Sugar Trade and the Role of Historical Colonial Linkages

ABSTRACT

Past colonialism has shaped current policies and patterns relating to sugar trade. To examine the effects of historical colonial linkages on sugar trade, the gravity model is estimated for a panel of raw sugar imports into 25 OECD countries from the rest of the world over the 1961-2016 period. Colonial linkages in a North-South direction increase sugar trade, but colonial linkages in a North-North direction decrease it. Several distinct North-South colonial channels are identified. Sugar trade is enhanced by the major empire shipping routes, rail infrastructure, cultural proximity and preferential market access.

JEL Classification: F14, F54, C33

Keywords: Colonialism, sugar trade, gravity model

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1. INTRODUCTION

The origins of modern global trade are founded in sugar. First encountered by the Europeans in the 15th century, sugar later became a staple good as the Age of Discovery and foreign dominance opened up trading routes and paved the way for the shipment of sugar back to the homeland. Indeed, colonial settlement and expansion often began with the seizure of lands for the purpose of producing sugar; cane plantations and the processing of sugar generated much wealth for Europeans (Mahler 1981; Parker 2012). The sweetness of sugar, however, belies a bitter history of a commodity harvested by slaves, as Africans were sold to white traders replaced Europeans in the plantations. Triangular trade – involving the exchange of goods for slaves between Europe and West Africa and the sale of slaves to transatlantic plantation owners in return for sugar (and, to a lesser extent, other plantation products such as coffee and tobacco) – helped drive the first wave of economic globalisation (Harms 2003). During the 18th century, sugar cane grown in the Caribbean and harvested by African slaves provided Britain with most of its sugar needs. Nevertheless, a twenty-year campaign to abolish slavery succeeded when a bill before Parliament was passed in 1807.[1]

Perhaps more than any other commodity, past colonialism has shaped current policies and patterns relating to sugar trade. The emergence of the sugar beet industry in Europe during the 19th century was encouraged by rebellion in the colonies and the disruption of sugar supplies (Mitchell 2004). Unable to compete with lower-cost sugar produced from cane in tropical

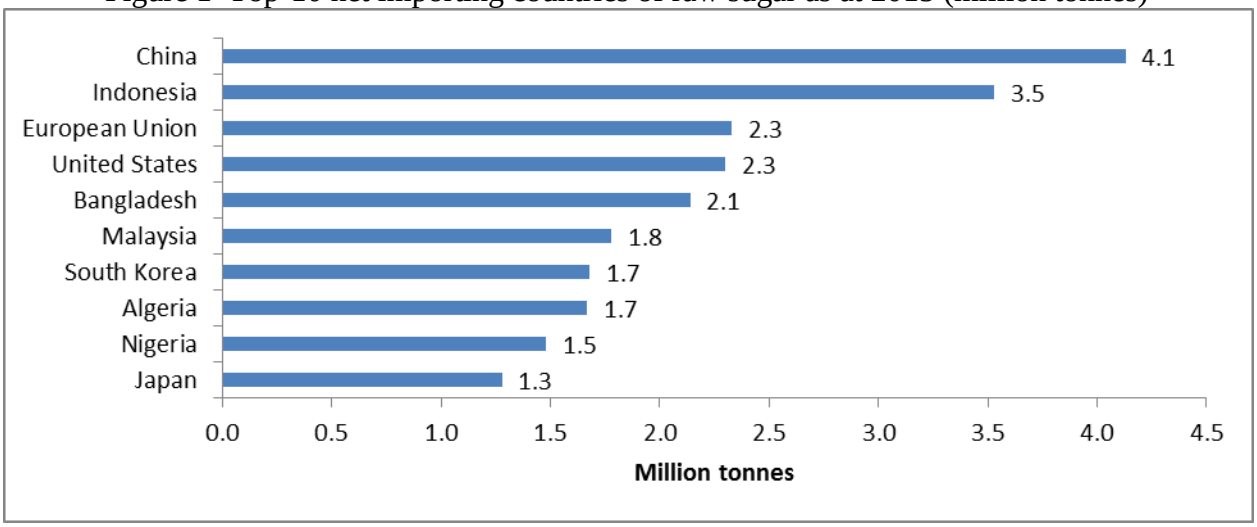
[1] Slavery had already been temporarily suspended in France in 1794, was banned in Denmark in 1803 and had been prohibited in several northern American states before 1807.

countries, many northern hemisphere countries subsidised the production of beet – a policy later adopted by the European Union (EU) as part of the Common Agricultural Policy (CAP). During the 20th century, the production of sugar cane grown in tropical climates recovered. In particular from the 1960s, a plethora of preferential trade agreements (PTAs) have granted non-reciprocal, preferential treatment to many former colonies. Currently, sugar cane cultivated in the southern hemisphere accounts for about three-quarters of all sugar produced, while the rest comes mainly from sugar beet grown in the more temperate climates of the northern hemisphere. This is not surprising, as sugar cane production enjoys a cost advantage of roughly half the average cost of sugar beet production (Mitchell 2004).

The top-10 net-importing and net-exporting countries of raw sugar are shown in Figures 1 and 2 respectively. Several features of the data are noteworthy. First, the EU member countries, the United States and Japan are among the largest net importers of raw sugar. These countries are also among the worst offenders of distortionary sugar policies (Mitchell 2004). Second, by far the largest net exporter of raw sugar is Brazil – also the world's largest producer – quadrupling the tonnage exported by Australia, the second largest net exporter of raw sugar. Third, Latin American countries (Brazil, Cuba, El Salvador, Guatemala, Mexico and Nicaragua) dominate the top-10 net exporters of raw sugar. Sub-Saharan Africa is represented by two countries (Mozambique and Swaziland) while Asia and Oceania are represented by one country each (Thailand and Australia respectively, the latter being the only advanced country among the ten). Interestingly, only three of the African, Caribbean and Pacific (ACP) countries that have received preferential access to the EU market feature among the top-ten net exporting countries (Cuba, Mozambique and Swaziland). Last, except for Thailand, all other top-10 net exporters of

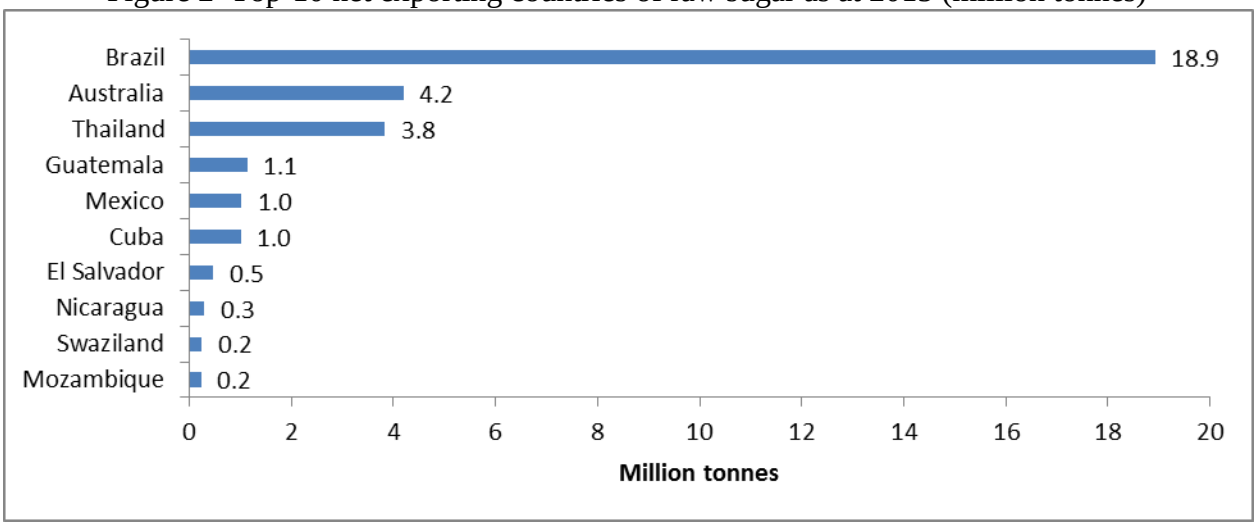
raw sugar have colonial linkages with European countries (see Appendix: Table A1). In other words, the data suggest current patterns of raw sugar trade reflect a colonial past.

Figure 1 Top-10 net importing countries of raw sugar as at 2015 (million tonnes)



Source: *International Sugar Organisation*.

Figure 2 Top-10 net exporting countries of raw sugar as at 2015 (million tonnes)



Source: *International Sugar Organisation*.

Only a few studies have emphasised the importance of a colonial history on patterns of trade. For historical epochs ranging from 1870 to 1939, Estevadeordal *et al*. (2003) and Mitchener and Weidenmier (2008) assess the role of empires in explaining trade patterns. Using

inter-war and post-war data (1928-1938 and 1949-1964 respectively), Eichengreen and Irwin (1998) include the lag of trade to capture the effect of historical events – past colonialism, migration and currency areas. More recently, Tomz *et al*. (2007) take account of colonial trade preferences in analysing the effect of international institutions on trade. In a similar vein, Francois and Manchin (2013) examine the trade effects of institutional and infrastructure quality, trade preferences as well as the colonial and geographic context. The effect of decolonisation on trade has also been examined, for example, by Head *et al*. (2010) who study the effect of independence on post-colonial trade. At a regional level, Brodzicki and Uminski (2017) analyse trade persistence and the role of the metropolitan regions. At a disaggregated level, studies quantifying the effect of a common colonial heritage on trade include Vollrath *et al*.'s (2009) analysis of the agricultural, manufactured food and clothing sectors; Raimondi and Olper's (2011) study of 18 food sectors; and Sun and Reed's (2010) analysis of agricultural trade creation and diversion effects of free trade agreements.

