ERIA Discussion Paper Series

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March 2017

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Keywords: Trade Integration, European Integration, Schengen Agreement, Gravity

JEL-Classification: F10, F15, N74, N94

* We thank H.-W. Sinn, Y. Yotov, and J. Zettelmeyer and seminar participants in Munich, Vienna and Yogyakarta for comments and suggestions.
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March 17, 2017

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I. INTRODUCTION

The Schengen Agreement is seen as an important milestone in the European integration process. In this paper, we test econometrically whether the agreement has indeed fulfilled the promises. More precisely, we ask whether Schengen has significantly spurred trade in goods and services amongst its members.

The agreement has abolished regular identity checks at internal EU borders, allowing them only in emergency situations and for limited periods of time. Schengen also sets out the modalities of cooperation in border-related police work. The agreement was signed in 1985 in the Luxembourg town of Schengen by Belgium, the Netherlands, Luxembourg, France, and Germany. In 1995, it was first enforced amongst seven countries (the above-mentioned five plus Spain and Portugal). The Schengen area has grown over time and today covers 26 countries. The EU members Bulgaria, Croatia, Cyprus, Ireland, Romania and the United Kingdom do not participate in Schengen while the non-EU countries Iceland, Norway, and Switzerland are part of it.

The Schengen Agreement is part and parcel of the complex European integration process. It complements the European customs union and single market, and the monetary union. By ending border controls, Schengen facilitates and accelerates the crossing of borders within Europe and delivers very tangible benefits for millions of travelers and commuters. Ademmer et al. (2015) argue that the reduction of waiting times at borders reduces trade costs, which should stimulate cross border exchange and the mobility of service providers as well as of consumers.[1] Tighter regional integration should yield welfare benefits for citizens. Conversely, the reintroduction

[1]Clearly, trade gains are not the only motivation for Schengen or European integration more broadly (see Baldwin et al., 2008).

of identity checks at internal Schengen borders as one consequence of the European refugee crisis of 2015 may jeopardize these gains.[2] The goal of this paper is to estimate the trade-creating effects of Schengen in order to shed light on the size of the benefits at stake when ending the agreement as a whole.[3]

To this end, it is important to acknowledge a special characteristic of the Schengen Agreement. Unlike the customs union, the single market, Eurozone membership or other regional trade agreements (RTAs), which all have a clear bilateral scope, the Schengen Agreement has an obvious and important spatial dimension. Land-borne trade flows between two countries in Europe may cross only one internal border (e.g., France - Germany) or up to eight of them (e.g., Portugal - Finland). Hence, Schengen membership treats country pairs heterogeneously, depending on the number of internal Schengen borders crossed. This feature is ignored in the small existing literature, which treats Schengen analogously to trade agreements and currency unions, e.g., Davis and Gift (2014) or Chen and Novy (2011).

Moreover, land-borne trade between two Schengen outsiders (e.g., Romania and the UK) or between Schengen outsiders and insiders (e.g., Turkey and Germany)

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[2]Monar (2014) offers a discussion of the *'Regulation (EU) 1051/2013 on common rules for the temporary re-introduction of border control at internal borders in exceptional circumstances'*. Trauner and Ripoll Servent (2016) argue that it is unclear whether the refugee crisis will strengthen or weaken the Schengen area in the long run.

[3]Our estimates imply long-run effects of undoing Schengen, assuming that check point conditions equivalent to the pre-Schengen era are re-established. Our data does not allow isolating the effects of temporary exemptions. Since the Agreement's implementation, border infrastructure and personnel have been built back whereas trade flows have grown considerably. Enforcing temporary exemptions where check-point conditions are worse than before Schengen suggests higher short-run effects than our long-run estimates suggest.

can also benefit from the agreement as goods transit through Schengen space.[4] We combine GIS data with information from Google Maps to count the number of Schengen borders crossed by truck (and ferry) along the shortest road distance between trading partners. This count variable is our measure of interest.

In contrast to existing studies, we do not exclude services trade or internal trade flows. We make progress by (i) using a more accurate definition of treatment, (ii) employing the most recent and most adequate data, and (iii) making full use of newest methodological advances, while strictly adhering to the predicaments of structural gravity theory as laid out in Head and Mayer (2014).

Our contribution is threefold: First, applying state-of-the art methods, we are able to provide an accurate partial equilibrium quantification of the trade (and trade cost) effects of Schengen. Flows of goods crossing a single Schengen border increase by 2.6% while services flows go up by 4.1% on average (equivalent to a drop in a tariff by 0.37 and 0.80 percentage points, respectively). Second, we consistently compare the trade effects of subsequent steps of European regional integration. Mutual EU membership increases trade in goods by 122.6% (53.2% for the Customs Union and 69.4% for the Single Market) and in services by 39.8% for all countries that have joined the EU after 1995. Other RTAs established after 1995 boost trade by an additional 35.3% in goods and 20.2% in services. The common adoption of the Euro in addition to EU membership is again more important for goods trade (15.3%) than for services trade (8.8%). So, Schengen is comparatively less important. Third,

[4]Typically, econometric analysis of bilateral trade data assumes that third countries are affected only through general equilibrium effects by bilateral trade integration. Schengen is an example where third countries are directly affected through shorter transit times. We are grateful to a referee for pointing this out.

exploiting its spatial dimension, we show that the trade cost effects of Schengen vary between 0.17 percentage points for Ireland to 0.83 percentage points for Estland, and that Schengen outsiders such as Turkey or Russia can benefit substantially (0.51 and 0.36 percentage points, respectively).

II. EMPIRICAL MODEL

Head and Mayer (2014) show that a broad class of general equilibrium trade models with constant elasticity of substitution aggregation gives rise to a gravity equation of the following form:

$$X_{ij,t}^{s} = \frac{Y_{i,t}^{s} E_{j,t}^{s}}{Y_{t}^{s}} \cdot \left(1 + \tau_{ij,t}^{s}\right)^{-\sigma^{s}} \left(\frac{\phi_{ij,t}^{s}}{\Omega_{i,t}^{s} \Omega_{j,t}^{s}}\right)^{1-\sigma^{s}}, \tag{1}$$

where $X_{ij,t}^{s}$ is the value of exports of country i to country j in sector s at time t, $Y_{i,t}^{s}$ is country i's value of production in sector $s \in \{G, S, T\}$ for goods, services, and total trade, respectively. $E_{j,t}^{s}$ is country j's expenditure in sector s, Y_{t}^{s} is the value of global output, $1 + \tau_{ij,t}^{s}$ is an ad valorem tariff factor, $\phi_{ij,t}^{s} \geq 1$ measures bilateral non-tariff "iceberg" trade costs, and $\sigma^{s} > 1$ is the sectoral elasticity of substitution.[5] In the literature, $1 - \sigma^{s}$ is often referred to as "the trade elasticity". The terms $\Omega_{i,t}^{s}$ and $\Omega_{j,t}^{s}$ are called "multilateral resistance" terms. They account

[5]Tariffs and non-tariff trade costs enter expression 1 with different exponents. The reason is that iceberg trade costs assume that $\phi_{ij,t}^{s} \geq 1$ units of a good must be produced in country i for one unit to arrive for consumption in country j. The fraction $\phi_{ij,t}^{s} - 1$ melts away in transit (Samuelson, 1954). Hence, in contrast to tariffs, higher non-tariff trade costs increase the physical quantity of goods to be shipped. This lowers (in absolute values) the elasticity of exports (price times quantity) with respect to $\phi_{ij,t}^{s}$ compared to the one with respect to $1 + \tau_{ij,t}^{s}$.

for the effects of third countries' trade costs on i's exporting and on j's importing behavior. These terms are generally unobserved and depend on bilateral trade costs between all trading partners worldwide.

Non-tariff trade costs $\phi^s_{ij,t}$ cannot be directly measured in the data but must be estimated. Suppressing sectoral indices to avoid cluttering, we follow common practice and specify

$$\phi_{ij,t} = \prod\nolimits_{\ell} \left(T^{\ell}_{ij,t}\right)^{\tilde{\delta}^{\ell}} \cdot \exp\left(\tilde{\beta}\text{Schengen}_{ij,t} + \sum\nolimits_{k} \tilde{\alpha}^{k} Z^{k}_{ij,t}\right), \tag{2}$$

where $T^{\ell}_{ij,t}$ denotes a trade cost shifter ℓ unrelated to policy (such as geographical or cultural distance). $Z^{k}_{ij,t}$ is an indicator variable capturing whether i and j are both taking part in an integration program k (such as the customs union, the single market, the monetary union, or any other RTAs.

Substituting (2) into (1) and assuming that other trade costs $\mathbf{T}^s_{ij}$ are time-invariant, we can write the estimation equation

$$X_{ij,t} = \exp\left[\beta\text{Schengen}_{ij,t} - \sigma \ln\left(1+\tau_{ij,t}\right) + \sum\nolimits_{k} \alpha^{k} Z^{k}_{ij,t} + \nu_{ij} + \nu_{i,t} + \nu_{j,t}\right] + \varepsilon_{ij,t}, \tag{3}$$

where $\beta \equiv (1-\sigma)\,\tilde{\beta}, \alpha^k \equiv (1-\sigma)\,\tilde{\alpha}^k$, and $\varepsilon_{ij,t}$ is a random disturbance. The terms ν_{ij}, $\nu_{i,t}$, and $\nu_{j,t}$ are country-pair, and year specific importer and exporter fixed effects, respectively. Their presence implies that time-invariant country-pair specific determinants of sectoral trade flows drop out of the equation. Moreover, they fully control for all exporter- and importer-specific time-varying determinants of trade (such as $Y_{i,t}, E_{j,t}, \Omega_{i,t}, \Omega_{j,t}$).

