

## **Online Appendix to “Hubs of Governance: Path-Dependence and Higher-order Effects of PTA Formation”**

In this appendix, we present a variety of robustness checks (none of which affect our results materially) as well as a more detailed analysis of the relative importance of different variables for different actors.

### **Visualizing Services PTA Networks**

To get a sense of evolutionary trends, it is useful to explore the negative-list and positive-list PTAs visually. Figure 1A shows the evolution of the network of positive-list agreements from 1994 to 2010. The size of individual nodes is weighted to reflect a greater number of PTAs.

It appears that until 2004, having a positive-list PTA did not necessarily create any further incentive to negotiate more such agreements—with the exception of Singapore that positions itself as a hub. By 2008, China also assumed the role of a hub, with spokes throughout Asia and Latin America, as did Japan. In 2010, the last year of positive-list PTA activity in our analysis period, several smaller hubs emerged (among them, New Zealand, Australia, and several ASEAN countries), but the network retained “loose ends” and countries that are only weakly embedded. It is noticeable, however, that Asian countries dominate among the positive-list network, and that several countries that otherwise prefer negative-list PTAs, as we will see next, are willing to conclude positive-list agreements with China.

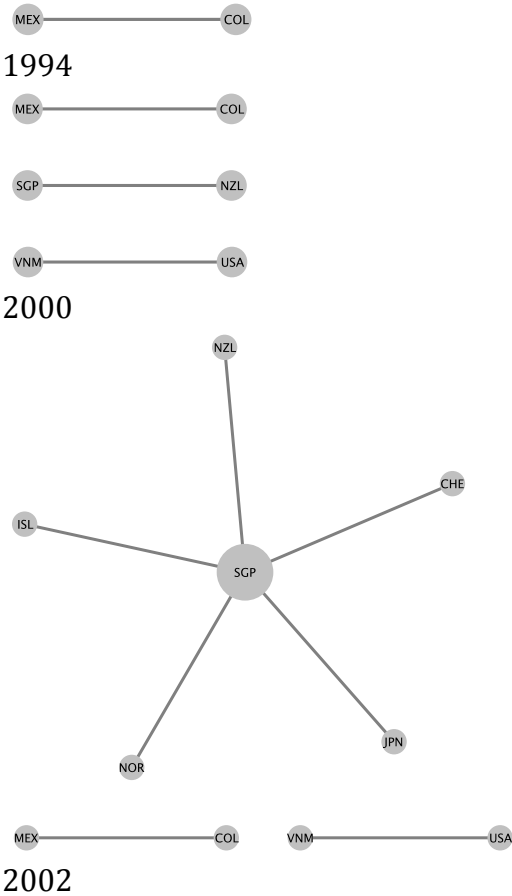
The negative-list PTA network shown in Figure 2A evolves quite differently. Following the signing of NAFTA, Chile formed PTAs with Canada and several Latin American neighbors, and quickly established itself as the primary services PTA hub in the region. This is noteworthy because during the same period the United States did not form any further PTAs, as the Clinton administration failed to obtain the Congressional authority to negotiate further trade agreements. In other words, the model of services liberalization in PTAs preferred by the US was not spread by its most important proponent, but by other countries, in particular Chile and Mexico.

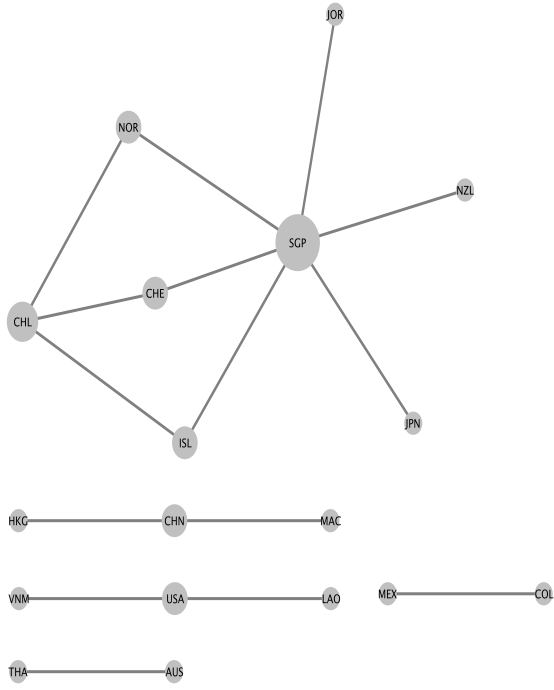
By 2003, the NAFTA approach had diffused to the Asian region through the US-Singapore and Panama-Republic of China (Taiwan) PTAs. Australia, Korea and Singapore became promoters of negative-list PTAs by 2008. In 2011, the network of negative-list PTAs had become dense, with almost all actors connected to most others within the network. There are only two “outliers:” Hong Kong is connected to New Zealand, and Uruguay—which legally as a Mercosur member state should not even form separate trade agreements—has a PTA tie with Mexico. The negative-list network is dominated by Latin American countries. The ASEAN countries are absent with the exception of Singapore and Brunei (via the P-4 agreement). Most of the negative-list PTA partners are also formal or informal US allies, although the US does not have PTAs with all of them. However a number of US allies are conspicuously missing from this network, among them Thailand and the Philippines.