In assessing the effect of a common colonial history on recent patterns of sugar trade, the contributions offered here are three-fold. First, a distinction is made between the effects on raw sugar trade of colonial ties with the global south (North-South linkages) and the global north (North-North linkages). Second, the channels through which the effects of North-South colonial linkages have endured over time are identified, namely technological innovations in infrastructure relating to the major empire shipping routes and rail lines; cultural proximity; and trade policies of both a preferential and a protectionist nature. Finally, the implications of recent policy reforms in terms of EU preferential schemes are examined.

The findings of the disaggregated analysis suggest a common colonial relationship has opposite effects depending on its direction; the import of raw sugar is enhanced if historical

linkages follow a North-South direction, but is suppressed by common linkages in a North-North direction. The non-uniform effect of sharing a common colonial past likely depends on the source of raw sugar: low-cost sugar cane originating mainly in the tropical and sub-tropical southern hemisphere versus high-cost sugar beet grown mainly in the temperate northern hemisphere. Furthermore, the effects of North-South historical colonial linkages on raw sugar trade are found to operate through several channels. Atlantic trading routes carved out by the major empires, together with rail infrastructure, significantly increase raw sugar trade. The effect of cultural proximity depends on whether the common language is spoken by a minority or majority of a country's population. Trade policy has mixed effects; the import of raw sugar trade is enhanced by preferential treatment and is reduced by protectionist policy in the form of tariffs, albeit not significantly in tandem with the phasing out of tariffs in the post-reform period. Finally, EU preferential market access granted to 19 ACP Sugar Protocol countries over the pre-reform period covering the Lomé Conventions and the Cotonou Agreement is found to raise trade significantly and substantially. For the post-reform period, an insignificant trade effect is obtained for developing countries that qualify under the Everything But Arms (EBA) initiative, while the recent formation (and ongoing negotiation) of regional economic partnership agreements (EPAs) has yet to have an effect on raw sugar trade.

The remainder of the article is laid out as follows. Section 2 presents the gravity model specification of bilateral trade in raw sugar and the estimation strategy. A description of the data and sources are provided in Section 3. The empirical findings in Section 4 are split between the gravity model results, robustness checks and the main channels through which North-South colonial linkages affect trade patterns. Section 5 concludes.

2. MODEL SPECIFICATION AND ESTIMATION

2.1 The Gravity Model

To examine the effects of historical colonial linkages on sugar trade, the gravity model specification is as follows:

$$\begin{aligned} IMPORTS_{ij}^{t} = \exp(&\beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln DIST_{ij} \\ &+ \beta_4 ADJ_{ij} + \beta_5 LOCK_j + \beta_6 COLNN_{ij} + \beta_7 COLNS_{ij} + \varepsilon_{ij}^t \end{aligned} \tag{1}$$

where $IMPORTS_{ij}^{t}$ refer to the bilateral import of raw sugar into 25 member countries of the Organisation of Economic Co-operation and Development (OECD, countries i) from the rest of the world (countries j) over the 1961-2016 time period t. The gravity variables include the natural logarithm ($\ln$) of GDP for both countries to denote economic size, and the log of geographic distance as a proxy for transport costs. Four dummy variables are included, two to capture geographical characteristics (adjoining land borders and landlocked countries), with historical colonial linkages between countries split in two different directions (North-North and North-South). The random error term is denoted by ε_{ij}^t. A summary of the gravity model variable definitions and data sources is provided in the Appendix (Table A2).

Anderson (1979) was the first to provide theoretical underpinnings for the gravity model using the properties of the expenditure equation of tradable goods, whereby the origin country's GDP is a proxy for the production of traded goods, and the destination country's GDP is a proxy for expenditure on traded goods. The derived gravity model also captured transport costs, hence GDP and distance, $DIST_{ij}$, should be positively and negatively signed respectively.

Closer ties between two countries – whether geographical, historical, cultural, political, legal or otherwise – tend to increase trade. An adjoining land border, ADJ_{ij}, can expand trade with neighbouring countries mainly because lower costs facilitate cross border transactions. On the other hand, as overland transport costs tend to be higher than shipping costs, landlocked countries, $LOCK_j$, are disadvantaged in trade terms because of their geographical position.

Of particular interest is the trade effect of sharing a common colonial past, split between North-North and North-South colonial dummies, $COLNN_{ij}$ and $COLNS_{ij}$ (see Appendix: Table A1). A shared colonial history may well boost current economic linkages, usually because past colonisation of another country means that the coloniser has contributed to the colony's state of institutions – and the language of those institutions. In the case of raw sugar, the effect of colonialism is qualified by its direction. Low-cost producers of sugar cane in tropical countries have long since had a cost advantage over producers of sugar beet in the advanced countries. As sugar consumption evolved from a scarce luxury to a daily necessity, the rich world sought to forge links – often by force – with the developing world. Indeed, much of the foreign land seized under colonial rule was used in the production of raw sugar cane, exploited for trade and wealth gains (see, inter alia, Mintz 1985). More recently, northern countries have granted trade preferences to selected southern countries, thereby enhancing their relative cost-competitiveness. Consequently, a positive sign is expected for the North-South dummy. In contrast, an expected negative sign for the North-North dummy is aligned with the protected higher-cost beet industries in the northern hemisphere.

2.2 Estimation Strategy

As trade costs can differ depending on location, three main approaches have been adopted in the literature. First, cross-country variation in trade costs can be proxied by international differences in aggregate price indexes, for example, an exchange rate index, an export unit value index or the GDP deflator (Bergstrand 1989). This approach, however, entails a degree of arbitrary selection of price indexes, without necessarily eliminating the omitted variable bias problem. Second, to account for all those factors which impede bilateral trade, Anderson and van Wincoop (2003) compute multilateral price terms capturing bilateral trade costs relative to all other trading partner countries. Modifying model (1) to allow for multilateral trade-resisting variables, the gravity model can be expressed as follows:

$$\begin{aligned} IMPORTS_{ij}^{t} = \exp(&\beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln DIST_{ij} \\ &+ \beta_4 ADJ_{ij} + \beta_5 LOCK_j + \beta_6 COLNN_{ij} + \beta_7 COLNS_{ij} \\ &- \ln P_i^{1-\sigma} - \ln P_j^{1-\sigma}) + e_{ij}^t \end{aligned} \tag{2}$$

subject to *N* equilibrium conditions

$$\begin{aligned} P_j^{1-\sigma} = \sum_i P_i^{\sigma-1} \exp(&\beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln DIST_{ij} \\ &+ \beta_4 ADJ_{ij} + \beta_5 LOCK_j + \beta_6 COLNN_{ij} + \beta_7 COLNS_{ij}) \end{aligned}$$

where the aggregate price indexes are replaced with price terms for the exporting and the importing countries, $P_i^{1-\sigma}$ and $P_j^{1-\sigma}$ (the multilateral resistance terms); and σ is the elasticity of substitution between all goods.

Last, Feenstra (2002) advocates the use of country fixed effects in preference to calculating complex price terms. As trade costs are often not directly observable or are difficult to measure,

this approach has the advantage of generating unbiased coefficient estimates in the presence of measurement problems. Model (2) can thus be restated:

$$\begin{aligned} IMPORTS_{ij}^{t} = \exp(&\beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln DIST_{ij} \\ &+ \beta_4 ADJ_{ij} + \beta_5 LOCK_j + \beta_6 COLNN_{ij} + \beta_7 COLNS_{ij} \\ &+ \gamma_i + \omega_j) + \mu_{ij}^t \end{aligned} \tag{3}$$

where the price terms are now represented by fixed effects for the exporting and the importing countries, γ_i and ω_j, respectively. With the additional dimensions of panel datasets, solving the omitted variable bias problem has emerged in the form of how to control correctly for heterogeneity across countries (Baltagi *et al*. 2003; Baldwin and Taglioni 2006; Stack 2009). Specifically, the generalised gravity model for a panel (with both cross-sectional and time dimensions) should allow for time-invariant country-pair dummies to capture the omission of bilateral trade determinants, as well as time-varying country dummies to capture the variation of multilateral resistance over time (Baldwin and Taglioni 2006).

The generalised gravity model specification, however, is problematic for estimating the determinants of sugar in so far as the time-invariant variables (including the colonial dummies) are subsumed into the country-pair dummies and hence cannot be estimated directly. Moreover, in noting that the generalised version of the gravity equation cannot explain patterns of zero trade flows, Helpman *et al*. (2008) develop an estimation procedure that uses information relating to both trading and non-trading countries. They argue that gravity model studies of countries with positive trade flows only – and omitting countries that do not trade with each other (ie zero bilateral trade flows) – can lead to biased results.

Estimating the log-linear gravity model in the presence of zeros – a common issue in disaggregated data – is problematic because the logarithm of zero is undefined. Haq *et al*. (2013)

outline several ways in which the issue of zeros has been dealt with. Zero trade flows have been dropped or replaced with small positive numbers, but the results are potentially biased. More often, one of three approaches have been used: Tobit regression with the zero observations censored; Heckman's (1979) two-stage sample selection approach that corrects for possible bias; and the Poisson estimator. Santos Silva and Tenreyo (2006) advocate the last of these be used to deal with the issue of zeros, on the grounds that the Poisson pseudo maximum likelihood (PPML) attains unbiased and consistent estimates of the gravity model. In a follow-up paper, they show that the estimator works well even when the proportion of zeros is large (Santos Silva and Tenreyo 2011).