Except Russia and China, all countries in our sample are WTO members. Therefore, they apply the same tariff to all trade partners (most-favored nation principle,

MFN), except in the case of a preferential trade agreement. Since we control for those explicitly, in principle, we could include the MFN tariff $t_{j,t}$ into the regression. We could identify σ^G even in the presence of the $\nu_{j,t}$ fixed effects due to the presence of intranational trade (for which $\tau_{j,t} = 0$); see Piermartini and Yotov (2016). In our regressions, we go one step further. We set $t_{ij,t} = \tau_{j,t} \times EXTRA_{ij}$, where $EXTRA_{ij}$ is a binary variable taking value 1 except if $j = i$ or when i and j are both part of the EU. This way, we identify σ^G on the variance between intra- and international trade flows, and between EU and non-EU flows. As a side effect, this specification extracts the tariff-component of EU integration (the customs union effect), leaving the non-tariff component (the single market effect). We refrain from doing the same for other RTAs.[6]

The use of such a saturated model has several advantages. First, it provides some immunization against omitted variable bias as time-invariant bilateral or time-dependent country-level factors affecting trade, which are not modeled by (1), are accounted for. Second, it frees us from approximating (or iteratively simulating) the multilateral resistance terms and from collecting sectoral output data (which are not always available in good quality). Third, the inclusion of bilateral fixed effects ν_{ij} is a defense against possible endogeneity concerns; see below.

We are interested in unbiased estimates of σ, α^k and, in particular, β. Contrary to the literature, we do *not* define $\text{Schengen}_{ij,t}$ as a binary variable taking value 1 if country i and country j have both ratified the Schengen Agreement. Such a definition mismeasures the treatment and misses systematic treatment heterogeneity:

[6]Clearly, the elasticity σ^s can be estimated for goods trade only since services trade is not subject to any tariffs. It should not be overinterpreted, because its identification rests only on very few observations.

A land-borne trade flow in Europe from i to j may cross one, two, or up to eight internal Schengen borders.[7] Moreover, the pair ij may benefit from lower transit costs, even if i and/or j are outsiders to Schengen. Therefore, we use a count variable $\text{Schengen}_{ij,t} = \{1, \ldots, 8\}$ registering the number of Schengen border crossings that land-borne trade between i and j involves.[8]

The existing literature (e.g., Davis and Gift, 2014) is largely silent on the possibility that selection of country pairs into Schengen may not be random. The estimate of β would be upward biased if trade shocks $\varepsilon_{ij,t} > 0$ increase the odds of a trade route connecting i and j to be affected by Schengen. However, joining a plurilateral agreement such as Schengen is not a bilateral decision, and transportation costs between countries i and j depend on the Schengen status of transit countries. Thus, reverse causality may not be a major issue (for further treatment of potential endogeneity see the robustness section). Nonetheless, we include country-pair fixed effects ν_{ij} to account for all time-invariant determinants that might jointly affect $\text{Schengen}_{ij,t}$ and $X_{ij,t}$. This also addresses omitted variable bias and the endogeneity of other policy variables $Z^k_{ij,t}$, such as EU, Eurozone, or RTA membership, – controls that are crucial to identify an unconfounded treatment effect β (see, e.g., Baier and Bergstrand, 2007).

It is important to acknowledge that the structural gravity equation (1) implies

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[7]Evidence from France suggests that about three quarters of intra-European trade is land-borne; see www.statistiques.developpementdurable.gouv.frntransportsn873.html.

[8]Rather than assuming linearity in the effect of Schengen borders, we could have specified an array of indicator variables, each taking the value of unity if one, two, three, ..., Schengen borders are crossed and zero else. However, it turns out that this strategy makes clean identification harder as we would have to estimate the effects of a further seven variables.

that the analysis should not only include *inter*national trade but also *intra*national trade, for which $i = j$ (see, e.g., Anderson and Yotov, 2015). Inference based on international flows alone is likely to lead to biased estimates. Yotov (2012), Dai et al. (2014), and Bergstrand et al. (2015) prove the importance of this issue in theory and also document the quantitative relevance of including own trade in the *ex post* evaluation of trade policy.

We estimate equation (1) by Poisson Pseudo Maximum Likelihood (PPML) methods as recommended by Santos Silva and Tenreyro (2006, 2011) and Head and Mayer (2014). Standard errors allow for clustering at the country-pair level. Identification relies on the time variation within country pairs with different exposure to mutual EU, RTA, or EMU membership and the number of Schengen borders relative to the total number of borders crossed (the latter is captured by the bilateral fixed effect ν_{ij}).

Before moving on, we briefly sketch expectations about the trade effects of Schengen. If border controls are abolished, waiting times and associated uncertainty are reduced such that international trade costs decline. Hence, we expect trade-creating effects of Schengen to be larger, the more Schengen borders a trade flow crosses. Other steps of European integration – customs union, single market, monetary union – target trade costs more directly, are more comprehensive, and therefore have more pronounced trade effects than Schengen. We expect to find a clear ranking of trade-creating effects. Moreover, the services sector is more strongly affected by Schengen than manufacturing, as easing the movement of people is a necessary precondition for many services to be provided.

III. DATA

We use yearly bilateral data on goods and services trade flows between and within countries, and sectoral output and expenditure data from the World Input-Output Database (WIOD), described by Timmer et al. (2015). The data capture 40 countries and the years 1995 to 2011,giving us $40 \times 40 \times 17 = 27,200$ observations per sector. Geographical and historical variables stem from CEPII. Information on RTAs come from the WTO.[9] MFN tariffs are taken from the World Integrated Trade Solutions (WITS-TRAINS) database.

Data on the successive accession of countries to the Schengen Agreement stem from the European Commission.[10] We combine GIS data with information from Google Maps to count the number of Schengen borders crossed by truck (and ferry) moving from economic centers of i to j in year t.

From an econometric point of view, the often bemoaned variable geometry of Europe is an advantage. It allows us to use panel econometrics to disentangle the different trade effects of EU, Eurozone, and Schengen membership and of other trade agreements (e.g., EU-Turkey customs union, or pre-accession treaties). While all EMU countries are EU members and estimated EMU effects must therefore be interpreted as additional to EU effects, this relationship constitutes the only strict subset to consider. First, not all EU members belong to Schengen or the EMU. Second,

[9]The RTA gateway is accessible via http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx.

[10]Starting with seven countries in 1995, the agreement was joined by Italy and Austria in 1997, Greece in 2000, Denmark, Finland, Iceland, Norway, and Sweden in 2001, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia in 2007, Switzerland in 2008. The EU members Bulgaria, Croatia, Cyprus, Ireland, Romania and the United Kingdom do not participate in Schengen, while the non-EU countries Iceland, Norway, and Switzerland do.

not all EMU members are part of Schengen and vice versa, and they have ratified the agreement at different times. Third, some Schengen countries are not part of the EU and, the way our Schengen variable is constructed, it directly affects also outsiders to both Schengen and the EU (e.g., Turkey and Russia).[11] While variable geometry helps with separately identifying the trade effects of overlapping intergration steps, one caveat must be kept in mind: the effects are identified through country pairs switching status; e.g., the single market coefficient reflects the effects of new members joining the EU in the period of observation (e.g., the 10 middle and eastern European countries, plus Romania and Bulgaria.)

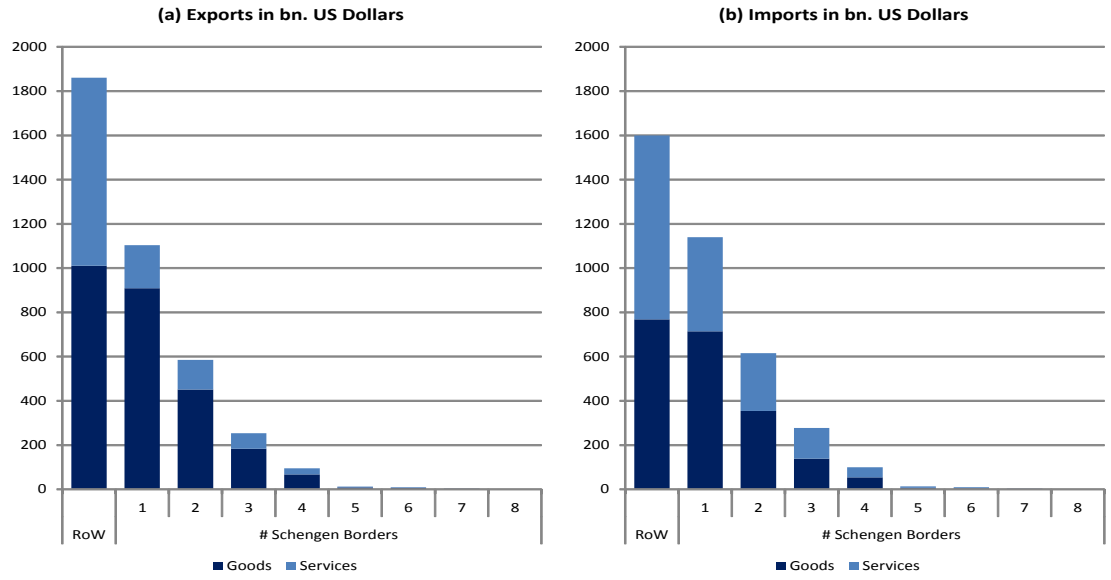
Since WIOD goes back exactly until 1995, the effects Schengen has on its founding members are absorbed by the country pair fixed effects, such that our estimates are driven exclusively by the 19 countries that have joined the Agreement over time. Similarly, our EU estimate is driven by those countries that have joined the EU after 1995. The same logic applies to the effects of RTAs that have entered into force before our period of investigation. The Euro became a real currency subject to a single monetary policy only in 1999 such that our EMU estimate fully captures the Euro effect.