Importantly, the separation into two different networks does not appear to be a simple consequence of ex ante country preferences. Rather, a number of countries start off with positive-list PTAs, but then switch onto the negative-list track, while others remain committed to positive-list agreements. However very few countries switch from negative-list to positive-list agreements.

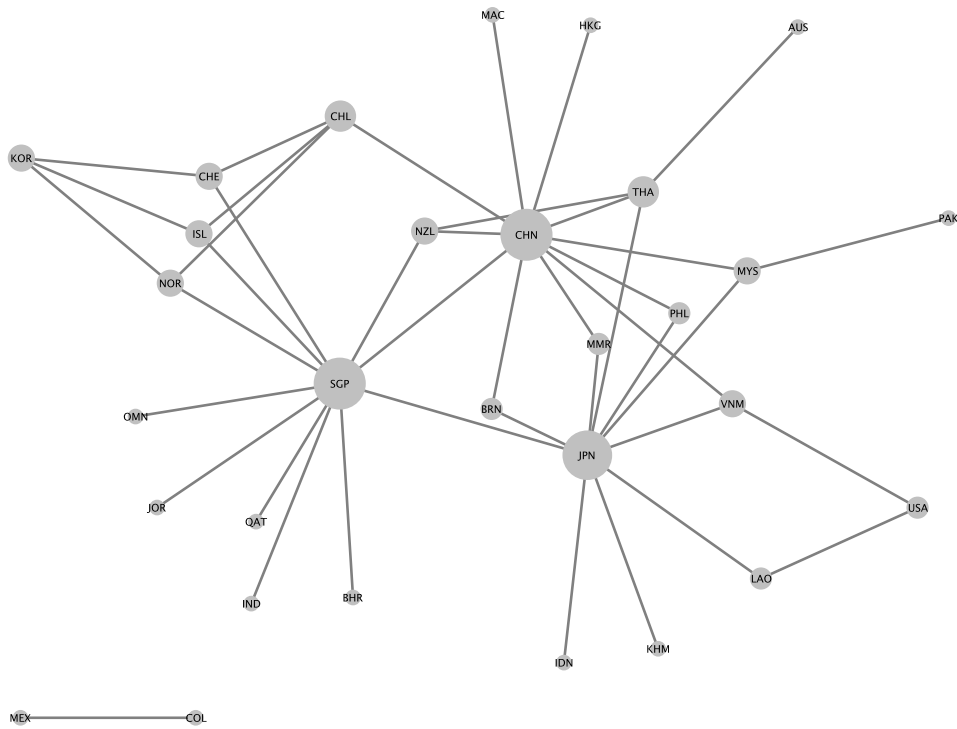
In summary, visual inspection of the networks shows several important trends: The positive-list network has several hubs—notably, China—and numerous spokes. By contrast, the negative-list network is densely connected, and its evolution appears to originate in NAFTA and spread among countries with close economic and political ties to the United States, but is not directly driven by the US.