Evaluating the performance of several estimators of the gravity model, Xiong and Cheng (2014) find that PPML passes the specification test, in contrast to the Heckman model. They also note that the Tobit and Heckman models are subject to potential bias arising from the logarithmic transformation. Using a gravity equation similar to model (3), Anderson *et al*. (2015) estimate general equilibrium effects of changes in trade costs, based on a combination of theoretical developments (Anderson 1979; Anderson and van Wincoop 2003), the preferred use of PPML to deal with the issue of zeros (Santos Silva and Tenreyro 2006) and the properties of PPML to produce consistent estimates in the presence of exporter and importer fixed effects (Fally 2015). Accordingly, the gravity model of raw sugar trade determinants is estimated using the Poisson estimator with country fixed effects.

3. DATA

The panel dataset consists of bilateral imports of raw sugar into 25 OECD member countries[2] from the rest of the world[3] over the period 1961 to 2016. The listed OECD countries include the EU member countries, Japan and the United States, all of which feature among the major net importers of raw sugar (see Figure 1).

The data sources are as follows. Raw sugar trade (SITC 0611: sugars, beet and cane, raw, solid) in US dollars, are obtained from the *International Trade by Commodity Statistics* (ITCS), OECD. GDP data (in current US dollars) are from the *World Development Indicators* (WDI), World Bank. Distance, measured in kilometres between the capital cities of the trading partner countries, and the dummy variables, are from the CEPII.

The summary statistics for the data, shown in Table 1, highlight some interesting features. First, raw sugar imports are characterised by many zeros and missing observations.[4] In linear form, the variance for raw sugar imports is much higher than the mean, suggesting the data are over-dispersed.[5] Second, the measures of spread (the standard deviation about its mean value

[2] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, South Korea, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

[3] The country coverage is based on the 223 partner countries included in the CEPII database.

[4] For the panel dataset of raw sugar imports between 25 OECD countries and 223 partner countries using three-year averages over the 1961-2016 period, the number of potential observations is reduced from 105,925 to 9,702 observations if the dependent variable is in linear form and estimated as a Poisson regression, but is further reduced to 8,393 observations if specified in logarithmic form.

[5] Among the family of Poisson estimators, the zero inflated Poisson (ZIP) model helps account for an excessive number of zeros while the negative binomial regression (NBREG) uses an extra parameter to model over-dispersion.

and the range between the minimum and the maximum values) for the core gravity variables (GDP and distance) are indicative of the wide-ranging sample of countries in the dataset.

Table 1 Summary statistics

Variable	Mean	Standard deviation	Minimum	Maximum	No. of obs
Raw sugar import determinants					
Raw sugar imports	5 326 211	2.38e+07	0.00	5.11e+08	9 702
Raw sugar imports (ln)	10.97	3.83	0.00	20.03	8 393
GDP_i (ln)	25.72	2.02	19.49	30.52	105 925
GDP_j (ln)	22.80	2.54	15.99	30.52	76 306
Distance (ln)	8.70	0.81	4.09	9.88	105 925
Adjacency	0.01	0.11	0.00	1.00	105 925
Landlocked	0.16	0.37	0.00	1.00	105 925
Colony: North-North	0.01	0.09	0.00	1.00	105 925
Colony: North-South	0.03	0.18	0.00	1.00	105 925
North-South colonial channels					
Empire-5	0.20	0.40	0.00	1.00	105 925
Rail lines-to-GDPPC ratio	5.93	22.72	0.25×10^{-2}	255.50	24 931
Ethnic language	0.13	0.34	0.00	1.00	105 925
Tariff (ln)	2.55	1.92	0.00	8.07	14 430
EU–ACP	0.02	0.15	0.00	1.00	105 925
EU–EBA	0.02	0.14	0.00	1.00	105 925
EU–EPA	0.01	0.09	0.00	1.00	105 925

4. EMPIRICAL RESULTS

4.1 Gravity Model Results

Table 2 presents the results for the gravity model of raw sugar import determinants between 25 OECD countries and the rest of the world, using three-year averages for the period 1961-2016.

The Poisson estimates for the basic model (without price terms)[6] are shown in column (1). Time and country-specific effects are included in column (2) to account for variation of characteristics

Table 2 Raw sugar import determinants (1961-2016)[a]

Regressors	Poisson	+ Time + Country FE	pre-Reform	post-Reform
GDP_i	0.42**	0.34**	0.20	–0.28
	(15.43)	(2.06)	(1.18)	(–0.36)
GDP_j	–0.09**	0.19	0.18	0.61
	(–4.50)	(1.54)	(1.54)	(0.95)
Distance	0.38**	–0.75**	–0.54**	–1.27**
	(5.92)	(–12.57)	(–8.52)	(–10.49)
Adjacency	0.97**	1.58**	1.70**	1.54**
	(3.10)	(8.19)	(6.47)	(7.71)
Landlocked	–0.91**	0.49	–	–1.09
	(–11.08)	(0.56)		(–1.10)
Colony: N-N	–0.76**	–0.69**	–0.42	–1.11**
	(–2.83)	(–2.43)	(–1.29)	(–3.00)
Colony: N-S	1.11**	1.47**	1.75**	0.85**
	(12.27)	(13.35)	(14.82)	(3.76)
No. of obs	8 931	8 931	6 503	2 434
Pseudo R^2	0.19	0.74	0.77	0.78
F test for the time and country fixed effects				
Time	–	115**	109**	7.91**
$Country_i$	–	1 469**	1 870**	545**
$Country_j$	–	54 812**	6 061**	580 000**

[a] The *z*-statistics in parentheses are heteroscedasticity robust.
** denotes significance at the 5% level; * denotes significance at the 10% level.

across countries.[7] Note that the goodness-of-fit (R^2) increases substantially when the specific effects are admitted into the model, with the independent variables explaining three quarters of

[6] Country-specific price terms are not included because of data limitations. For example, the producer price indexes for sugar beet and sugar cane from FAOSTAT are available for the years 1992-2015 only. Moreover, including these price terms is problematic because some countries have broad-ranging values associated with high inflation – and even hyperinflation, for example, Zimbabwe, Brazil, Belarus, Turkey and Venezuela.

the variance of the dependent variable. The joint significance of the country fixed effects, as indicated by the F tests, suggests their inclusion in the model is warranted.

To gain an insight into the changing nature of raw sugar import determinants over time, columns (3) and (4) show the sub-period results for the pre-reform (1961-2007) and post-reform periods (2008-2016). Indeed, the recent major reform of the EU's sugar policy is the first of its kind since the Common Market Organisation (CMO) was established in 1968 to ensure a fair income for sugar producers (via guaranteed minimum support prices) and the availability of adequate supplies. In essence, EU sugar policy combined import duties and export refunds to protect the internal market while the production quota system served to limit the total quantity eligible for price support. Consequently, sugar has received high support when compared even with other products covered by the EU's Common Agricultural Policy (Nolte *et al*. 2010). At the same time, the EU has imported sugar under various preferential schemes. As part of the domestic policy reforms, the unilateral preferences granted by the EU to the ACP countries are being replaced with reciprocal (full or interim) regional EPAs that are compatible with World Trade Organisation (WTO) rules.

The results shown in Table 2 suggest the model coefficient signs are broadly in line with theoretical priors. Specifically, the core gravity variables (GDP and distance) are correctly signed for the preferred model specification (column 2); while omitting the country fixed effects incurs an incorrectly signed distance coefficient (column 1). The larger distance coefficient for the post-

[7] Anderson *et al*. (2015) suggest the country fixed effects should be time-varying for panel data, but in view of the large number of dummies and the failure of the Poisson estimator to converge, time effects are included in the model instead. As a robustness check, a least squares regression with time-varying country fixed effects was run; the strong, positive and significant coefficient for the North-South colonial dummy remains intact (results available on request).

reform subsample suggests a rise in transaction costs over time in line with the 'distance puzzle'.[8] Although positively signed, the GDP coefficients deviate from their theoretical values of unity; Baldwin and Taglioni (2006) have previously pointed out that the economic mass coefficients can tend towards zero because GDP is merely a proxy for the production and expenditure of tradable goods in the origin and destination countries.

Adjacent borders significantly increase trade in raw sugar, while the downside of being landlocked is wiped out for the preferred specification. More interesting are the distinct effects of the North-North and North-South colonial dummies. The negatively signed coefficient for the North-North colonial dummy suggests historical colonial ties between the rich countries suppress trade in raw sugar. Although insignificant in the pre-reform period, its magnitude and significance increases in the post-reform period. In contrast, a strong positive and significant effect is found for the North-South colonial dummy, implying the effect of colonial ties endures long after many countries have gained independence. The magnitude of its effect, however, decreases over time. These results suggest the non-uniform effect of sharing a common colonial past depends on the direction of trade, which in turn depends on the source of raw sugar: cane from the tropical South or beet from the temperate North.