Figure 1 shows how exports and imports of EU-27 countries are distributed across country-pairs involving the crossing of one to eight Schengen borders.

In 2011, 35% of goods trade of EU-27 countries crosses one Schengen border. The shares are 17%, 7%, and 3% for two, three or more than three borders, respectively. For services trade the shares are 21%, 13%, 7%, and 3%, respectively. The residual

[11]Note that our estimated Schengen effect can be interpreted individually even if non-EU Schengen countries are not included in WIOD.

Figure 1
Total EU-27 Trade in bn. US Dollar along the Number of Schengen Borders Crossed, 2011



Note: Distribution of EU members' trade according to number of Schengen borders crossed in a bilateral relation. RoW denotes rest of the world.

originates from outside the EU-27.[12] Extra-Schengen air-borne trade is unlikely to benefit from the Schengen Agreement; sea-borne trade, however, may well benefit, as goods are shipped from major seaports to consumers (see robustness checks).

[12]Note that RoW includes all trade beyond the 40 countries distinguished by WIOD. This comprises countries such as Norway, Switzerland, Iceland, and the Balkan, including Croatia. Gravity estimation results are thus slightly downward biased. Not considering RoW in calculating ad-valorem tariff equivalents would induce an upward bias. By including WIOD's RoW aggregate in ad-valorem tariff analysis, we opt for the more conservative approach given the null that Schengen does not affect trade flows.

IV. BENCHMARK RESULTS

Table 1 provides results for total, goods, and services trade. The regression models follow equation (1). They show that the effect of Schengen is substantially overestimated when failing to control for other elements of EU integration. Moreover, controlling for MFN tariffs in regressions for goods trade, we obtain an estimate of the tariff elasticity equal to −2.4. By construction, explicitly controlling for MFN tariffs only changes the effect of EU integration. Column (4) provides the effect of the EU inclusive of tariff elimination, column (5) exclusive of it. We can exploit this difference to separate the effects of the customs union from that of the single market.

Table 1
The Impact of Schengen on Bilateral Exports (1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Schengen	0.054***	0.0003	0.106***	0.026***	0.026***	0.067***	0.040*
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Both EU		0.617***		0.800***	0.527***		0.335***
		(0.07)		(0.07)	(0.11)		(0.08)
Both Euro		0.030		0.137***	0.142***		0.084*
		(0.02)		(0.03)	(0.03)		(0.04)
Other RTA		0.250***		0.294***	0.302***		0.184**
		(0.07)		(0.06)	(0.07)		(0.07)
Tariff					-2.443***		
					(0.57)		

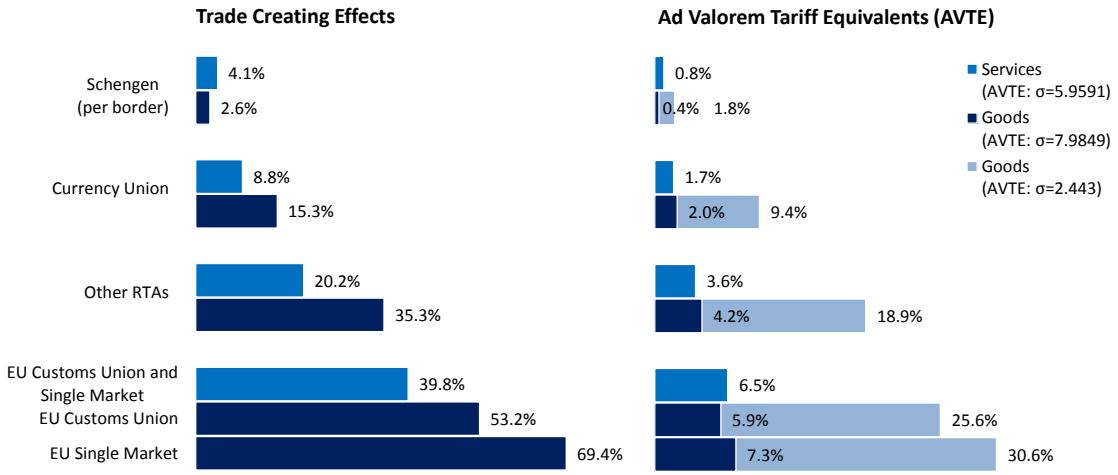
Note: ***, **, * denote significance at the 1%, 5%, 10% levels, respectively. All models estimated using Poisson Pseudo Maximum Likelihood (PPML) methods. Robust standard errors (in parentheses) allow for clustering at the country-pair level. Pair as well as year specific importer and exporter fixed effects included but not reported. Number of observations: 27,200.

Figure 2 provides a quantitative interpretation based on the results on Table 1. The effect of a *single* Schengen border between a country pair leads, on average, to

an increase in goods trade of about 2.6% and in services trade of 4.1%.[13]

The figure shows very clearly that other steps of EU integration have led to substantially more trade creation than Schengen. Mutual EU membership proves most important for trade integration. The cumulative effects of the customs union and the single market increased trade in services by 39.8% and goods trade by 122.6%. The latter can be split up into a customs union effect of 53% and a single market effect of 69%.[14] Other RTAs boost trade in services by 20.2% and trade in goods by 35.3%. The mutual adoption of the Euro in addition to EU membership is more important for goods trade (15.3%) than for services trade (8.8%).

FIGURE 2
Trade Creation Effects and Implied Ad Valorem Tariff Equivalents of Integration Policies



Note: Calculations based on Table 1.

[13]Estimated coefficients are translated by calculating $\%\Delta X^s = 100 \times [e^{\beta^s} - 1]$.

[14]Egan and Guimarães (2017) show that the Single Market still holds unrealized potential, as trade impediments continue to elicit business complaints and governments shield specific domestic industries from increased competition.

To express these estimates as *ad valorem* tariff equivalents (AVTEs), we need the elasticity of substitution σ^s.[15] We borrow two consistent external estimates from Egger et al. (2012), who report $\hat{\sigma}^G = 7.9849$ and $\hat{\sigma}^S = 5.9591$. For goods trade, our MFN result also suggests an internal elasticity of substitution estimate $\hat{\sigma}^G = 2.443$; for services, however, we cannot estimate σ^S due to the lack of tariffs. Note that our internal elasticity estimate is identified only via a relatively low number of observations. Its magnitude is thus substantially smaller compared to the literature and yields high AVTEs. Moreover, it cannot be compared consistently to the external services elasticity of substitution. We will therefore only use it for illustrative purposes, calculating intervals for ad valorem tariff equivalents for our baseline results, but resort to the consistent external estimates by Egger et al. (2012) for any further analyses.

The right hand side of Figure 2 depicts ad valorem tariff equivalents to the estimated trade effects. The combined EU effect equals a tariff reduction of 6.5 percentage points for services. The corresponding combined EU effect for goods trade (not depicted) ranges from 10.8 (using the elasticity of substitution by Egger et al., 2012) to 42.6 (using our own estimate) percentage points. The separated customs union effect on goods trade corresponds to an AVTE between 5.9% and 25.6%, and the single market implied AVTE lies between 7.3% and 30.6%, depending on the chosen elasticity. The RTA effects are equivalent to a tariff reduction of 3.6 percentage points for services and between 4.2 and 18.9 percentage points for goods. Common membership in the Euro Area implies trade effects equivalent to a reduction in tariffs of 1.7 percentage points for trade in services and 2.0 to 9.4 percentage points for trade in goods. Finally, one additional Schengen border is

[15] $\%\text{AVTE}^s = 100 \times [(e^{\beta^s})^{(1/(1-\sigma^s))} - 1]$.

equivalent to a reduction in tariffs of 0.8 percentage points for trade in services and 0.37 to 1.8 percentage points for trade in goods.

Our findings add to the literature on the trade effects of European integration. However, this literature often does not control for the effects of the Schengen Agreement, which may bias the estimated effects of EU or Eurozone membership. To the largest extent, it also neither disaggregates between goods and services trade, nor does it incorporate domestic trade flows. The literature has produced very heterogeneous estimates of the trade effects of the Euro.[16] As pointed out by Baldwin et al. (2008), earlier papers suffered from misspecified econometric models; avoiding these pitfalls and applying state-of-the-art modeling techniques, we generate very plausible estimates.