Figure 1A: Positive-list PTA network

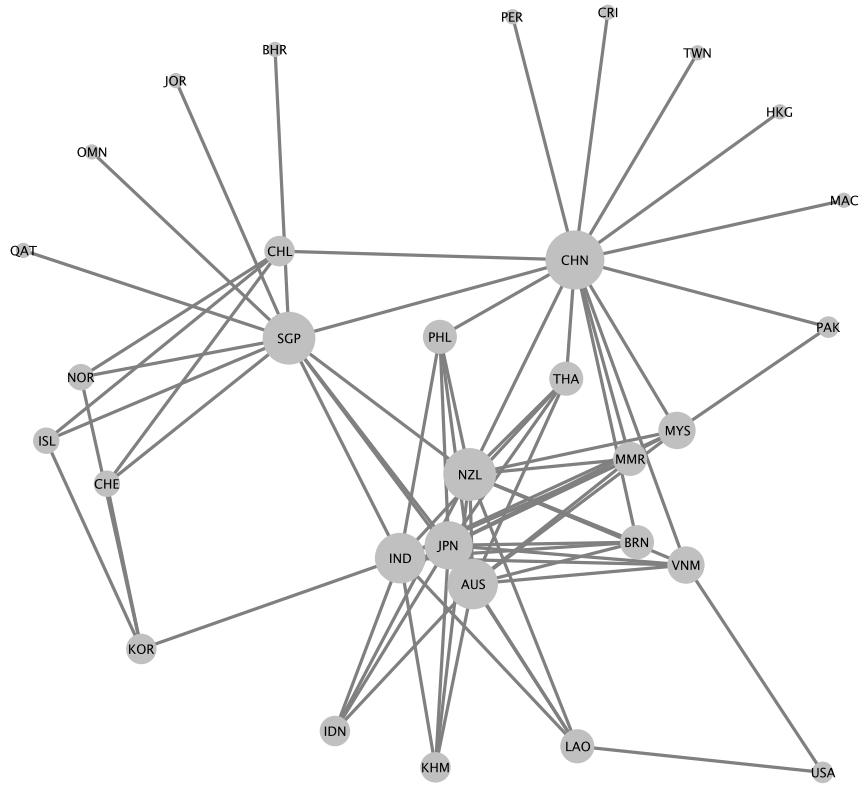




2004



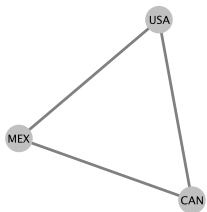
2008



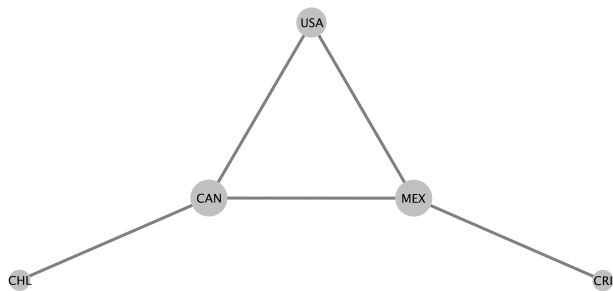
MEX ——— COL

2010

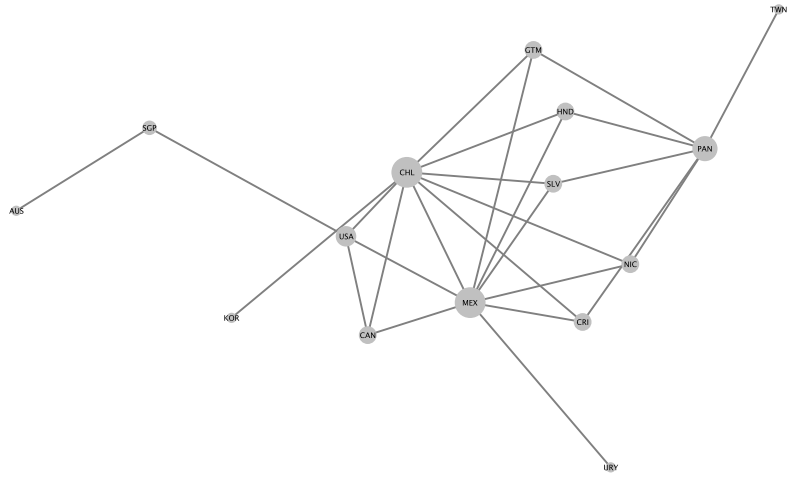
Figure 2A: Negative-list PTA network



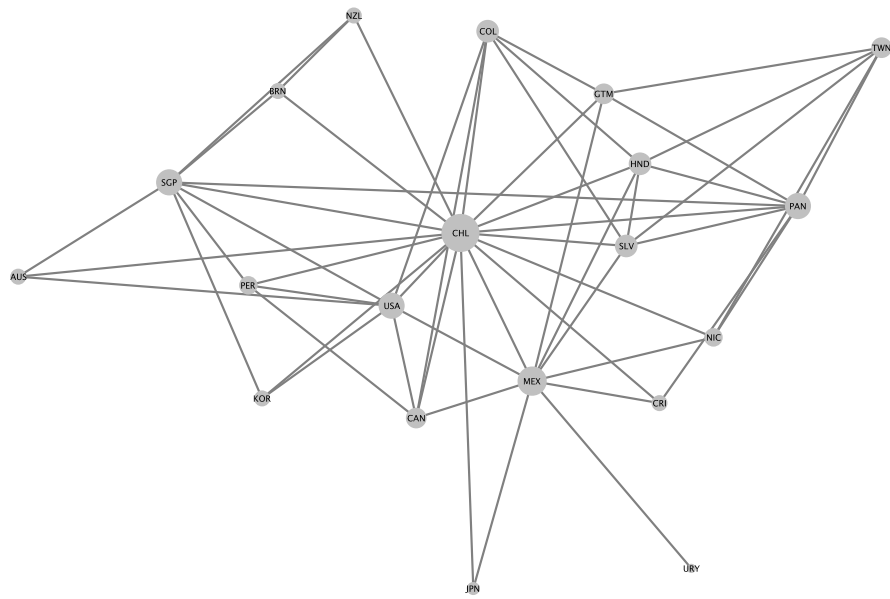
1992



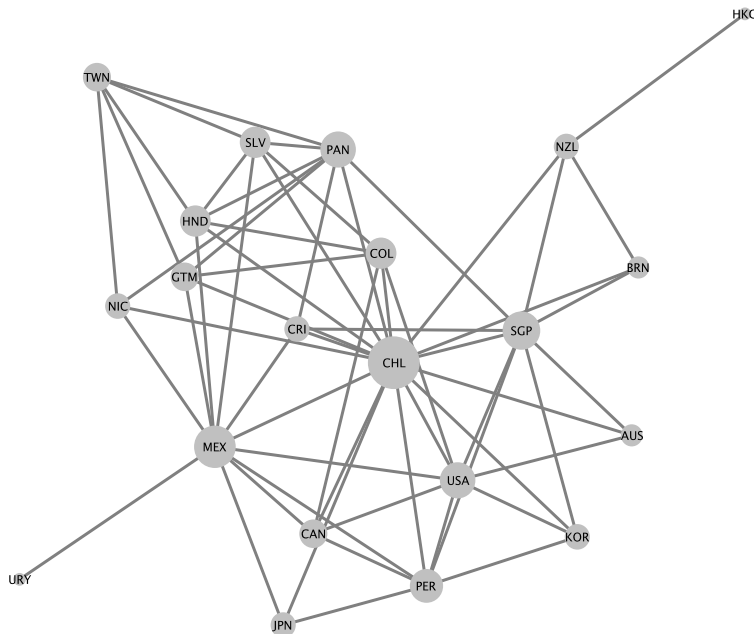
1996



2003



2008



2011

### Robustness Checks

All results are shown in Table 1. First, in our model in the paper we use (the log of) FDI from the US in the services sector of the country in question to control for the influence of US multinational firms in a host country. It could be expected that countries with a lot of FDI would be more likely to choose negative-list agreements. Our results show that this is not the case. As a robustness check, we substitute the total FDI stock in the country. This measure is quite strongly correlated ( $\rho = 0.71$ ) with US FDI in our sample, so that it is unsurprising that the results (shown in the column titled **Total FDI**) do not differ very much.

Second, many countries have negotiated bilateral investment treaties (BITs), of which at least some could affect the regulation of investment in services. We therefore include a dyadic changing covariate called *BitInForce*, equal to 1 in the years when a BIT is in ratified and in force between two countries. Our data draws on Haftel and Thompson (2013) for BITs ratified prior to 2007, and our own addition of later ratification dates based on the UNCTAD Investment Policy Hub's [International Investment Agreements Navigator Database](#). EU member countries are important signatories of BITs, but the EU as unitary actor in our analysis period does not negotiate investment treaties, investment only became "Commission Competence" with the Treaty of Lisbon. We therefore created a variable called *BitInForceEU3* that is equal to 1 when each of the three biggest economies in the EU (Great Britain, France and Germany) had a BIT in force with the respective partner country. Results are shown in the columns titled **BITs** and **BITs (EU)**. Neither parameter approaches statistical significance. The other results remain unchanged.