4.2 Robustness Checks

Several robustness tests are undertaken to check the sensitivity of the results for the preferred model specification of raw sugar imports. First, to test whether the results are sensitive to the

[8] A revolution in world trade, containerisation and the concomitant reduction of shipping costs – and shipping times – should lower the distance elasticity over time. The puzzling increase in its elasticity, however, is partly explained by the intermodal nature of freight whereby the transfer of cargo from ships to trains and trucks has also involved a transfer of operating costs.

specification of the model, per capita income levels for both countries are included as additional regressors. In identifying separate roles for GDP and per capita GDP, Bergstrand (1989) amalgamates the factor-proportions theory (primarily a supply-oriented theory) and the demand-based theory of similarity of demand characteristics within a Heckscher–Ohlin–Chamberlain–Linder framework. In essence, the per capita income variables capture factor endowment variables in the exporting country (Heckscher 1919; Ohlin 1933) and demand generated by non-homothetic preferences in the importing country (Linder 1961). Therefore, the coefficients for income per capita will be positively signed if the good exchanged is a luxury in consumption, is capital-intensive in production and its elasticity of substitution exceeds unity. In contrast, negatively signed coefficients accrue if the good exchanged is a necessity in consumption and is labour-intensive in production.

Second, to check whether the world's largest exporter of raw sugar (see Figure 2) is driving the results, the model is re-estimated for a subsample of countries that excludes Brazil, following the approach of Emlinger *et al.* (2008) to drop observations for some geographic areas. In fact, Brazil dominates world trade, accounting for 40 per cent of global exports of raw sugar in 2014 (ISO 2017). Nevertheless, the flexibility of Brazilian sugar producers to allocate their cane yield between sugar and ethanol production can lead to cyclical periods of over- and under-supply and thus variation of trade (Nolte *et al*. 2010). The subsample of countries eliminates this potential source of uncertainty.

Third, the model is re-estimated using alternative estimators, namely the ZIP model, which helps account for an excessive number of zeros; NBREG, which uses an extra parameter to model over-dispersion; and two-stage least squares (2SLS), which is an instrumental variables (IV) approach, to control for possible endogeneity arising from reverse causality. The causality

between colonial linkages and trade need not necessarily be unidirectional. Former empires may have colonised areas where trade linkages were already well-established or where there was potential for strong trade linkages between the region and the metropole (Mitchener and Weidenmier (2008). As an instrument for empires, they use a lagged value of the size of other empires, measured by area. In a similar vein, the instruments used for the North-North and North-South colonial dummies are based on land area, whereby the value of unity for the respective colonial dummies is replaced with joint land area. Joint land area should serve as a good instrument for colonial linkages given that much foreign land was seized under colonial

Table 3 Robustness checks[a,b]

Regressors	Model specification	Subsample	ZIP	NBREG	2SLS
GDP_i	1.43**	0.24	0.33**	0.28*	–0.14
	(2.16)	(1.45)	(2.04)	(1.70)	(–0.71)
GDP_j	0.36	0.05	0.19	0.05	–0.07
	(1.28)	(0.41)	(1.60)	(0.51)	(–0.61)
Distance	–0.75**	–0.73**	–0.73**	–1.18**	–1.08**
	(–12.56)	(–12.03)	(–12.01)	(–21.17)	(–17.64)
Adjacency	1.58**	1.54**	1.52**	1.25**	1.49**
	(8.18)	(7.77)	(7.85)	(9.57)	(10.08)
Landlocked	–0.50	0.69	–0.92**	–0.92**	–2.30**
	(–0.31)	(0.75)	(–4.77)	(–4.77)	(–5.89)
Colony: N-N	–0.70**	–0.53*	–0.63**	–0.30*	–1.26**
	(–2.56)	(–1.89)	(–2.20)	(–1.76)	(–4.80)
Colony: N-S	1.47**	1.77**	1.44**	1.25**	1.17**
	(13.30)	(13.90)	(13.06)	(9.35)	(3.31)
GDP per $capita_i$	–1.09*	–	–	–	–
	(–1.73)				
GDP per $capita_j$	–0.22	–	–	–	–
	(–0.73)				
No. of obs	8 931	8 666	8 931	8 931	7 683
R^2	0.74	0.75	–	–	0.55
Robust score χ^2 test[c]	–	–	–	–	26.48**
Robust regression *F*-test[c]	–	–	–	–	14.56**

[a] All regressions include time and country fixed effects.
[b] The *z*-statistics in parentheses are heteroscedasticity robust.
[c] A test of the null hypothesis that the colonial dummies are exogenous (Wooldridge 1995).
** denotes significance at the 5% level; * denotes significance at the 10% level.

rule, implying a direct link between the two.[9] The results for the robustness checks are shown in Table 3. Although there is some variation in the magnitude and significance of the remaining model coefficients, the positive and significant coefficient for the North-South dummy is robust across the range of sensitivity checks.

4.3 North-South Colonial Channels

Having established a strong positive influence of North-South colonial linkages on raw sugar imports, this section analyses the main channels through which the effects of colonial ties have endured over time.

4.3.1 Potential Colonial Channels

First, the rise of European colonial empires began with the Age of Exploration and the pioneering long-distance maritime travel by the Portuguese and the Spanish. Indeed, innovations in shipping technology relating to rigging and hull design coupled with knowledge of oceanic navigation helped bring about Atlantic trade opportunities, the passage to Asia around the Cape of Good Hope and the discovery of the New World (Acemoglu *et al*. 2005). Other major empires included the French, Dutch and British empires, the last becoming the largest in history as improved transport technologies brought the global regions of Asia, Africa, the Americas and Oceania within its reach. To consider the effect of the five major empires on raw sugar imports, a dummy variable, $EMPIRE5_i$, is set equal to one for France, the Netherlands, Portugal, Spain and

[9] The (simple) correlation between the instruments and the colonial dummies is reasonably high (0.59 and 0.47), while the correlation between the instruments and imports is limited (–0.04 and 0.11).

the United Kingdom and zero otherwise.[10] In seeking to explain the rise of Western Europe, Acemoglu *et al*. (2005) use a similarly defined dummy variable to capture the potential for trade via Atlantic routes by the nations most directly involved in trade and colonialism.

Second, faster steamships paving the way for ocean travel were not the only transport technologies to help expand colonial rule abroad. Darwin (2012) notes that shipping and railway technologies (and the telegraph) made it possible to expand, police and govern empires with a relatively small army and administration. Rail networks – critical to the Industrial Revolution and the development of export economies – remain an important mode of land transport. Consequently, total railway routes measured in kilometres and scaled by GDP per capita, $RAIL_j^t$, sourced from the WDI, World Bank, is used to assess the effect of a country's internal transport network on raw sugar trade. Raballand (2003) employs a similarly scaled measure of infrastructure to take account of the difference between large and small countries.

Third, commerce and colonisation spread European languages to indigenous populations. Based on the principles of mercantilism and imperial preference, merchants had a strong financial incentive to learn the language of colonists in order to sell more goods (Mitchener and Weidenmier 2008). Speaking the colonial language along with familiarity of foreign customs and norms can help lower transaction costs and payment frictions associated with trade. For example, social networks and informal relationships can encourage deals where laws of contract are weak which, in turn, help foster trade. Even if the main language spoken by the population differed

[10] Only the major empires engaged in substantial Atlantic trade and colonial activity are considered. Smaller empires (such as those of Germany and the United States) did not play a major role in long-distance oceanic trade.

from that of the imperial power,[11] a lingua franca often sprung up around commercial centres (Mitchener and Weidenmier 2008). Accordingly, a common ethnic language dummy, $LANG_{ij}$, sourced from the CEPII, is used to analyse the trade effect of cultural proximity. Francois and Manchin (2013) also use this measure as a proxy for linguistic or cultural heritage.

Last, trade policy can also act as a channel through which North-South colonial ties can affect trade in sugar. Sugar is one of the most policy-distorted of all commodities and among the worst offenders are the EU, Japan and the United States where producer prices are supported at levels much higher than international prices (Mitchell 2004; Elobeid and Beghin 2006). With a combination of production quotas, import controls and export subsidies, support has been greatest in the EU (Mitchell 2004). In the United States, domestic prices are supported at about double world prices, quotas are in place to limit production, and tariff rate quotas (TRQs) limit imports. In Japan, government intervention in the sugar market takes the form of guaranteed minimum prices for sugar beet and cane, controls on raw sugar imports, prohibitive duties on refined sugar imports, high tariffs on imported products containing sugar, as well as quotas, tariffs and other controls on sugar substitutes. As a measure of sugar protection, tariffs levied on the product category 1701 (cane or beet, solid), is sourced from the Trade Analysis Information System (TRAINS), United Nations Conference on Trade and Development (UNCTAD) and defined as the log of the (simple average) tariff, $\ln(1+\tau_{ij}^{t})$, in line with others in the empirical literature (Cipollina and Salvatici 2010; Francois and Manchin 2013).

The flipside of protectionism is preferential treatment. Colonies may well have provided an avenue for European powers to set up preferential trading arrangements (Estevadeordal *et al*.

[11] The incentive to learn the language of the colonists was counterbalanced by the self-serving interests of the Europeans to respect local customs and laws – including the institution of slavery.

2003). Policies adopted by Imperial powers included: tariff assimilation, which in effect created a customs union between the metropole and the colony; preferential tariff policies with lower or zero tariffs applied on imports from the colony; and 'open door' policies where, instead of differential policies at the border, levies were often used to protect local industries or to raise revenue for the fiscal authority (Mitchener and Weidenmier 2008). Imperial preferences under the British Commonwealth Preference Scheme (1932) were granted on the basis of 'home producers first, empire producers second and foreign producers last'.

