Number of products by firm/Average exports by product between the Republic of Ireland and a sample of 192 countries, 2000-2015.
All variables except for Common border, Common language, South-North and EU dummies are in logs.
Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.
All regressions include year and 4-digit NACE dummies.

Table 3 gives estimated fixed-effect gravity equations for Irish exports by firm, now distinguishing between Irish- and foreign-owned firms. Perhaps the most striking feature of the table, given widespread discussion of the "duality" of Irish industry, is the broad similarity in behaviour across the two groups of exporters.[5]

For Northern Ireland, both effects are of similar magnitude overall, driven mainly by large coefficients for the intensive margin dummy, with a small but significant dummy for the extensive margin for Irish-owned firms that is not matched by foreign-owned ones. A similar contrast, though even stronger, can be seen in the dummy variables for exports to Britain and the EU. Both are highly significant and positive for total firm exports, driven by

[5]This dual economic structure has featured regularly in writings on the Irish economy. See, for example, Stewart (1976), Barry and Hannan (1996), Ruane and Ugur (2005) and Neary (2006).

the intensive margin. However, whereas Irish-owned firms export significantly more products to both these markets, the opposite is true of foreign-owned firms; a finding that provides partial support for the "dual economy" hypothesis.

7 Conclusion

In this paper we have re-examined the question raised by Fitzsimons, Hogan, and Neary (1999) of how much the border between Ireland and Northern Ireland affects trade between the two parts of the island of Ireland using a mixture of data on aggregate and firm-level trade flows. We find that although the aggregate data generates the same result of largely insignificant effects found in the earlier paper, when we look at firm-level data, we find a positive and significant border effect for trade overall, as well as at firm and product level.

The primary determinant of this effect is through the intensive margin. This holds in terms of average exports per firm and also average exports per product within firms. We also find evidence that exports to Northern Ireland relative to other destinations significantly increased at all margins in the recovery from the 2008 financial crisis, and even more so from 2011 onwards. The steady upward trend in the importance of exports to Northern Ireland relative to all other exports is broadly consistent with a pattern of increased integration of the Irish and Northern Irish economies, though it has to be seen in the context of the relatively small share of total Irish exports that go to Northern Ireland.

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