Third, the literature on diffusion has often operationalized channels of possible diffusion as having a common official language (which greatly facilitates the adoption of legal rules, regulations and treaty clauses from the other country) or has having a common legal origin. We draw on [CEPII datasets](#) for these variables (Head, Mayer, and Ries 2010; Melitz and Toubal 2012). For the case of the EU, we consider all 26 official languages. For the legal origin, we do not consider the EU to have a specific legal origin, as services liberalization by EU required assent by the member states, which in turn have diverse English, Roman-Dutch, Napoleonic and German legal origins. We call these variables *CommonLanguage* and *CommonLegalOrigin*. Results are shown in the columns titled **Common Legal Origin** and **Common Language**. Neither of these variables is statistically significant, so we find no evidence of diffusion through these channels.

### Correlation Matrix and Summary Statistics

Tables 2 and 3 show the correlation between our independent variables and summary statistics. The only variables that are relatively highly correlated are US trade and US FDI in services.

### Relative Importance of Network Effects and Covariates

Indlekofer and Brandes (2013) present a method to calculate the relative importance of multiple explanatory variables for stochastic actor-oriented models (SAOMS) like those implemented in RSiena. While SAOMS are usually based on multinomial logit models, a particular challenge arises that prevent us from simply calculating odds ratios when comparing (as opposed to directly calculating) substantive effects: The impact of a micro-step depends largely on the local network structure around an actor, but the network is endogenously changing over time through the micro-steps of all actors. Accordingly, the relative importance of different variables may change across actors and over time. In our paper, space constraints prevent us from presenting all of these nuances. If a model is specified with associated parameters  $\theta$  of the evaluation function, then the term actor decision of actor  $i$  refers to the set  $S_i = \{1, \dots, N\}$  of available alternatives actor  $i$  could choose. The probability distribution  $\pi_i$  assigns to each choice a value of  $\pi_i(j)$  which is referred to as the choice probability of choice  $j$ , with all choice probabilities summing up to 1. To assess the impact of the  $k$ th parameter on the actor decision, the choice probabilities associated with each effect in a model containing all parameters except the  $k$ th are compared with the choice of parameters in the model with this parameter. To compare the probability distributions, the sum of the absolute values of the pointwise difference is compared.

$$\|\pi_i - \pi_j^{(-k)}\|_1 = \sum_{j=1}^N |\pi_i(j) - \pi_i^{-k}(j)|$$

This gives a relative importance of each parameter for each actor at each observation point out of a total of 1 (which would imply that a single parameter fully determines the actor's choice. Figures 3A and 4A show the calculations of the relative importance of the parameters for our 53 actors and 11 time points, i.e. the fully disaggregated version of figure 3 in the main paper.

Given the size of the graphs we do not recommend printing but rather inspection on the screen. Number references for countries are given in table 4. See Indlekofer and Brandes (2013) for further details. The necessary calculations are available in *RSiena* through the function *sienaRI()*.