For sugar in particular, under the Commonwealth Sugar Agreement (CSA) the United Kingdom guaranteed to purchase specified quantities of sugar from the Commonwealth countries for a price higher than the market price. With its accession into the European Community (EC) in 1973, this preferential agreement was replaced with the Sugar Protocol attached to the Lomé Convention, under which specified import quotas of cane sugar at the same guaranteed prices as EC producers (about three times the world market price) were allocated primarily to a subset of the ACP countries (Garside *et al*. 2005).[12]

The non-reciprocal preferential treatment of the ACP countries under the Sugar Protocol was largely retained in the later Lomé Conventions and the Cotonou Agreement. Specifically, the import quantities of sugar specified under the Lomé Convention, known as 'preference sugar' were expanded in 1995 ('special preference sugar'), but at a lower price and a quantity that

[12] The origin of trade preferences for the ACP countries goes back to the Treaty of Rome signed in 1957, which expressed a commitment to the prosperity of European (mostly French) colonies. After gaining independence, reciprocal preferences between six European countries and 19 (mostly African) former colonies were enshrined in the Yaoundé Conventions signed in 1963 and 1969 (Persson 2008). To accommodate the preferences of British former colonies, Yaoundé was replaced with the Lomé Convention and European-African co-operation was expanded to the Caribbean and Pacific countries – 46 developing countries in all.

varied according to import needs (Mitchell 2004). Import allocations were also granted to India and were expanded to several developing countries in 2001 under the EBA initiative while several Balkan countries also received temporary access to the EU market (Mitchell 2004).

Pressures to reform the preferential sugar regime – leading to the phasing out of the Sugar Protocol – arose from three distinct sources (Ackrill and Kay 2011). First, duty free and quota free (DFQF) imports from the developing countries under the EBA initiative would undermine the preferential treatment offered to ACP countries under the Sugar Protocol. Second, a WTO ruling required the EU to substantially reduce its volumes of subsidised sugar exports. Finally, maintaining a protectionist sugar regime became increasingly difficult in the face of ongoing CAP reforms undertaken since 1992 to cut support prices.

During the transition period to phase out the Sugar Protocol, guaranteed prices are to decrease and eventually be abolished; quotas are to come to an end; and imports from the ACP countries are to become DFQF under seven regional EPAs. In essence, the EPAs are trade and development partnerships between the EU and ACP countries, with the main aims of providing tariff and quota free access to the EU market (for all goods, not just for sugar); fostering trade-related co-operation; and promoting sustainable development through investment. A summary of the EU–ACP PTAs and EPAs is provided in the Appendix (Table A3).

Preferential treatment is most often captured by a dummy variable denoting the formation of a particular trade agreement (Zahniser *et al*. 2002; Baier and Bergstrand 2007; Grant and Lambert 2008). Three dummies – one covering the pre-reform period and two covering the post-reform period – are constructed to capture the potential beneficial effects of EU preferential

market access on raw sugar trade.[13] First, the $EU - ACP_{ij}^{t}$ dummy is defined as unity for the 19 ACP Sugar Protocol countries under the Lomé Conventions and the Cotonou Agreement over the pre-reform period 1976-2007.[14] Second, the $EU - EBA_{ij}^{t}$ dummy takes the value of unity from 2009 onwards – the date from which imports for any country classified as a developing country became DFQF.[15] Third, the $EU - EPA_{ij}^{t}$ dummy takes the value of one if an ACP country has entered into a full or interim EPA.[16] In short, to allow for the main channels through which North-South colonial ties can affect trade in raw sugar, the gravity model variables are summarised as follows:

[13] Note that the dataset based on 25 OECD countries accounts for the 15 established member countries of the EU only. Over time, the European Economic Community (EEC), with its six founding members (Belgium, France, (West) Germany, Italy, Luxembourg and the Netherlands), was expanded by four rounds of enlargement when Denmark, Ireland and the United Kingdom joined in 1973; Greece in 1981; Portugal and Spain in 1986; and Austria, Finland and Sweden in 1995. The dataset does not account for the three most recent rounds of enlargement, which increased the number of EU member countries to 28.

[14] The 19 ACP Sugar Protocol countries are Barbados, Belize, Congo, Côte d'Ivoire, Fiji, Guyana, Jamaica, Kenya, Madagascar, Malawi, Mauritius, Saint Kitts and Nevis, Suriname, Swaziland, Tanzania, Trinidad and Tobago, Uganda, Zambia and Zimbabwe.

[15] Currently, 47 countries qualify for EBA status: Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, DR Congo, Djibouti, East Timor, Guinea, Eritrea, Ethiopia, The Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Laos, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, São Tomé and Príncipe, Senegal, Sierra Leone, Solomon Islands, Somalia, South Sudan, Sudan, Tanzania, Togo, Tuvalu, Uganda, Vanuatu, Yemen and Zambia (United Nations, 2017).

[16] The EPA dummy is based on information in the Appendix (Table A3).

$$
\begin{aligned}
IMPORTS_{ij}^{t} = \exp(&\beta_1 \ln GDP_i^t + \beta_2 \ln GDP_j^t + \beta_3 \ln DIST_{ij} \\
&+ \beta_4 ADJ_{ij} + \beta_5 LOCK_j + \beta_6 COLNN_{ij} + \beta_7 COLNS_{ij} \\
&+ \eta_1 EMPIRE5_i + \eta_2 RAIL_j^t + \eta_3 LANG_{ij} \\
&+ \eta_4 \ln TARIFF_{ij}^t + \eta_5 PTA_{ij}^t + \gamma_i + \omega_j) + u_{ij}^t
\end{aligned}
\tag{4}
$$

4.3.2 Colonial Channel Estimates

Table 4 presents the gravity model results which include the North-South colonial channels. For ease of comparison, the baseline specification (without colonial channels) is shown in column (1). Columns (2) to (6) show the independent effects of the various channels on raw sugar imports. Column (7) shows the results when all the colonial channels are simultaneously included in the model.

Table 4 Raw sugar import determinants and North-South colonial channels[a,b]

Regressors	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Raw sugar import determinants							
GDP_i	0.34**	0.34**	0.61*	0.34**	0.80**	0.35**	0.79**
	(2.06)	(2.06)	(1.88)	(2.09)	(2.21)	(2.15)	(1.98)
GDP_j	0.19	0.19	0.46*	0.19	0.23	0.21*	0.38
	(1.54)	(1.54)	(1.78)	(1.57)	(1.18)	(1.67)	(1.12)
Distance	–0.75**	–0.75**	–1.31**	–0.74**	–0.90**	–0.80**	–1.41**
	(–12.57)	(–12.57)	(–12.59)	(–12.25)	(–10.15)	(–13.01)	(–8.18)
Adjacency	1.58**	1.58**	1.27**	1.55**	2.23**	1.49**	1.35**
	(8.19)	(8.19)	(5.89)	(8.00)	(4.34)	(7.80)	(2.54)
Landlocked	0.49	0.49	2.59**	0.47	0.28	–0.16	1.33**
	(0.56)	(0.56)	(4.07)	(0.53)	(0.34)	(–0.18)	(2.00)
Colony: N-N	–0.69**	–0.69**	–0.71**	–0.76**	–3.44**	–0.56**	–2.08**
	(–2.43)	(–2.43)	(–2.71)	(–2.60)	(–7.88)	(–2.00)	(–3.02)
Colony: N-S	1.47**	1.47**	0.87**	1.39**	1.50**	1.33**	0.46
	(13.35)	(13.35)	(3.26)	(10.18)	(10.18)	(11.02)	(0.84)
North-South colonial channels							
Empire-5	–	2.10**	–	–	–	–	1.95**
		(5.53)					(2.50)
Rail lines	–	–	0.01**	–	–	–	0.01**
			(3.58)				(3.51)
Ethnic language	–	–	–	0.11	–	–	0.76**
				(0.99)			(3.49)
Tariff	–	–	–	–	–0.10**	–	–0.06
					(–2.78)		(–1.22)
EU-ACP	–	–	–	–	–	1.18**	1.44**
						(7.18)	(5.62)
EU-EBA	–	–	–	–	–	1.05**	0.46
						(4.68)	(1.31)
EU-EPA	–	–	–	–	–	0.27	–
						(1.12)	
No. of obs	8 931	8 931	5 426	8 931	4 917	8 931	3 136
Pseudo R^2	0.74	0.74	0.82	0.74	0.78	0.75	0.85

[a] All regressions include time and country fixed effects.
[b] The *z*-statistics in parentheses are heteroscedasticity robust.
** denotes significance at the 5% level; * denotes significance at the 10% level.

The existence of former major European empires exerts a strong positive effect on sugar trade, as shown in Column (2).[17] Long after the empires have dissolved, their transatlantic trading routes remain in place with consequential effects on the volumes of sugar traded. In other words, trading routes have helped maintain a degree of economic dependence, despite political independence. This result is consistent with Mitchener and Weidenmier (2008), who find empire membership more than doubles bilateral trade in a historical context.

Although small in magnitude, rail lines are also found to be beneficial for the import of raw sugar (column 3). A good network of rail connectivity is essential to transport many bulky agricultural goods overland, including raw sugar, consistent with the findings in the literature (Donaldson 2010; Mitchener and Weidenmier 2008).

Trade in raw sugar is found to be unresponsive to a common ethnic language (column 4); having acclimatised to local customs and habits over time, the associated lower transaction costs no longer have an effect.[18] In analysing economic performance, Acemoglu *et al*. (2005) obtain

[17] Re-estimating the model with individual dummies for the five major empires, the results suggest a positive and significant trade effect for all empires except the Dutch empire. In terms of the magnitude of effects, the British empire coefficient is found to be highest, reflecting its maritime might, followed by that of Portugal, Spain and France. The non-uniform effects across the empires reflect differing levels and durations of engagement in colonial sugar production and trade, but may also accrue from differing trade policies or varying transaction costs (Mitchener and Weidenmier 2008).