To compare the overall trade effect of the Schengen Agreement to those of the EU, the Eurozone, or other RTAs, we need to consider that the total pair-level effect of the Schengen Agreement increases with the number of borders crossed between trade partners. To evaluate this in more detail, we take into account that country pairs differ with respect to the number of Schengen borders crossed by bilateral land-borne trade. When two internal borders are involved, the AVTE for goods amounts to 0.74%;[17] with three border crossings, we get 1.11%, and so forth; analogously for services trade. Accounting for the different trade structures of all EU-27 country pairs, the total average trade creating effect of Schengen is 2.81%, corresponding to

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[16]See the work of Micco et al. (2003), Flam and Nordström (2006) Baldwin and Taglioni (2007), Bun and Klaassen (2007). Berger and Nitsch (2008), Bergin and Lin (2012) and Camarero et al. (2014).

[17]$100 \times [(e^{2 \cdot \beta})^{(1/(1-\sigma))} - 1]$, using the elasticity of substitution by Egger et al. (2012). Applying our own elasticity estimate for goods trade increases goods AVTEs about fivefold.

an AVTE of between 0.46% and 1.02% (applying $\sigma_1^T = 7.1948$ and $\sigma_2^T = 3.8144$, an EU-27 sector-share weighted mean of σ^S and σ_1^G or σ_2^G respectively.).[18] Hence, the average trade creation induced by the Schengen Agreement alone is relatively low compared to the EU, the Euro, and other RTAs.[19]

Heterogeneity Across Member States. Clearly, diverse countries will be affected differently by Schengen, simply because geography, history, and specialization patterns imply that countries are heterogeneous with respect to the average number of Schengen borders that typical trade flows need to cross. To illustrate this, every country has its own break-down analogous to Figure 1. Calculating average AVTEs for available (geographically) European countries,[20] we find that peripheral countries such as Estonia, Latvia, and Finland display the highest AVTEs (0.83%, 0.81%, and 0.80% respectively, see Appendix Table A5 for details). These countries typically trade across several internal Schengen borders. At the lower end, geographically central economies such as Germany or France display smaller AVTEs (0.34% each). Ireland, whose main trade partners are the Schengen outsiders UK and US, features the lowest AVTE with 0.17%. Interestingly, Figure 3 shows that

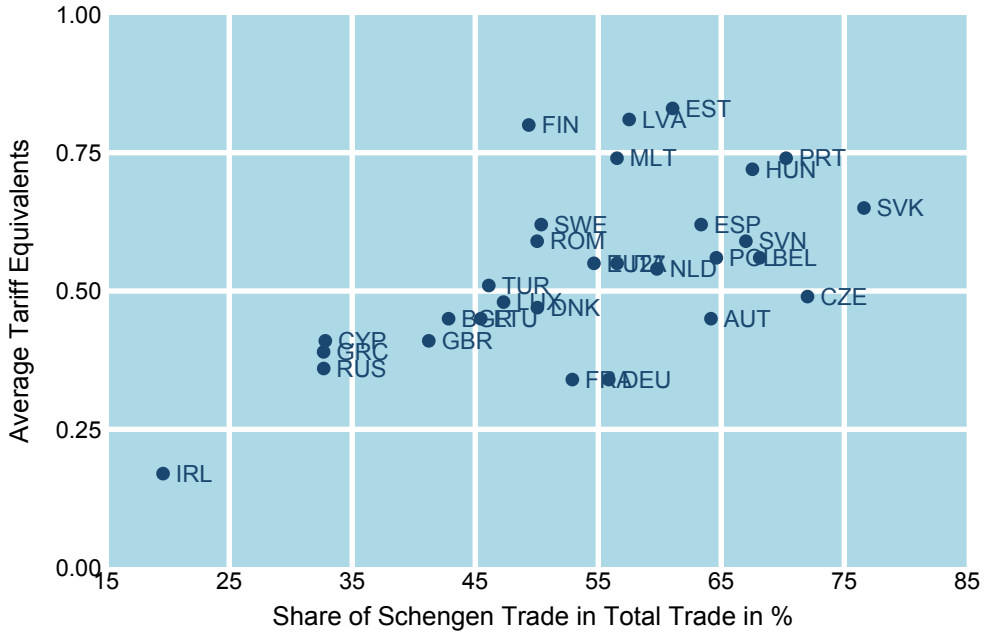
[18] In our data, 61% of EU-27 trade is in goods, 39% in services.

[19] We believe that a Schengen AVTE of below 1% is entirely plausible. Schengen does speed up the flow of traffic, but effects should not be overstated. Evidence from the US-Canadian border suggests that waiting times for trucks are about 20 minutes on average (see Appendix, Table A4). With an average transportation cost margin of about 10% (Anderson and van Wincoop, 2004), such a tariff equivalent implies that identity checks increase transportation costs by at most 10%. The 3% tariff equivalent used in Aussilloux and Le Hir (2016) and Boehmer et al. (2016) would, in turn, imply an increase in transportation costs by an implausible 30%.

[20] We average across sectors and trade partners.

Schengen outsiders such as Russia or Turkey benefit from the removal of internal border controls, too. Their average trade costs savings from Schengen amount to 0.20% and 0.32% for goods and 0.57% and 1.08% for services trade, respectively.

Figure 3
Average Share of Trade Affected by Schengen and Associated Tariff Equivalents



Note: Average tariff equivalents of membership to the Schengen Agreement, assuming sectoral trade elasticities provided by Egger et al. (2012).

Obviously, the overall magnitude of reported AVTEs depends on the assumed underlying trade elasticities, which we haven taken from Egger et al. (2012) to ensure comparability across sectors. As a sensitivity check, we instead assume a uniform elasticity of substitution of 6 and calculate AVTEs again. Clearly, assuming a higher (lower) elasticity of substitution for services (goods and total) trade, leads to lower (higher) AVTEs. Qualitatively, our key findings remain unchanged; see Table A6 in the Web Appendix for details.

Overall, our findings suggest an ad valorem tariff equivalent markedly below

the 3% assumed by Aussilloux and Le Hir (2016) or Boehmer et al. (2016), and Schengen effects for goods trade are clearly below the significantly larger long-run gravity estimates of previous studies such as Chen and Novy (2011), Davis and Gift (2014), or Aussilloux and Le Hir (2016). This implies that the spatial dimension and thus the number of Schengen borders to cross along the transit route matters for the identification of the Schengen effect and is preferable over using a simple indicator variable.

V. ROBUSTNESS ANALYSIS

Table 2 reports a number of robustness checks. Each row shows the estimated Schengen effects obtained by departing from some of the choices made in our baseline specification underlying the results reported in Table 1.[21] For goods trade, column (2) does not control for MFN tariffs, while column (3) does.

First, Panel A of Table 2 varies the sample. In the benchmark model, we have excluded products which are most likely transported by pipeline, ship or train (gas, petrol, mining & quarrying products). Including them, the effect of a Schengen border on bilateral goods exports increases from an AVTE of 0.37% to an AVTE of 0.50% (0.49%) in column (2) (column (3)); see row [1].[22] This can be taken as evidence that at least some of the sectoral trade is carried by trucks (e.g., coal, earths, metal). The AVTEs of the EU, the Eurozone, and other RTAs remain very similar to our previous findings.

In row [2], we address potential endogeneity concerns by excluding the three most

[21] Tables A7 - A16 in the Web Appendix provide full details.

[22] Assuming $\sigma^G = 7.9849$.

Table 2
Robustness: Schengen Effects in Alternative Models

Dep. var.: Bilateral Exports

	Total Trade	Goods (S1)	Goods (S2)	Services
	(1)	(2)	(3)	(4)
PANEL A: Alternative Sample Composition				
[1] Including mining, gas, petrol	0.007	0.035***	0.034***	0.040*
	(0.01)	(0.01)	(0.01)	(0.02)
[2] Excluding main bilateral trade partners	-0.003	0.017***	0.017***	0.043**
	(0.01)	(0.01)	(0.01)	(0.02)
[3] Intracontinental trade only (European Sample)	0.005	0.034***	0.034***	0.057***
	(0.01)	(0.01)	(0.01)	(0.02)
PANEL B: Alternative Measurement of Treatment				
[4] Treating intercontinental trade flows	0.024**	0.050***	0.048***	0.073***
	(0.01)	(0.01)	(0.01)	(0.03)
[5] Schengen as binary variable [0;1]	0.030**	0.070***	0.072***	0.065
	(0.01)	(0.02)	(0.02)	(0.04)
[6] Chen and Novy (2011) indicator [0;0.5;1]	0.161***	0.254***	0.247***	0.300***
	(0.03)	(0.03)	(0.03)	(0.06)
PANEL C: Alternative Econometric Choices				
[7] Pooled over sectors	0.0003	0.026***	0.026***	0.040**
	(0.01)	(0.01)	(0.01)	(0.02)
[8] Baier and Bergstrand (2009) MR-Terms	0.005	0.037***	0.038***	0.034
	(0.01)	(0.01)	(0.01)	(0.02)
[9] No bilateral fixed effects	-0.130	-0.084	-0.128***	-0.148
	(0.08)	(0.07)	(0.06)	(0.09)
PANEL D: Heterogeneity				
[10] Schengen Bin [1]	0.026	0.084***	0.089***	-0.048
	(0.02)	(0.02)	(0.02)	(0.06)
Schengen Bin [2]	0.036	0.113***	0.117***	-0.012
	(0.02)	(0.03)	(0.03)	(0.07)
Schengen Bin [3; 8]	0.054*	0.140***	0.138***	0.169*
	(0.03)	(0.03)	(0.03)	(0.09)