**Table 1: Robustness Checks**

	Total FDI		BITs		BITs (EU)		Common Legal Origin		Common Language	
	Parameter estimate	S.E.	Parameter estimate	S.E.	Parameter estimate	S.E.	Parameter estimate	S.E.	Parameter estimate	S.E.
Balance	0.259	0.108 *	0.254	0.098 **	0.252	0.097 **	0.266	0.105 *	0.280	0.112 *
(sqrt) Degree <sub>j</sub>	3.635	0.852 ***	3.537	0.748 ***	3.555	0.760 ***	3.634	0.793 ***	3.833	0.844 ***
Distance	-0.155	0.367	-0.313	0.357	-0.330	0.351	-0.259	0.362	-0.138	0.378
Trade	0.169	0.120	0.126	0.108	0.132	0.108	0.098	0.110	0.097	0.104
PTA in Goods	-0.964	0.965	-1.019	0.928	-1.026	0.954	-1.166	0.985	-1.115	1.014
Democracy	-0.082	0.331	-0.199	0.350	-0.189	0.342	-0.236	0.357	-0.358	0.371
Democracy <sub>j</sub> × Democracy <sub>j</sub>	-0.042	0.091	-0.051	0.090	-0.054	0.093	-0.045	0.094	-0.062	0.098
ln GDP	0.339	0.637	0.260	0.355	0.265	0.340	0.320	0.348	0.286	0.350
ln GDP similarity	1.787	1.498	1.467	1.597	1.447	1.564	1.514	1.599	1.525	1.645
ln GDP/cap	0.602	0.741	0.572	0.703	0.543	0.686	0.693	0.725	0.844	0.706
<b>Negative-list PTAs</b> GDP/cap similarity	0.629	1.558	0.630	1.624	0.555	1.688	-0.431	1.707	-0.388	1.761
ln US Trade	-0.216	0.104 *	-0.309	0.122 *	-0.314	0.123 *	-0.321	0.123 **	-0.347	0.134 **
ln China Trade	-0.146	0.175	-0.153	0.178	-0.153	0.171	-0.154	0.177	-0.150	0.184
US Alliance	5.684	2.147 **	4.886	2.164 *	4.964	2.199 *	5.268	2.131 *	5.708	2.355 *
Services Trade/GDP	0.073	0.035 *	0.059	0.034	0.061	0.033	0.063	0.033	0.057	0.034
ln US FDI		▴	0.204	0.175	0.205	0.177	0.202	0.170	0.200	0.182
GATS commitments	0.086	0.040 *	0.092	0.035 **	0.090	0.035 **	0.091	0.036 *	0.086	0.037 *
ln FDI	0.061	0.540		▴		▴		▴		▴
BIT in force		▴	0.068	0.548		▴		▴		▴
BIT in force (with EU)		▴		▴	-0.148	0.540		▴		▴
Common legal origin		▴		▴		▴	0.843	0.513		▴
Common official language		▴		▴		▴		▴	1.256	0.657
Balance	0.025	0.104	0.004	0.086	0.003	0.090	0.003	0.085	0.007	0.086
(sqrt) Degree <sub>j</sub>	2.410	0.664 ***	1.996	0.580 ***	1.990	0.587 ***	1.994	0.580 ***	2.046	0.621 ***
Distance	0.190	0.321	0.243	0.310	0.221	0.310	0.230	0.312	0.263	0.326
Trade	0.368	0.168 *	0.333	0.167 *	0.324	0.169	0.349	0.169 *	0.340	0.165 *
PTA in Goods	-0.160	0.707	-0.161	0.664	-0.159	0.649	-0.159	0.657	-0.152	0.649
Democracy	-0.215	0.147	-0.587	0.165 ***	-0.576	0.165 ***	-0.574	0.161 ***	-0.583	0.159 ***
Democracy <sub>j</sub> × Democracy <sub>j</sub>	-0.110	0.048 *	-0.100	0.046 *	-0.100	0.044 *	-0.100	0.046 *	-0.102	0.046 *
ln GDP	-0.801	0.345 *	-0.590	0.288 *	-0.582	0.283 *	-0.606	0.280 *	-0.601	0.282 *
ln GDP similarity	0.229	1.941	-0.453	1.829	-0.408	1.818	-0.428	1.781	-0.383	1.829
ln GDP/cap	0.068	0.325	0.257	0.433	0.253	0.420	0.253	0.414	0.256	0.418
<b>Positive-list PTAs</b> GDP/cap similarity	-0.099	1.034	-0.184	1.038	-0.185	1.053	-0.295	1.031	-0.331	1.049
ln US Trade	-0.005	0.054	-0.470	0.164 **	-0.463	0.155 **	-0.479	0.160 **	-0.470	0.165 **
ln China Trade	0.128	0.051 *	0.098	0.062	0.097	0.061	0.091	0.059	0.094	0.058
US Alliance	-0.014	0.499	0.051	0.535	0.029	0.522	0.032	0.538	0.024	0.538
Services Trade/GDP	-0.045	0.015 **	-0.048	0.015 ***	-0.048	0.015 **	-0.049	0.015 ***	-0.050	0.014 ***
ln US FDI		▴	0.583	0.188 **	0.577	0.179 **	0.594	0.180 ***	0.586	0.190 **
GATS commitments	-0.065	0.029 *	-0.049	0.031	-0.049	0.029	-0.051	0.029	-0.051	0.029
ln FDI	0.760	0.292 **		▴		▴		▴		▴
BIT in force		▴	0.296	0.419		▴		▴		▴
BIT in force (with EU)		▴		▴	0.176	0.394		▴		▴
Common legal origin		▴		▴		▴	-0.041	0.392		▴
Common official language		▴		▴		▴		▴	0.315	0.526

Results are based on 3000 simulation runs. \* p < 0.05, \*\* p < 0.01, \*\*\* p < 0.001. Year rate parameters not shown.