[18] Language is defined as a country's ethnic language spoken by at least 9 per cent of a country's population. Testing for the effect of the official or national language yields a negative and significant result. This counter-intuitive result is at least partly explained by the trade protectionist policies of the former colonial powers. Indeed, many English-speaking Caribbean producers that were offered high guaranteed prices under the Sugar Protocol have persevered with outdated practices (such as harvesting by hand), thereby making it difficult to compete with the mechanised

similar findings in so far as the rise of Europe is attributed to profits involved in Atlantic trade and colonialism, while distinctive European characteristics including culture and religion are relegated to insignificance.

Not surprisingly, tariffs reduce bilateral trade in raw sugar (column 5). Since Europeans first established domestic sugar industries in the early 1800s – encouraged by subsidising higher-cost sugar beet production in reaction to rebellion and disrupted supplies in the colonies – a long tradition of protectionism has characterised the sugar industry.[19] Indeed, the clash between sugar beet and sugar cane has remained a centrepiece of sugar policy in Europe (Mitchell 2004). In effect, Northern countries have protected their domestic producers from cheap imports, even though many are net sugar importers.

At the same time the sugar industry is also defined by preferential market access (Garside *et al*. 2005). Indeed, in the presence of domestic import protection, preferential market access for raw sugar has been presented as a development policy (Ackrill and Kay, 2011). Representing one of the longest standing and highest preference margin granting agreements (Williams and Ruffer 2003), the EU-ACP Sugar Protocol is found to raise trade significantly and substantially (column 6). A similarly high trade effect is obtained for the EUs EBA initiative, reflecting the large number of beneficiaries under this scheme, including former beneficiaries under the Sugar Protocol. The recent formation (and ongoing negotiation) of regional EPAs has yet to have an

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sugar operations of Brazil and Australia. Faced with high average costs and low productivity, the consequence is borne out in shrinking exports of raw sugar.

[19] In Northern countries, the sugar industry has become highly politicised with concomitant arguments for protectionist trade policies. Under the CAP, for example, sugar is the only sector that receives predictable terms for delivering and buying beet without competition scrutiny, implying EU beet growers are more protected than any other farmers (European Commission, 2016).

effect on the imports of raw sugar trade. Take, for example, the CARIFORUM EPA with 15 Caribbean countries and territories. Apart from Belize, where sugar provides a quarter of export earnings, the decline of sugar in the region is rife. Some have closed down their last sugar factories, abandoning cane in favour of more profitable activities (Saint Kitts and Nevis; Trinidad and Tobago) while elsewhere the sugar industry is under pressure as losses mount up, workers are laid off and exports dwindle (Barbados, Guyana and Jamaica). This process has been driven strongly by the extent of the EU sugar policy reform, notably the abandonment of high prices paid for preferential sugar, replaced by DFQF market access but at much lower prices.

Putting all the colonial channels together, the results for the full model are shown in column (7) in Table 4. In terms of the trade policy variables, Scoppola *et al*. (2018) have previously included tariffs and PTA dummies in a trade model of agricultural and food products. Accordingly, tariffs should reduce trade while the effect of PTAs is indeterminate, depending on whether the associated lowering of non-tariff barriers is outweighed by the cost of compliance with the preferential scheme, for example through additional costs associated with rules of origin.

When all colonial channels are included in the model, the most notable change in the results is that the North-South colonial dummy becomes insignificant. In other words, the legacy of colonial ties between the old and new worlds is picked up by the combined effects of the various channels in the full model. Some of the channels also become insignificant in the full model, namely tariffs and the EU-EBA dummy, likely reflecting the phasing out of tariffs on sugar for countries that qualify for EBA status, becoming zero after 2009. In contrast, the effect of a common minority language becomes significant.[20]

[20] Testing for the effect of national language in the full model, its coefficient remains negative and significant.

The inclusion of the various channels in the model also has consequences for the remaining model coefficients, mainly in relation to an increased magnitude of effect (importer GDP, distance, landlocked and the North-North colonial dummy). In addition, the geographic disadvantage of landlocked countries becomes a significant advantage when connected by railways (columns 3 and 7). Note that the inclusion of all channels in the model reduces the number of observations (data for railway routes are available from 1980 onwards, while tariff information is available for 1988-2014). Therefore, the model coefficients are not directly comparable across the different sample periods.

4.3.3 Counterfactual Predictions

So far, the statistical significance of North-South colonial linkages has been established. It is also useful to consider the economic significance of the results. In other words, what is the counterfactual change in the dependent variable if the value for each colonial channel is hypothetically altered? A typical counterfactual comparative static exercise using the gravity model involves hypothetically changing some bilateral friction (for example, the removal of a tariff) and calculating the effects on trade flows (Anderson *et al*. 2015).

Taking each colonial channel in turn, the percentage change in the mean of the dependent variable is calculated under the following scenarios: (1) if the five major European empires had never existed; (2) if rail lines in partner countries had increased by 100 per cent; (3) if countries had not shared the same minority language; (4) if raw sugar trade had been liberalised; and (5) if PTAs had been eliminated. In essence, this amounts to resetting tariffs and the dummy variables (empire5, language and PTAs) to zero while the value of rail lines is doubled in view of the time and money spent on infrastructure planning.

A comparison of the means of the dependent variable, shown in Table 5, suggests the greatest effect on raw sugar imports emanates from empires, without which the imports of raw sugar would be up to one-third lower. The effect of eliminating PTAs is more modest, reducing raw sugar trade by one-tenth. Expanding a country's internal transport network of railways would increase raw sugar trade by up to one-tenth. The trade effect of no common language is relatively minor while the effect of removing tariffs is negligible.

Table 5 Counterfactual predictions

	Empire-5	Rail lines	Ethnic language	Tariff	EU PTAs
Counterfactual change in the mean of the dependent variable (US$ million)					
Predicted value	1.84	1.82	1.83	2.99	1.79
Predicted counterfactual value	1.34	1.96	1.76	3.00	1.63
Percentage change	–27%	7.71%	–3.76%	0.58%	–9.14%

5. CONCLUSIONS

Using a gravity model for a panel of bilateral imports of raw sugar into 25 OECD countries from the rest of the world over the 1961-2016 period, the effect of historical colonial linkages on sugar trade is assessed. In distinguishing between the geographical types of the colonial partner, opposing coefficient signs for the colonial dummies are found: positive in a North-South direction and negative in a North-North direction. These results suggest the legacy of a common colonial past depends on the type of sugar traded and the climatic location of the ex-colony, with raw sugar coming either from lower-cost sugar cane grown mainly in tropical regions or higher-cost sugar beet grown in more temperate climates.

Multiple channels through which North-South colonial linkages continue to affect trade are also identified. First, transatlantic and long-distance maritime connections contribute

positively to the global patterns of raw sugar imports, reflecting trading routes first opened up during the Empire era. A good network of rail connectivity is also essential to transport bulky agricultural goods like sugar. Taken together, these findings suggest that further infrastructure developments such as improved port efficiency and an extended internal transport network – and indeed facilitating intermodal transport linkages that connect ports with overland transport systems through containerisation – can help enhance the trade benefits of historical colonial linkages for Southern countries.

Second, the spread of commerce and colonisation also dispersed European languages and cultures. The effect on raw sugar imports, however, depends on whether the common language is spoken by a minority or majority of a country's population – the effect turning negative for a common national language, likely reflecting the protectionist trade policies of the former colonial powers.

Third, despite a long tradition of protectionism in the sugar industry, protectionist trade policy in the form of tariffs is not a significant barrier to the import of raw sugar in the full model, in tandem with the phasing out of tariffs on sugar for countries that qualify for EBA status, becoming zero after 2009.

Last, EU preferential market access granted to 19 ACP Sugar Protocol countries over the pre-reform period covering the Lomé Conventions and the Cotonou Agreement is found to raise trade significantly and substantially. In other words, EU policy initiated in 1975 offering selective, non-reciprocal trade preferences to former colonies have helped maintain historical trade flows in sugar. For the post-reform period, an insignificant trade effect is obtained for developing countries that qualify under the EBA initiative while the recent formation (and ongoing negotiation) of regional EPAs has yet to have an effect on raw sugar trade. In short,

long-standing historical linkages between Europe and its former colonies continue to exert a strong influence on the policies and patterns of sugar trade along well-worn paths.

REFERENCES

Acemoglu, D., S. Johnson and J. Robinson (2005), The rise of Europe: Atlantic trade, institutional change, and economic growth, *American Economic Review*, 95(3), 546-579.

Ackrill, R. and A. Kay (2011), Multiple streams in EU policy-making: The case of the 2005 sugar reform, *Journal of European Public Policy*, 18(1), 72-89.

Anderson, J. E. (1979), A theoretical foundation for the gravity equation, *American Economic Review*, 69(1), 106-116.

Anderson, J. E. and E. van Wincoop (2003), Gravity with gravitas: A solution to the border puzzle, *American Economic Review*, 93(1), 170-192.

Anderson, J. E., M. Larch and Y. V. Yotov (2015), Estimating general equilibrium trade policy effects: GE PPML, *CESifo Working Paper Series* No. 5592.

Baier, S. L. and J. H. Bergstrand (2007), Do free trade agreements actually increase members' international trade?, *Journal of International Economics*, 71(1), 72-95.

Baldwin, R. and D. Taglioni (2006), Gravity for dummies and dummies for gravity equations, *NBER Working Paper* No. 12516.