Note: Specification 1 (S1) does not explicitly control for tariffs, while specification 2 (S2) does. ***, **, *, denote significance at the 1%, 5%, and 10% level, respectively. Robust clustered standard errors reported in parentheses. For details see Tables A7 - A16 in the Appendix. Default estimation technique is PPML (unless stated otherwise).

important trade partners of each country from the sample, as trade shocks pertaining to them could have driven the decision to join the Schengen area. The results support our previous findings. The exclusion of important trade partners reduces the magnitude of a Schengen border on goods trade to an AVTE of 0.24%, while it

slightly increases the magnitude on services trade to 0.87%.[23] The magnitudes of the EU, the Eurozone, or other RTA effects are reduced.[24]

Row [3] focuses on *intra*continental European trade only (treating Turkey and Russia as geographical Europe). Results remain very similar to our benchmark results. As expected, coefficients increase slightly in magnitude, as all extracontinental trade flows are excluded from the sample. Focusing on intracontinental European trade only leads to an AVTE on goods trade of 0.49% and 1.14% on services trade. Similarly, the EU, the Euro area, and further RTA effects increase in magnitude.

Second, Panel B looks at alternative measurements of treatment. In row [4], we assume that *inter*continental trade of third countries with Schengen members crosses, on average, one internal Schengen border. While extra-Schengen air-borne trade is unlikely to benefit from Schengen, sea-borne trade may well benefit, as goods are transported from major seaports to the interior of the continent.[25] As expected, treating intercontinental trade by one Schengen border on average slightly inflates estimates and leads to statistically significant estimates for total trade. We find AVTEs of 0.39% for total trade,[26] 0.71% (0.68%) for goods in column (2) (column (3)), and 1.46% for services. All other controls remain similar in magnitude relative to our benchmark results.

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[23]Assuming $\sigma^S = 5.9591$.

[24]Note that these estimates are subject to sample selection bias. The direction of the bias depends on the systematic characteristics of the trade partners dropped.

[25]Note that no information on transport modes for global trade, or even trade within Europe, is available. Hence, assuming an average of one border crossing for trade that does not originate in geographical Europe only provides an approximation of treated intercontinental trade values.

[26]Assuming $\sigma^T = 7.1948$.

Row [5] employs a binary Schengen indicator as in Davis and Gift (2014) or Aussilloux and Le Hir (2016). This more than doubles the estimated Schengen effect. In addition, the trade effect on services trade is now less accurately measured.[27] The trade effects of the EU, the Euro, and other RTAs remain close to our benchmark findings.

Similarly, coding whether both, one or none of the trade partners are Schengen members ($Schengen = 0, 0.5, 1$), as in Chen and Novy (2011), strongly inflates the Schengen estimates (row [6]), suggesting an AVTE of 3.6% (3.5%) for goods in column (2) (column (3)) and of 5.9% for services trade. Comparing these estimates to the ones obtained using our own measure of treatment suggests that ignoring the geographic features of the Schengen area leads to an overestimation of the Schengen Agreement's trade effects. Recall that, accounting for the different trade structures of all EU-27 country pairs, the total average trade creating effect of Schengen obtained using our more exact measure of treatment is 2.81%, i.e., an AVTE of only 0.46%.

Panel C varies econometric choices. Row [7] pools over all 35 sub-sectors (see Table A3 in the Appendix) instead of aggregating trade, with standard errors allowing for clustering at the country-pair–subsector level.[28] This increases the number

[27]Note that this binary Schengen indicator disregards the geographical component of Schengen but simply measures the average trade effect of both trade partners being Schengen members, whereas we measure the average trade effect of one Schengen border en route between two countries. By accounting for the spatial distribution of Schengen borders, our treatment measure allows a more sophisticated disentanglement of the actual border effects at work.

[28]Multiway clustering addresses intraclass correlation at the subsectoral and at the country pair level, hedging against the risk of inflating Type I error rates.

of observations from 27,200 to 380,800 for goods and to 514,539 for services trade. Next to country pair fixed effects, we apply year specific importer, exporter, and sector fixed effects.[29] This choice leaves our baseline results given in Table 1 virtually unchanged in terms of sign, magnitude, and level of significance.

In the following we deviate from our preferred and state-of-the-art methodology. We find that these choices make it harder to disentangle the trade effects of integration, not only for Schengen but also for other measures such as the EU or RTAs. In row [8], we follow a different approach in controlling for multilateral resistance. Instead of using year specific importer and exporter fixed effects, we follow Baier and Bergstrand (2009) by using a Taylor Series expansion to explicitly control for unobserved multilateral resistances. This strategy requires us to additionally control for exporter supply and importer demand, which we extract from WIOD. We construct a vector $\mathbf{MR}^s_{ij,t}$ that contains first-order approximations of the terms $\Omega^s_{i,t}$ and $\Omega^s_{j,t}$ for all types of trade costs.[30] This change in methodology only marginally increases the estimated Schengen effect for goods trade and slightly decreases that for services trade, leading to a lower level of significance on the latter. This is also true for the EU, the Euro, and the RTA trade effects. Nevertheless, the overall order

[29] Choosing country pair-sector fixed effects and year specific importer and exporter fixed effects instead does not change our results.

[30] More precisely, multilateral resistance terms are calculated based on a linearized version of the canonical trade model that underlies equation (1). They are calculated for any trade cost proxy ϕ_{ij} as $MR\_\phi^s_{ij,t} = \left[\left(\sum_{k=1} \lambda^s_{k,t}\phi_{ik}\right) + \left(\sum_{m=1} \delta^s_{m,t}\phi_{mj}\right) - \left(\sum_{k=1}\sum_{m=1} \lambda^s_{k,t}\delta^s_{m,t}\phi_{km}\right)\right]$, where $\delta^s_{m,t}$ denotes country m's share in total world supply, $S^s_{m,t}/S^s_t$ in sector s, and $\lambda^s_{k,t}$ is an analogously defined sectoral demand share. ϕ_{ij} can be the log of distance, an adjacency dummy, a dummy for intranational trade, or various trade policy dummies governing the membership of a pair in Schengen, the EU, the Eurozone, or other RTAs.

of magnitude of the estimated coefficients remains very similar and thus leaves our key findings unchanged.

If we do not control for time-invariant determinants that might jointly affect trade integration (i.e., Schengen, EU, Euro, RTAs) and export volumes, we face omitted variable bias and potential endogeneity of policy variables. In row [9], we replace bilateral fixed effects by explicit trade cost proxies, such as bilateral distance, dummies for adjacency, intrantional trade, and common language. As expected, this leads to implausible effects not only on Schengen membership, but also on all other trade policy variables – except for the Eurozone. This result is reminiscent of Baier and Bergstrand (2007), who show that bilateral fixed effects are a crucial ingredient in the identification of causal effects of trade agreements because common but unobserved time-invariant determinants of both trade and the conclusion of agreements lead to biased estimates if they are not accounted for.

Finally, Panel D actually tests the heterogeneous effects of the Schengen Agreement, additionally to calculating them for all countries in our sample in the previous section. To approach this, we break the Schengen variable into subsets based on the number of borders crossed. We take bins which contain observations with one Schengen border, observations with two Schengen borders, and those with three or more (up to eight) Schengen borders.[31] Zero Schengen borders are our reference category. Similar to the baseline specification, the heterogeneity across the number of Schengen borders to be crossed is best identified for goods trade, as these are generally the most stable results – total trade faces an aggregation bias and services

[31]We have very little observations with more than 3 Schengen borders. This leads to issues when trying to identify effects empirically for these observations. We thus take them together in one bin and see this as an additional exercise to calculating the heterogeneous effects separately.

trade results are only marginally statistically significant. We find positive effects for total trade, but only the effect on three or more Schengen borders is statistically significant on the 10% level. Similarly, we find positive and statistically significant effects on goods trade, the size of them monotonically depending on the number of borders crossed. While Schengen increased trade for pairs with one border by 9.2%, those with two borders already experience a trade increase by 12.3% and the trade of country pairs with three or more borders increased on average by 15%. For services this again looks different. While we cannot identify a statistically significant effect for one or two borders relative to zero borders, three or more borders exert a statistically significant effect and increase services trade for these pairs by 18.4%. The stronger effect on services than on goods for many Schengen borders is again not surprising, as Schengen also promotes the mobility of individuals, which is more important for the cross-border provision of services than of goods and might be even more relevant for pairs with many Schengen borders. Overall, this shows that – due to the skewed distribution of the number of Schengen borders – it is not easy to empirically identify the heterogeneity across countries, particularly for services trade.

VI. CONCLUSION

In the present paper, we analyze the impact of the Schengen Agreement on trade in goods and services. We contribute to the literature by recognizing the spatial structure of the Schengen treatment, fully accounting for other European integration steps, and taking transit routes and the number of Schengen borders to be crossed *en route* into account.