**Table 2: Correlation Matrix**

	Democracy	In GDP	In GDP/cap	Trade	Distance	GATS commitments	In US FDI	Services Trade/GDP	Alliance	China Trade	US Trade	PTA in Goods
Democracy	1.000											
In GDP	0.202	1.000										
In GDP/cap	0.368	0.333	1.000									
Trade	0.158	0.502	0.261	1.000								
Distance	0.088	-0.004	0.029	0.118	1.000							
GATS commitments	0.409	-0.030	0.133	-0.027	0.091	1.000						
In US FDI	0.402	0.675	0.433	0.397	0.022	0.046	1.000					
Services Trade/GDP	-0.123	-0.309	0.256	-0.054	-0.034	-0.202	-0.056	1.000				
Alliance	0.470	0.110	0.141	0.057	0.083	0.386	0.319	-0.292	1.000			
China Trade	0.194	0.509	0.385	0.307	-0.033	-0.071	0.391	0.105	-0.145	1.000		
US Trade	0.193	0.468	0.260	0.293	0.007	-0.003	0.714	-0.094	0.421	0.162	1.000	
PTA in Goods	-0.030	0.041	0.019	0.191	-0.215	-0.052	0.028	0.022	-0.010	0.039	0.015	1.000

**Table 3: Summary Statistics**

Statistic	Democracy	Positive-list PTA	Negative-list PTA	In GDP	In GDP/cap	Trade	Distance	GATS commitments	In US FDI	Services Trade/GDP	US Alliance	China Trade	US Trade	PTA in Goods
	Mean	4.664	0.015	0.020	11.625	8.945	15.275	8.686	68.831	4.296	18.422	0.377	12.147	12.856
Minimum	1.000	0.000	0.000	6.637	5.771	0.000	0.000	34.300	0.000	3.395	0.000	0.000	0.000	0.000
Maximum	7.000	1.000	1.000	16.607	11.336	27.188	9.894	93.800	14.392	128.069	1.000	19.205	20.769	1.000
St. Dev.	1.817	0.123	0.139	2.025	1.232	7.013	1.466	14.614	4.381	16.153	0.485	3.371	3.223	0.296

**Table 4: Numbering of Actors in Sample**

Actor No.	Country	Actor No.	Country
1	Australia	28	Mexico
2	Bangladesh	29	Myanmar
3	Bahrain	30	Mongolia
4	Brunei	31	Mauritius
5	Canada	32	Malaysia
6	Switzerland	33	Nicaragua
7	Chile	34	Norway
8	China	35	Nepal
9	Colombia	36	New Zealand
10	Costa Rica	37	Oman
11	Ecuador	38	Pakistan
12	European Union	39	Panama
13	Guatemala	40	Peru
14	Hong Kong SAR	41	Philippines
15	Honduras	42	Papua New Guinea
16	Indonesia	43	Qatar
17	India	44	Russia
18	Island	45	Singapore
19	Israel	46	Solomon Islands
20	Jordan	47	El Salvador
21	Japan	48	Thailand
22	Cambodia	49	Turkey
23	South Korea	50	Taiwan (ROC)
24	Laos	51	Uruguay
25	Sri Lanka	52	USA
26	Macao SAR	53	Vietnam
27	Morocco		

## References

Haftel, Yoram Z., and Alexander Thompson. 2013. "Delayed Ratification: The Domestic Fate of Bilateral Investment Treaties." *International Organization* 67(02): 355–87.

Head, Keith, Thierry Mayer, and John Ries. 2010. "The Erosion of Colonial Trade Linkages after Independence." *Journal of International Economics* 81(1): 1–14.

Indlekofer, Natalie, and Ulrik Brandes. 2013. "Relative Importance of Effects in Stochastic Actor-Oriented Models." *Network Science* 1(03): 278–304.

Melitz, Jacques, and Farid Toubal. 2012. *Native Language, Spoken Language, Translation and Trade*. Paris: Centre d'Etudes Prospectives et d'Informations Internationales. CEPII Working Paper.