Baltagi, B. H., P. Egger and M. Pfaffermayr (2003), A generalized design for bilateral trade flows models, *Economics Letters*, 80(3), 391-397.

Bergstrand, J. H. (1989), The generalized gravity equation, monopolistic competition, and the factor-proportions theory in international trade, *Review of Economics and Statistics*, 71(1), 143-153.

Brodzicki, T. and S. Uminski (2017), A gravity panel data analysis of foreign trade by regions: The role of metropolises and history, *Regional Studies*, 52(2), 261-273.

Centre d'études prospectives et d'informations internationales (CEPII, 2017), DOI: http://www.cepii.fr/CEPII/en/bdd_modele/bdd.asp.

Cipollina, M. and L. Salvatici (2010), The trade impact of European Union agricultural preferences, *Journal of Economic Policy Reform*, 13(1), 87-106.

Darwin, J. (2012), *Unfinished Empire: The global expansion of Britain*, London: Penguin Books Ltd.

Donaldson, D. (2010), Railroads of the Raj: Estimating the impact of transportation infrastructure, *NBER Working Paper* No. 16487.

Eichengreen, B. and D. A. Irwin (1998), The role of history in bilateral trade flows. In J. A. Frankel (ed.), *The Regionalization of the World Economy*, 33-62, Chicago: University of Chicago Press.

Elobeid, A. and J. Beghin (2006), Multilateral trade and agricultural policy reforms in sugar markets, *Journal of Agricultural Economics*, 57(1), 23-48.

Emlinger, C., F. Jacquet and E. Chevassus Lozza (2008), Tariffs and other trade costs: Assessing obstacles to Mediterranean countries' access to EU-15 fruit and vegetable markets, *European Review of Agricultural Economics*, 35(4), 409-438.

Estevadeordal, A., B. Frantz and A. M. Taylor (2003), The rise and fall of world trade, 1870-1939, *Quarterly Journal of Economics*, 118(2), 359-407.

European Commission (EC, 2016), DOI: http://ec.europa.eu/agriculture.

Fally, T. (2015), Structural gravity and fixed effects, *Journal of International Economics*, 97(1), 76-85.

Feenstra, R. C. (2002), Border effects and the gravity equation: Consistent methods for estimation, *Scottish Journal of Political Economy*, 49(5), 491-506.

Food and Agriculture Organization of the United Nations (FAOSTAT, 2017), DOI: http://www.fao.org/faostat/en.

Francois, J. and M. Manchin (2013), Institutions, infrastructure, and trade, *World Development*, 46(1), 165-175.

Garside, B., T. Hills, J. C. Marques, C. Seeger and V. Thiel (2005), Who gains from sugar quotas?, *ODI-LSE Destin DV406 Research Project*.

Grant, J. H. and D. M. Lambert (2008), Do regional trade agreements increase members' agricultural trade?, *American Journal of Agricultural Economics*, 90(3), 765-782.

Harms, R. (2003), Early globalization and the slave trade, *Yale Global Online*, DOI: https://yaleglobal.yale.edu/content/early-globalization-and-slave-trade.

Haq, Z. U., K. Meilke and J. Cranfield (2013), Selection bias in a gravity model of agrifood trade, *European Review of Agricultural Economics*, 40(2), 331-360.

Head, K., T. Mayer and J. Ries (2010), The erosion of colonial trade linkages after independence, *Journal of International Economics*, 81(1), 1-14.

Heckman, J. J. (1979), Sample selection bias as a specification error, *Econometrica*, 47(1), 153-161.

Heckscher, E. (1919), The effect of foreign trade on the distribution of income, *Ekonomisk Tidskrift*, 21, 497-512.

Helpman, E., M. Melitz and Y. Rubinstein (2008), Estimating trade flows: Trading partners and trading volumes, *Quarterly Journal of Economics*, 123(2), 441-487.

International Sugar Organization (ISO, 2017), DOI: http://www.isosugar.org.

Linder, S. B. (1961), *An essay on trade and transformation*, New York: John Wiley and Sons.

Mahler, V. A. (1981), Britain, the European Community, and the developing Commonwealth: Dependence, Interdependence, and the political economy of sugar, *International Organization*, 35(3), 467-492.

Mintz, S. W. (1985), *Sweetness and Power: The place of sugar in modern history*, London: Penguin.

Mitchell, D. (2004), Sugar Policies: Opportunity for Change, *World Bank Policy Research Working Paper* No. 3222.

Mitchener, K. J. and M. Weidenmier (2008), Trade and Empire, *Economic Journal*, 118(533), 1805-1834.

Nolte, S., H. Grethe, J. Buysse, B. Van der Straeten, D. Claeys, L. Lauwers and G. Van Huylenbroeck (2010), Modelling preferential sugar imports of the EU: A spatial price equilibrium analysis, *European Review of Agricultural Economics*, 37(2), 165-186.

Ohlin, B. G. (1933), *Interregional and international trade*, Cambridge: MIT Press.

Organisation for Economic Cooperation and Development (OECD, 2017), *International Trade by Commodity Statistics*, DOI: http://dx.doi.org/10.1787/itcs-data-en.

Parker, M. (2012), *The sugar barons: Family, corruption, empire, and war in the West Indies*, New York: Walker & Company.

Persson, M. (2008), Trade facilitation and the EU-ACP economic partnership agreements, *Journal of Economic Integration*, 23(3), 518-546.

Raballand G (2003), Determinants of the negative impact of being landlocked on trade: An empirical investigation through the central Asian case, *Comparative Economic Studies*, 45, 520-536.

Raimondi, V. and A. Olper (2011), Trade elasticity, gravity and trade liberalisation: Evidence from the food industry, *Journal of Agricultural Economics*, 62(3), 525-550.

Santos Silva, J. M. C. and S. Tenreyo, (2006), The log of gravity, *The Review of Economics and Statistics*, 88(4), 641-658.

Santos Silva, J. M. C. and S. Tenreyo, (2011), Further simulation evidence on the performance of the Poisson pseudo-maximum likelihood estimator, *Economics Letters*, 112(2), 220-222.

Scoppola, M., V. Raimondi and A. Olper (2018), The impact of EU trade preferences on the extensive and intensive margins of agricultural and food products, *Agricultural Economics*, 49(2), 251-263.

Stack, M. M. (2009), Regional integration and trade: Controlling for varying degrees of heterogeneity in the gravity model, *The World Economy*, 32(5), 772-789.

Sun, L. and M. R. Reed (2010), Impacts of free trade agreements on agricultural trade creation and trade diversion, *American Journal of Agricultural Economics*, 92(5), 1351-1363.

Tomz, M., J. L. Goldstein and D. Rivers (2007), Do we really know that the WTO increases trade? Comment, *American Economic Review*, 97(5), 2005-2018.

United Nations, World Economic Situation and Prospects (2017), DOI: http://www.un.org/en/development/desa/policy/wesp/index.

United Nations Conference on Trade and Development (UNCTAD, 2017), *Trade Analysis Information System*, DOI: http://unctad.org/en/Pages/DITC/Trade-Analysis/Non-Tariff-Measures/NTMs-trains.aspx.

Vollrath, T. L., M. J. Gehlhar and C. B. Hallahan (2009), Bilateral import protection, free trade agreements, and other factors influencing trade flows in agriculture and clothing, *Journal of Agricultural Economics*, 60(2), 298-317.

Williams, G. and T. Ruffer (2003), *Addressing the impact of preference erosion in sugar on developing countries*, Oxford: Oxford Policy Management and LMC International Ltd.

Wooldridge, J. M. (1995), Score diagnostics for linear models estimated by two stage least squares. In G. S. Maddala, P. C. B. Phillips and T. N. Srinivasan (eds.), *Advances in Econometrics and Quantitative Economics*, 66-87, Oxford: Blackwell.

World Bank (2017), *World Development Indicators* (May 2017), UK Data Service, DOI: http://dx.doi.org/10.5257/wb/wdi/2017-15-13.

Xiong, B. and S. Chen (2014), Estimating gravity equation models in the presence of sample selection and heteroscedasticity, *Applied Economics*, 46(24), 2993-3003.

Zahniser, S. S., D. Pick, G. Pompelli and M. J. Gehlhar (2002), Regionalism in the western hemisphere and its impact on US agricultural exports: A gravity-model analysis, *American Journal of Agricultural Economics*, 84(3), 791-797.