Using a more accurate definition of the Schengen treatment and making full use

of the newest methodological advances, our PPML results imply a ranking of trade policy effects. Schengen significantly helps fostering trade integration in goods and services trade, namely by 2.6% and 4.1% per Schengen border, respectively, in our preferred specification. Drawing on structural estimates of the sectoral elasticity of substitution by Egger et al. (2012), this equals an ad valorem tariff equivalent of 0.37% in goods trade and 0.80% in services trade. The total average trade creation effect of Schengen is about 2.81%, corresponding to a drop in tariffs of about 0.46 percentage points.

Quite plausibly, in comparison with EU and Eurozone membership, and with other RTAs, the average trade creation induced by the Schengen Agreement alone is relatively low. EU membership boosts trade in goods by 122.6% (53.2% due to the customs union and 69.4% due to the single market) and in services by 39.8%, respectively. Other RTAs increase trade in goods by an additional 35.3% and in services by 20.2%. Common membership in the Eurozone is again more important for goods trade than for services trade, 15.3% and 8.8%, respectively.

We find substantial heterogeneity across countries, because geography, history, and specialization patterns imply that countries are heterogeneous with respect to the average number of Schengen borders that their trade flows need to cross. Peripheral countries benefit most from Schengen. Interestingly, through transit effects, Schengen outsiders also benefit from the removal of border controls within the Schengen area.

Finally, although the trade promoting effects of Schengen seem relatively small compared to other integration measures, abolishing the Schengen area implies bearing further cost which are not as easily quantifiable. The free movement of people can be considered a climax in the ongoing process of European integration which, if

forfeited, might jeopardize the European idea and many of its political achievements. In this context, a question to be addressed in future research should be whether an ongoing European integration process could be ensured *in spite of* (rather than because of) ending the Schengen Agreement.

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WEB APPENDIX to
The Trade Effects of Border Controls: Evidence from the European Schengen Agreement

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March 17, 2017

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A Web Appendix

Table A1
Summary Statistics

variable	N	mean	sd	max	min
$\text{Exports}_{ij,t}$	27,200	20.39	272.13	12385.98	0.00
$\text{Schengen}_{ij,t}$	27,200	0.79	1.31	8.00	0.00
$\text{Schengen}_{ij,t}$ (S = 1)	27,200	0.99	1.25	8.00	0.00
$\text{Schengen}_{ij,t}$ [0;1]	27,200	0.13	0.34	1.00	0.00
$\text{Schengen}_{ij,t}$ [0;0.5;1]	27,200	0.34	0.35	1.00	0.00
$\text{Both EU}_{ij,t}$	27,200	0.26	0.44	1.00	0.00
$\text{Both Euro}_{ij,t}$	27,200	0.08	0.27	1.00	0.00
$\text{Other RTA}_{ij,t}$	27,200	0.23	0.42	1.00	0.00
$\ln \text{Supply}_{i,t}$	27,200	13.03	1.82	17.06	8.78
$\ln \text{Demand}_{j,t}$	27,200	12.33	1.82	16.54	8.26
$\ln \text{Distance}_{ij}$	27,200	8.03	1.14	9.81	2.13
Adjacency_{ij}	27,200	0.06	0.23	1.00	0.00
$\text{Common Language}_{ij}$	27,200	0.05	0.22	1.00	0.00
Colony_{ij}	27,200	0.04	0.19	1.00	0.00
$\text{Colony post 1945}_{ij}$	27,200	0.01	0.12	1.00	0.00
Same Country_{ij}	27,200	0.02	0.14	1.00	0.00
$\ln\text{MFN}_{ij,t}$	27,200	0.08	0.09	0.50	0.00

Note: Summary statistics for the complete sample and total trade.

Table A2
WIOD Country List

ISO Code	Country
AUS	Australia
AUT	Austria
BEL	Belgium
BGR	Bulgaria
BRA	Brazil
CAN	Canada
CHN	China, People's Rep. of
CYP	Cyprus
CZE	Czech Republic
DEU	Germany
DNK	Denmark
ESP	Spain
EST	Estonia
FIN	Finland
FRA	France
GBR	United Kingdom
GRC	Greece
HUN	Hungary
IDN	Indonesia
IND	India
IRL	Ireland
ITA	Italy
JPN	Japan
KOR	Korea
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia
MEX	Mexico
MLT	Malta
NLD	Netherlands
POL	Poland
PRT	Portugal
ROM	Romania
RUS	Russia
SVK	Slovak Republic
SVN	Slovenia
SWE	Sweden
TUR	Turkey
TWN	Taiwan
USA	United States

Table A3
WIOD Sector List

Sector	ISIC rev.3	Description
C01	AtB	Agriculture, Hunting, Forestry and Fishing
C02	C	Mining and Quarrying
C03	15t16	Food, Beverages and Tobacco
C04	17t18	Textiles and Textile Products
C05	19	Leather, Leather and Footwear
C06	20	Wood and Products of Wood and Cork
C07	21t22	Pulp, Paper, Paper , Printing and Publishing
C08	23	Coke, Refined Petroleum and Nuclear Fuel
C09	24	Chemicals and Chemical Products
C10	25	Rubber and Plastics
C11	26	Other Non-Metallic Mineral
C12	27t28	Basic Metals and Fabricated Metal
C13	29	Machinery, Nec
C14	30t33	Electrical and Optical Equipment
C15	34t35	Transport Equipment
C16	36t37	Manufacturing, Nec; Recycling
C17	E	Electricity, Gas and Water Supply
C18	F	Construction
C19	50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
C20	51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
C21	52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
C22	H	Hotels and Restaurants
C23	60	Inland Transport
C24	61	Water Transport
C25	62	Air Transport
C26	63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
C27	64	Post and Telecommunications
C28	J	Financial Intermediation
C29	70	Real Estate Activities
C30	71t74	Renting of M&Eq and Other Business Activities
C31	L	Public Admin and Defense; Compulsory Social Security
C32	M	Education
C33	N	Health and Social Work
C34	O	Other Community, Social and Personal Services
C35	P	Private Households with Employed Persons

Table A4
Waiting time for commercial vehicles and traffic volume at US–Canadian border checkpoints, 2014

	Waiting time (minutes)				
Border Station	mean	min	max	# vehicles	Station share
ME: Calais	0	0	0	62,352	1.1%
ME: Houlton	1	0	6	84,043	1.4%
ME: Jackman	0	0	0	84,755	1.5%
ME: Madawaska	3	0	15	19,238	0.3%
MI: Detroit	20	10	30	1,600,000	27.6%
MI: Port Huron	7	0	37	778,268	13.4%
MI: Sault Ste. Marie	5	0	15	38,932	0.7%
MN: Intertiol Falls	0	0	0	16,528	0.3%
MT: Sweetgrass	20	10	45	145,803	2.5%
ND: Pembi	18	12	36	229,079	3.9%
NY: Alexandria Bay	15	NA	NA	192,551	3.3%
NY: Buff.-Niagara Falls	24	11	36	962,076	16.6%
NY: Champ.-Rouses Pt.	45	NA	NA	285,195	4.9%
NY: Massena	0	0	0	23,188	0.4%
NY: Ogdensburg	10	NA	NA	37,726	0.7%
VT: Derby Line	20	NA	NA	97,836	1.7%
VT: Highgate Springs	15	NA	NA	93,914	1.6%
VT: Norton	0	0	0	11,161	0.2%
WA: Blaine	8	0	0	367,994	6.3%
WA: Lynden	10	NA	NA	41,580	0.7%
WA: Point Roberts	10	NA	NA	18,121	0.3%
WA: Sumas	25	10	100	149,361	2.6%
Other	NA	NA	NA	462,508	8.0%
Weighted Mean / Sum	18			5,802,209	100%