APPENDIX

Table A1 Colonial listing

	Coloniser	Colonised
North-North direction	Austria	Bosnia and Herzegovina, Croatia, Czech Republic, Slovenia
	Denmark	Iceland
	France	Canada, United States
	Germany	Poland
	Greece	Cyprus, Turkey
	Japan	South Korea
	Netherlands	Luxembourg
	Spain	United States
	Sweden	Estonia, Finland
	Turkey	Albania, Armenia, Bosnia and Herzegovina, Bulgaria, Cyprus, Macedonia FYR, Serbia and Montenegro
	United Kingdom	Australia, Canada, Cyprus, Hong Kong, Ireland, Israel, Malta, New Zealand, United States
North-South direction	Australia	Christmas Island, Cocos Islands, Nauru, Papua New Guinea
	Belgium	Burundi, DR Congo, Rwanda
	Denmark	Faroe Islands, Greenland
	France	Algeria, Benin, Burkina Faso, Cambodia, Cameroon, Central African Republic, Chad, Congo, Comoros, Côte d'Ivoire, Djibouti, Dominican Republic, Gabon, French Guiana, Guadeloupe, Guinea, Lao PDR, Lebanon, Liberia, Madagascar, Mali, Martinique, Mauritania, Morocco, New Caledonia, Niger, French Polynesia, Réunion, Saint Pierre and Miquelon, Senegal, Seychelles, Syria, Togo, Tunisia, Vanuatu,

	Vietnam, Wallis and Futuna Islands
Germany	Burundi, Micronesia, Namibia, Nauru, Northern Mariana Islands, Palau, Papua New Guinea, Rwanda, Samoa
Italy	Libya, Somalia
Japan	Korea DPR, Micronesia, Northern Mariana Islands, Palau, Taiwan
Netherlands	Aruba, Netherlands Antilles, Indonesia, South Africa, Suriname
New Zealand	Cook Islands, Niue, Samoa, Tokelau
Portugal	Angola, Brazil, Cape Verde, East Timor, Guinea-Bissau, Macau, Mozambique, São Tomé and Príncipe
Spain	Argentina, Bolivia, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Equatorial Guinea, Falkland Islands, Guatemala, Honduras, Mexico, Micronesia, Nicaragua, Northern Mariana Islands, Panama, Paraguay, Peru, Philippines, Puerto Rico, Uruguay, Venezuela, Western Sahara
Turkey	Egypt, Iraq, Libya, Palestine, Syria, Tunisia, Yemen
United Kingdom	Anguilla, Antigua and Barbuda, The Bahamas, Bahrain, Bangladesh, Barbados, Belize, Bermuda, Botswana, Brunei Darussalam, Cayman Islands, Christmas Island, Cocos Islands, Cook Islands, Dominica, Egypt, Eritrea, Falkland Islands, Fiji, The Gambia, Ghana, Gibraltar, Grenada, Guyana, India, Jamaica, Jordan, Kenya, Kiribati, Kuwait, Lesotho, Malawi, Malaysia, Maldives, Mauritius, Montserrat, Myanmar, Nauru, Nigeria, Niue, Pakistan, Palau, Palestine, Papua New Guinea, Pitcairn Island, Qatar, Saint Helena, Saint Kitts and Nevis, Saint Lucia, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, Sudan, Swaziland, Tanzania, Tokelau, Tonga, Trinidad and Tobago, Tuvalu, Turks and Caicos Islands, Uganda, Saint Vincent and the Grenadines, United Arab Emirates, Vanuatu, British Virgin Islands, Yemen, Zambia, Zimbabwe
United States	Micronesia, Northern Mariana Islands, Philippines, Palau, Puerto Rico

Note: Data are sourced from CEPII (2017).

Table A2 Model variables defined and data sources

Variable	Description	Source
Raw sugar import determinants		
$IMPORTS_{ij}^{t}$	OECD imports of raw sugar trade, in US dollars, from the rest of the world.	International Trade by Commodity Statistics (ITCS), OECD.
$\ln GDP_{i}^{t}$	The log of GDP for the OECD countries (OECD-25).	World Development Indicators (WDI), World Bank.
$\ln GDP_{j}^{t}$	The log of GDP for the rest of the world (ROW-223).	World Development Indicators (WDI), World Bank.
$\ln DIST_{ij}$	The log of the great circle distance, in kilometres, between two capital cities.	CEPII.
ADJ_{ij}	A dummy variable equal to unity if both countries share an adjacent border.	CEPII.
$LOCK_{j}$	A dummy variable equal to unity if country$_j$ is a landlocked country.	CEPII.
$COLNN_{ij}$	A dummy variable equal to unity if both countries share a common colonial past in a North-North direction.	CEPII.
$COLNS_{ij}$	A dummy variable equal to unity if both countries share a common colonial past in a North-South direction.	CEPII.
North-South colonial channels		
$EMPIRE5_{i}$	A dummy variable equal to unity denoting five major empires (France, the Netherlands, Portugal, Spain and the United Kingdom).	Acemoglu *et al*. (2005).
$RAIL_{j}^{t}$	Total railway routes, in kilometres, as a ratio of GDP per capita.	World Development Indicators (WDI), World Bank.
$LANG_{ij}$	A dummy variable equal to unity if both countries share a common ethnic language.	CEPII.
$\ln TARIFF_{ij}^{t}$	The log of tariffs, $(1+\tau_{ij}^{t})$, defined as the (simple average) tariff levied on the product category 1701 (cane or beet, solid).	Trade Analysis Information System (TRAINS), UNCTAD.
$EU-ACP_{ij}^{t}$	A dummy variable equal to unity denoting preferential treatment for the 19 ACP Sugar Protocol countries.	European Commission and the World Trade Organisation (WTO).
$EU-EBA_{ij}^{t}$	A dummy variable equal to unity denoting developing countries included in the Everything But Arms initiative.	European Commission and the World Trade Organisation (WTO).
$EU-EPA_{ij}^{t}$	A dummy variable equal to unity denoting membership of a full or interim economic partnership agreement.	European Commission and the World Trade Organisation (WTO).

Table A3 Summary of EU–ACP preferential trade agreements (PTAs) and economic partnership agreements (EPAs)

Agreement	Date of signature	Date of entry into force	Countries
Yaoundé I	20 July 1963	1 June 1964	The Associated African States and Madagascar (AASM) comprising 18 African ex-colonies: Benin, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, DR Congo, Côte d'Ivoire, Gabon, Madagascar, Mali, Mauritania, Niger, Rwanda, Senegal, Somalia and Togo.
Yaoundé II	29 July 1969	1 Jan 1971	A partnership with 19 African states (AASM and Mauritius).
Lomé I	28 Feb 1975	1 April 1976	Co-operation between 46 developing African, Caribbean and Pacific (ACP) countries consisting of 19 African states (AASM and Mauritius) and 27 additional countries: The Bahamas, Barbados, Botswana, Equatorial Guinea, Ethiopia, Fiji, The Gambia, Ghana, Grenada, Guinea, Guinea-Bissau, Guyana, Jamaica, Kenya, Lesotho, Liberia, Malawi, Nigeria, Samoa, Sierra Leone, Sudan, Swaziland, Tanzania, Tonga, Trinidad and Tobago, Uganda and Zambia.
Lomé II	31 Oct 1979	1 Jan 1981	Twelve additional countries (Cape Verde, Comoros, Djibouti, Dominica, Kiribati, Papua New Guinea, Saint Lucia, São Tomé and Príncipe, Seychelles, Solomon Islands, Suriname and Tuvalu) bring the total number of ACP countries to 58.
Lomé III	8 Dec 1984	1 March 1985	The total number of ACP countries increases to 66 with the addition of eight more countries: Angola, Antigua and Barbuda, Belize, Mozambique, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Vanuatu and Zimbabwe.
Lomé IV	15 Dec 1989	1 March 1990	ACP membership increases to 69 as three more countries join: the Dominican Republic, Haiti and Namibia. For the revised Lomé IV Convention, the accession of Eritrea brings the total number of ACP countries to 70.
Cotonou[1]	23 June 2000	1 April 2003	Negotiating with nine additional countries (Cook Islands, Cuba, East Timor, Marshall Islands, Micronesia, Nauru, Niue, Palau, South Africa), the Cotonou Agreement with 79 countries replaces the Lomé Conventions.
CARIFORUM[2]	15 Oct 2008	1 Nov 2008	Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Saint Kitts and Nevis, Saint

			Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago.
Southern African Development Community[3]	10 June 2016	10 Oct 2016	Botswana, Lesotho, Mozambique, Namibia, South Africa and Swaziland.
West Africa[4]	–	–	Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo.
East African Community[5]	–	–	Burundi, Kenya, Rwanda, Tanzania and Uganda.
Eastern and Southern Africa[6]	–	–	Comoros, Djibouti, Eritrea, Ethiopia, Madagascar, Malawi, Mauritius, Seychelles, Somalia, Sudan, Zambia and Zimbabwe.
Central Africa[7]	–	–	Cameroon, Central African Republic, Chad, Congo, DR Congo, Equatorial Guinea, Gabon, São Tomé and Príncipe.
Pacific[8]	–	–	Cook Islands, East Timor, Fiji, Kiribati, Marshall Islands, Micronesia, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

Note: Based on information from the European Commission (2017) and the World Trade Organisation (2017).

[1] Although not a signatory, Cuba was included in the ACP-EU partnership. East Timor became the last member after gaining independence.

[2] Ratification by Haiti is still pending.

[3] Mozambique ratified the agreement on 28 April 2017, which will enter into provisional application after being submitted to the Council. Angola has the option to join the agreement in the future.

[4] The EU initialled an EPA with the West African states on 30 June 2014. The signature process is ongoing. Côte d'Ivoire signed an interim EPA on 26 November 2008, which entered into provisional application on 3 September 2016. Ghana signed an interim EPA on 28 July 2016, which entered into provisional application on 15 December 2016.

[5] The EU initialled an EPA with the Eastern African Community (EAC) on 16 October 2014.

[6] The EU is currently negotiating an EPA with the Eastern and Southern African (ESA) countries. Madagascar, Mauritius, Seychelles and Zimbabwe signed an interim EPA on 29 August 2009, which entered into provisional application on 14 May 2012.

[7] The EU is currently negotiating an EPA with the Central African countries. Cameroon signed an interim EPA on 15 January 2009, which entered into provisional application on 4 August 2014.

[8] The EU is currently negotiating an EPA with 14 Pacific countries. Fiji and Papua New Guinea signed an interim EPA on 30 July 2009 and 11 December 2009 respectively, which entered into provisional application on 20 December 2009 for Papua New Guinea and 28 July 2014 for Fiji.