Table A5
Ad Valorem Tariff Equivalents due to Schengen, by Country

Country	Ad Valorem Tariff Equivalents					Share of Schengen Trade		
	Goods		Services	Total Trade		Goods	Services	Total Trade
	$\sigma_1^G = 7.9849$	$\sigma_2^G = 2.443$	$\sigma^S = 5.9591$	$\sigma_1^T = 7.1948$	$\sigma_2^T = 3.8144$			
EST	0.63%	3.08%	1.20%	0.83%	1.83%	68.87%	52.50%	61.04%
LVA	0.64%	3.15%	1.09%	0.81%	1.80%	67.76%	50.20%	57.51%
FIN	0.67%	3.26%	1.12%	0.80%	1.76%	52.29%	43.26%	49.35%
MLT	0.42%	2.05%	1.15%	0.74%	1.65%	51.16%	59.95%	56.52%
PRT	0.64%	3.14%	0.97%	0.74%	1.64%	79.40%	58.41%	70.27%
HUN	0.60%	2.94%	1.03%	0.72%	1.60%	73.13%	55.39%	67.53%
SVK	0.53%	2.60%	0.96%	0.65%	1.43%	79.37%	69.53%	76.60%
SWE	0.58%	2.84%	0.73%	0.62%	1.38%	60.83%	36.08%	50.36%
ESP	0.47%	2.29%	0.94%	0.62%	1.37%	67.12%	58.03%	63.36%
ROM	0.48%	2.36%	0.80%	0.59%	1.30%	57.13%	42.77%	50.03%
SVN	0.51%	2.47%	0.78%	0.59%	1.30%	73.98%	53.29%	67.00%
BEL	0.44%	2.14%	0.81%	0.56%	1.24%	74.40%	59.89%	68.12%
POL	0.47%	2.30%	0.77%	0.56%	1.24%	72.23%	49.66%	64.60%
ITA	0.44%	2.13%	0.83%	0.55%	1.22%	60.68%	48.83%	56.53%
NLD	0.47%	2.29%	0.69%	0.54%	1.19%	72.05%	45.39%	59.77%
TUR	0.32%	1.58%	1.08%	0.51%	1.13%	40.60%	59.00%	46.10%
CZE	0.40%	1.97%	0.76%	0.49%	1.08%	75.69%	60.18%	72.01%
LUX	0.46%	2.26%	0.60%	0.48%	1.06%	86.06%	42.98%	47.30%
DNK	0.44%	2.17%	0.56%	0.47%	1.03%	69.89%	38.09%	50.05%
LTU	0.57%	2.80%	0.44%	0.45%	1.00%	78.92%	28.26%	45.45%
BGR	0.35%	1.73%	0.63%	0.45%	0.99%	47.00%	37.70%	42.83%
AUT	0.37%	1.80%	0.62%	0.45%	0.99%	72.71%	50.68%	64.16%
CYP	0.36%	1.75%	0.52%	0.41%	0.91%	44.87%	28.53%	32.81%
GBR	0.30%	1.46%	0.58%	0.41%	0.90%	45.58%	38.03%	41.22%
GRC	0.36%	1.75%	0.48%	0.39%	0.86%	45.04%	28.27%	32.67%
RUS	0.20%	0.99%	0.57%	0.36%	0.81%	30.71%	33.99%	32.68%
DEU	0.30%	1.46%	0.43%	0.34%	0.75%	60.02%	42.55%	55.85%
FRA	0.29%	1.42%	0.44%	0.34%	0.74%	58.87%	39.88%	52.89%
IRL	0.14%	0.69%	0.22%	0.17%	0.37%	23.79%	15.96%	19.62%
EU 27 Mean	0.46%	2.23%	0.75%	0.55%	1.21%	63.66%	45.71%	54.65%
EU 27 Median	0.46%	2.26%	0.76%	0.55%	1.22%	67.76%	45.39%	56.52%
EU 27	0.38%	1.86%	0.64%	0.46%	1.02%	62.03%	43.92%	54.96%

Note: Sorted by Total AVTE in descending order. AVTEs have been calculated dependent on each country's trade volumes of goods and services trade across the number of Schengen borders. The counterfactual trade volumes have been calculated respective of estimated Schengen effects from the gravity estimation. AVTEs result from the difference in counterfactual (cf) to observed (obs) trade, assuming $\sigma_1^G = 7.9849$, $\sigma_1^S = 5.9591$ structurally estimated by Egger et al. (2012), $\sigma_2^G = 2.443$ (goods elasticity of substitution estimate from own analysis) and $\sigma_1^T = 7.1948$, $\sigma_2^T = 3.8144$ (EU-27 sector-share weighted mean of σ^S and σ_1^G or σ_2^G respectively), for goods, services, and total trade: $(X^{s,cf}/X^{s,obs})^{(1/\sigma^s)} - 1 \, \forall \, s \in \{G, S, T\}$.

Table A6
Average Tariff Equivalents due to Schengen, by Country

Country	Average Tariff Equivalents ($\sigma = 6$)			Share of Schengen Trade in Total Trade		
	Goods	Services	Total Trade	Goods	Services	Total Trade
EST	0.88%	1.19%	1.03%	68.87%	52.50%	61.04%
LVA	0.90%	1.08%	1.01%	67.76%	50.20%	57.51%
FIN	0.93%	1.11%	0.99%	52.29%	43.26%	49.35%
MLT	0.59%	1.14%	0.92%	51.16%	59.95%	56.52%
PRT	0.90%	0.96%	0.92%	79.40%	58.41%	70.27%
HUN	0.84%	1.02%	0.90%	73.13%	55.39%	67.53%
SVK	0.74%	0.95%	0.80%	79.37%	69.53%	76.60%
SWE	0.81%	0.72%	0.77%	60.83%	36.08%	50.36%
ESP	0.66%	0.93%	0.77%	67.12%	58.03%	63.36%
ROM	0.68%	0.79%	0.73%	57.13%	42.77%	50.03%
SVN	0.71%	0.78%	0.73%	73.98%	53.29%	67.00%
BEL	0.61%	0.80%	0.69%	74.40%	59.89%	68.12%
POL	0.66%	0.77%	0.69%	72.23%	49.66%	64.60%
ITA	0.61%	0.83%	0.69%	60.68%	48.83%	56.53%
NLD	0.66%	0.69%	0.67%	72.05%	45.39%	59.77%
TUR	0.45%	1.07%	0.63%	40.60%	59.00%	46.10%
CZE	0.57%	0.75%	0.61%	75.69%	60.18%	72.01%
LUX	0.65%	0.59%	0.60%	86.06%	42.98%	47.30%
DNK	0.62%	0.55%	0.58%	69.89%	38.09%	50.05%
LTU	0.80%	0.44%	0.56%	78.92%	28.26%	45.45%
BGR	0.50%	0.63%	0.55%	47.00%	37.70%	42.83%
AUT	0.52%	0.61%	0.55%	72.71%	50.68%	64.16%
CYP	0.50%	0.51%	0.51%	44.87%	28.53%	32.81%
GBR	0.42%	0.57%	0.51%	45.58%	38.03%	41.22%
GRC	0.50%	0.48%	0.48%	45.04%	28.27%	32.67%
RUS	0.28%	0.57%	0.45%	30.71%	33.99%	32.68%
DEU	0.42%	0.43%	0.42%	60.02%	42.55%	55.85%
FRA	0.41%	0.43%	0.42%	58.87%	39.88%	52.89%
IRL	0.20%	0.22%	0.21%	23.79%	15.96%	19.62%
EU 27 Mean	0.64%	0.74%	0.68%	63.66%	45.71%	54.65%
EU 27 Median	0.65%	0.75%	0.69%	67.76%	45.39%	56.52%
EU 27	0.53%	0.63%	0.57%	62.03%	43.92%	54.96%

Note: Sorted by Total AVTE in descending order. AVTEs have been calculated dependent on each country's trade volumes of goods and services trade across the number of Schengen borders. The counterfactual trade volumes have been calculated respective of estimated Schengen effects from the gravity estimation. AVTEs result from the difference in counterfactual (cf) to observed (obs) trade, assuming $\sigma = 6$: $(X^{cf}/X^{obs})^{(1/\sigma)} - 1$.

Table A7

The Impact of Schengen on Bilateral Exports, including all Sectors (1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Schengen_{ij,t}$	0.061***	0.007	0.109***	0.035***	0.034***	0.067***	0.040*
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
$Both\ EU_{ij,t}$		0.592***		0.744***	0.475***		0.335***
		(0.07)		(0.07)	(0.10)		(0.08)
$Both\ Euro_{ij,t}$		0.054**		0.147***	0.152***		0.084*
		(0.02)		(0.03)	(0.03)		(0.04)
$Other\ RTA_{ij,t}$		0.236***		0.268***	0.268***		0.184**
		(0.06)		(0.06)	(0.07)		(0.07)
$MFN_{ij,t}$					-2.342***		
					(0.50)		

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer and exporter fixed effects included but not reported. Number of observations: 27,200.

Table A8

Endogeneity of Schengen and Bilateral Exports, excluding Gas, Fuel, Coke, Mining & Quarrying and the 3 Most Important Trade Partners (1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Schengen_{ij,t}$	0.041***	-0.003	0.085***	0.017**	0.017**	0.075***	0.043**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
$Both\ EU_{ij,t}$		0.607***		0.710***	0.493***		0.342***
		(0.07)		(0.07)	(0.09)		(0.07)
$Both\ Euro_{ij,t}$		-0.026		0.067**	0.071**		0.087*
		(0.03)		(0.03)	(0.03)		(0.05)
$Other\ RTA_{ij,t}$		0.250***		0.170***	0.163***		0.144**
		(0.07)		(0.06)	(0.06)		(0.06)
$MFN_{ij,t}$					-1.818***		
					(0.50)		

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer and exporter fixed effects included but not reported. All specifications exclude the 3 most important trade partners of each country. Number of observations: 25,160.

Table A9

The Impact of Schengen on Bilateral Exports, excluding Gas, Fuel, Coke, Mining & Quarrying, European Sample (1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Schengen_{ij,t}$	0.061***	0.005	0.120***	0.034***	0.034***	0.081***	0.057***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
$Both\ EU_{ij,t}$		0.993***		1.380***	1.423***		0.471***
		(0.10)		(0.10)	(0.10)		(0.16)
$Both\ Euro_{ij,t}$		0.033		0.155***	0.155***		0.081**
		(0.02)		(0.03)	(0.03)		(0.04)
$Other\ RTA_{ij,t}$		0.617***		0.843***	0.843***		0.342**
		(0.10)		(0.09)	(0.09)		(0.16)
$MFN_{ij,t}$					0.361		
					(0.36)		

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer and exporter fixed effects included but not reported. Number of observations: 14,297.

Table A10

The Impact of Schengen on Bilateral Exports, excluding Gas, Fuel, Coke, Mining & Quarrying, Intercontinental Trade with one Schengen Border (1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Schengen_{ij,t}$	0.072***	0.024***	0.122***	0.050***	0.048***	0.094***	0.073***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
$Both\ EU_{ij,t}$		0.594***		0.779***	0.508***		0.298***
		(0.07)		(0.07)	(0.11)		(0.09)
$Both\ Euro_{ij,t}$		0.021		0.129***	0.135***		0.074*
		(0.02)		(0.03)	(0.03)		(0.04)
$Other\ RTA_{ij,t}$		0.249***		0.293***	0.301***		0.181**
		(0.07)		(0.06)	(0.07)		(0.07)
$MFN_{ij,t}$					-2.433***		
					(0.57)		
	(0.12)	(0.15)	(0.25)	(0.29)	(0.35)	(0.11)	(0.14)

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer and exporter fixed effects included but not reported. Number of observations: 27,200.

Table A11

The Impact of Schengen on Bilateral Exports, excluding Gas, Fuel, Coke, Mining & Quarrying, Dummy (1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Schengen [0;1]	0.148***	0.030**	0.252***	0.070***	0.072***	0.134***	0.065
	(0.02)	(0.01)	(0.03)	(0.02)	(0.02)	(0.04)	(0.04)
Both $EU_{ij,t}$		0.602***		0.788***	0.514***		0.344***
		(0.07)		(0.07)	(0.11)		(0.08)
Both $Euro_{ij,t}$		0.023		0.130***	0.134***		0.083*
		(0.02)		(0.03)	(0.03)		(0.04)
Other $RTA_{ij,t}$		0.250***		0.295***	0.302***		0.184**
		(0.07)		(0.06)	(0.07)		(0.07)
$MFN_{ij,t}$					-2.444***		
					(0.57)		

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer and exporter fixed effects included but not reported. Number of observations: 27,200.

Table A12

The Impact of Schengen on Bilateral Exports, excluding Gas, Fuel, Coke, Mining & Quarrying, Indicator (1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Schengen [0;0.5;1]	0.306***	0.161***	0.493***	0.254***	0.247***	0.346***	0.300***
	(0.03)	(0.03)	(0.05)	(0.03)	(0.03)	(0.05)	(0.06)
Both $EU_{ij,t}$		0.559***		0.738***	0.469***		0.260***
		(0.07)		(0.07)	(0.11)		(0.09)
Both $Euro_{ij,t}$		0.011		0.118***	0.124***		0.065
		(0.02)		(0.03)	(0.03)		(0.04)
Other $RTA_{ij,t}$		0.247***		0.291***	0.299***		0.177**
		(0.07)		(0.06)	(0.07)		(0.07)
$MFN_{ij,t}$					-2.426***		
					(0.57)		

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer and exporter fixed effects included but not reported. Number of observations: 27,200.

Table A13

The Impact of Schengen on Bilateral Exports, excluding Gas, Fuel, Coke, Mining & Quarrying, Pooled over Sectors (1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Schengen_{ij,t}$	0.054***	0.0003	0.106***	0.026***	0.026***	0.067***	0.040*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Both $EU_{ij,t}$		0.617***		0.800***	0.527***		0.335***
		(0.08)		(0.10)	(0.11)		(0.08)
Both $Euro_{ij,t}$		0.030		0.137***	0.142***		0.084*
		(0.02)		(0.03)	(0.03)		(0.04)
Other $RTA_{ij,t}$		0.250***		0.294***	0.302***		0.184**
		(0.08)		(0.09)	(0.10)		(0.07)
$MFN_{ij,t}$					-2.443***		
					(0.40)		
Observations	897,600	897,600	380,800	380,800	380,800	514,539	514,539

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer, exporter, and sector fixed effects included but not reported.

Table A14

The Impact of Schengen on Bilateral Exports, excluding Gas, Fuel, Coke, Mining & Quarrying, Baier and Bergstrand (2009) MR-Terms (1995 - 2011)

Dependent Variable:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Schengen_{ij,t}$	0.060***	0.005	0.118***	0.037***	0.038***	0.060***	0.034
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Both $EU_{ij,t}$		0.651***		0.818***	0.653***		0.330***
		(0.09)		(0.09)	(0.11)		(0.09)
Both $Euro_{ij,t}$		0.029		0.124***	0.126***		0.079*
		(0.03)		(0.03)	(0.03)		(0.05)
Other $RTA_{ij,t}$		0.275***		0.322***	0.313***		0.168**
		(0.08)		(0.08)	(0.08)		(0.08)
$MFN_{ij,t}$					-1.350**		
					(0.55)		
ln $Supply_{i,t}$	0.651***	0.649***	0.740***	0.736***	0.751***	0.554***	0.550***
	(0.07)	(0.07)	(0.07)	(0.07)	(0.06)	(0.09)	(0.09)
ln $Demand_{j,t}$	0.438***	0.439***	0.407***	0.401***	0.394***	0.445***	0.453***
	(0.07)	(0.07)	(0.08)	(0.08)	(0.07)	(0.09)	(0.09)

Note: ***, **, *, denote significance at the 1%, 5%, and 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair, country, and time fixed effects included but not reported. All specifications include Baier and Bergstrand (2009) multilateral resistance terms for all trade costs. Number of observations: 25,857.

Table A15

The Impact of Schengen on Bilateral Exports, excluding Gas, Fuel, Coke, Mining & Quarrying, PPML without bilateral fixed effects
(1995 - 2011)

Dep. var.:	Bilateral Exports						
	Total Trade		Goods			Services	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Schengen$_{ij,t}$	-0.437***	-0.130	-0.196***	-0.084	-0.139**	-0.655***	-0.148
	(0.06)	(0.08)	(0.05)	(0.07)	(0.06)	(0.09)	(0.09)
Both EU$_{ij,t}$		-1.098***		-0.496***	-0.923***		-1.661***
		(0.19)		(0.16)	(0.15)		(0.22)
Both Euro$_{ij,t}$		0.299***		0.212**	0.252***		0.277
		(0.12)		(0.09)	(0.09)		(0.19)
Other RTA$_{ij,t}$		-1.415***		-0.975***	-0.449**		-2.376***
		(0.16)		(0.15)	(0.20)		(0.21)
MFN$_{ij,t}$					-8.873***		
					(1.74)		
ln Distance$_{ij}$	-2.314***	-2.211***	-2.011***	-1.957***	-1.569***	-2.723***	-2.537***
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.09)	(0.07)
Adjacency$_{ij}$	-1.710***	-0.888***	-0.970***	-0.518***	-0.402***	-3.209***	-1.616***
	(0.12)	(0.15)	(0.10)	(0.16)	(0.14)	(0.26)	(0.19)
Common Language$_{ij}$	0.064	0.279*	0.194	0.336**	0.062	0.513*	0.686***
	(0.25)	(0.16)	(0.24)	(0.15)	(0.18)	(0.26)	(0.19)
Colony$_{ij}$	0.318	0.039	0.142	-0.023	-0.135	0.713***	0.210
	(0.21)	(0.18)	(0.18)	(0.17)	(0.17)	(0.25)	(0.20)
Colony post 1945$_{ij}$	-0.877**	-0.758*	-0.732*	-0.644	0.751*	-1.395***	- 1.172**
	(0.43)	(0.40)	(0.43)	(0.41)	(0.43)	(0.52)	(0.46)
Same Country$_{ij}$	-0.757*	-0.504**	-0.855**	-0.618***	0.254	-1.207**	-0.931*
	(0.40)	(0.22)	(0.41)	(0.23)	(0.23)	(0.56)	(0.50)

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer and exporter fixed effects included but not reported. Number of observations: 27,200.

Table A16
The Impact of Schengen on Bilateral Exports estimated in Bins (1995 - 2011)

Dep. var.:	Bilateral Exports			
	Total Trade	Goods		Services
	(1)	(2)	(3)	(4)
Schengen Bin [1]	0.026	0.084***	0.089***	-0.048
	(0.02)	(0.02)	(0.02)	(0.06)
Schengen Bin [2]	0.036	0.113***	0.117***	-0.012
	(0.02)	(0.03)	(0.03)	(0.07)
Schengen Bin [3; 8]	0.054*	0.140***	0.138***	0.169*
	(0.03)	(0.03)	(0.03)	(0.09)
Both EU	0.601***	0.778***	0.504***	0.331***
	(0.07)	(0.07)	(0.11)	(0.08)
Both Euro	0.024	0.129***	0.134***	0.088**
	(0.02)	(0.03)	(0.03)	(0.04)
Other RTA	0.250***	0.294***	0.302***	0.184**
	(0.07)	(0.06)	(0.07)	(0.07)
Tariff			-2.450***	
			(0.57)	

Note: ***, **, * denote significance at the 1%, 5%, 10% level, respectively. Robust clustered standard errors reported in parentheses. Pair as well as year specific importer and exporter fixed effects included but not reported. Number of observations: 27,200.

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