Estimating the Impact of Missing Totalization Agreement

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Abstract

The number of international social security agreements (totalization agreements) signed by the United States is significantly smaller than the number signed by other countries such as Canada and the U.K. This paper estimates the impact of the missing totalization agreements — the agreements that other countries such as Mexico and Turkey have signed with Canada but not the U.S. We find suggestive evidence that international social security agreements increase labor mobility. Using a difference-in-differences framework, we estimate that, on average, the social security agreements between Canada and countries that have no social security agreement with the U.S. reduced Canadian (relative to U.S.) exports to and increased Canadian imports from those countries. Moreover, we find the impact on exports increases over time and is concentrated among the agreements enacted either before 1995 or after 2010 with countries that have a low real GDP per capita, a low exports-to-GDP ratio, and a medium imports-to-GDP ratio, while the impact on imports is concentrated in the first three years following the social security agreements with middle-sized countries at the upper end of the distribution of real GDP per capita.

Citation

Introduction

Since the late 1970s, the United States has established a network of bilateral Social Security agreements that coordinate the U.S. Social Security program with the comparable programs of other countries.[1] These international social security agreements, often called the "totalization agreements," have three main purposes. First, they eliminate dual social security taxation, the situation that occurs when a worker from one country works in another country and is required to pay social security taxes to both countries on the same earnings. Second, the agreements help fill gaps in benefit protection for workers who have divided their careers between the U.S. and another country. Finally, totalization agreements permit unrestricted payment of benefits to residents of the two countries.

After the agreement with Iceland entered into force on March 1, 2019, the U.S. now has a totalization agreement with 30 countries. In comparison, Canada has a social security agreement with 58 countries,[2] and the number for the U.K. is 47, including 30 countries within the European Economic Area (EEA) and 17 countries outside the EEA.[3]

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[1] This introductory paragraph draws from the description by the Social Security Administration. https://www.ssa.gov/international/agreements_overview.html

[2] See the table at https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/payroll/payroll-deductions-contributions/canada-pension-plan-cpp/foreign-employees-employers/canada-s-social-agreements-other-countries.html. Australia is not listed in the table, although it seems the two countries do have an agreement in force, which would bring the number of agreements to 59. See https://www.dss.gov.au/about-the-department/international/international-social-security-agreements/current-international-social-security-agreements/social-security-agreement-between-australia-and-canada

[3] https://www.gov.uk/claim-benefits-abroad/where-you-can-claim-benefits

Table 1: Countries with a social security agreement with Canada but not the U.S.

Country	Date in Force	Country	Date in Force
Antigua and Barbuda	January 1, 1994	Latvia	November 1, 2006
† Barbados	January 1, 1986	Lithuania	November 1, 2006
Bulgaria	March 1, 2014	Macedonia	November 1, 2011
China	January 1, 2017	Malta	March 1, 1992
Croatia	May 1, 1999	Mexico	May 1, 1996
Cyprus	May 1, 1991	Morocco	March 1, 2010
Dominica	January 1, 1989	Peru	March 1, 2017
Estonia	November 1, 2006	† Philippines	March 1, 1997
Grenada	February 1, 1999	Romania	November 1, 2011
Guernsey	January 1, 1994	St. Kitts and Nevis	January 1, 1994
India	August 1, 2015	Saint Lucia	January 1, 1988
† Israel	September 1, 2003	Saint Vincent and the Grenadines	November 1, 1998
† Jamaica	January 1, 1984	† Serbia	December 1, 2014
Jersey	January 1, 1994	Trinidad and Tobago	July 1, 1999
		† Turkey	January 1, 2005

Note: Countries marked with † also have a social security agreement with the U.K

Table 1 lists the 29 countries which have a social security agreement with Canada but not the U.S. The countries marked with † also have a social security agreement with the U.K. Also shown is the date on which each agreement with Canada entered into force. Many of these agreements have been in force for decades. Both the large number of countries and the number of years those agreements have been in force suggest that it is not that the countries in the table do not have the willingness or ability to sign a social security with the U.S.

One potential reason is that, different from most other countries that conclude international social security agreements as treaties, the U.S. concludes them as congressional-executive agreements pursuant to statute, and the authorizing statute, the U.S. Social Security Act's Section 233, has some special requirements regarding such international agreements including that they (1) be bilateral only; (2) be concluded with countries having social insurance systems of general application, under which periodic benefits (or the actuarial equivalent thereof) are paid on account of old-age,

disability, or death; (3) include provisions for eliminating dual social security taxation on the same work; and (4) include provisions allowing the combination of periods of coverage earned in both countries for purposes of establishing benefit entitlement.

This brings two questions: (1) Whether these special requirements are indeed responsible for the missing agreements — the agreements that other countries such as Mexico and Turkey have signed with either Canada or the U.K. or both but not the U.S., and (2) whether the missing agreements have put the U.S. at a disadvantage relative to other countries such as Canada and the U.K.

This paper focuses on the second question. Conceptually, by reducing the tax and increasing benefit protection for citizens of one country working in another and vice versa, international social security agreements may affect labor mobility and, in turn, other macroeconomic outcomes such as bilateral trade.

We focus on the social security agreements between Canada and countries that have no social security agreement with the U.S. The social security agreements between the U.K. and countries that have no social security agreement with the U.S. are not used for three reasons. First, as mentioned above, most of the countries that have a social security agreement with the U.K. but not the U.S. are in the EEA, which may have a separate impact on any outcome of interest and thus make it harder to isolate the causal impact of the social security agreements. Second, many of the social security agreements between non-EEA countries and the U.K. were signed before 1980s when the data for our empirical analysis were not available. Finally, because the U.K. and the U.S. are on two different continents, the impact of a social security

agreement for the U.K. may be less applicable to the U.S. than the impact of a social security agreement for Canada.

Empirically, we find suggestive evidence that international social security agreements increase labor mobility. In particular, after the social security agreement between Canada and the Philippines entered into force in 1997, there has been a much larger increase in the population born in the Philippines but living in Canada than in the U.S. which has no social security agreement with the Philippines.

Using a difference-in-differences framework, we estimate that, on average, the social security agreements between Canada and countries that have no social security agreement with the U.S. reduced the bilateral exports from Canada to those countries (relative to the U.S. exports to those countries) by about 8.8% in the first 10 years. As the same time, the agreements also increased the bilateral imports by Canada from those countries (relative to the U.S. imports from those countries) by about 9%, although the estimate is not statistically different from zero due to a large standard error.

Moreover, we find the impacts on both exports and imports are heterogeneous. In particular, the estimates suggest that the impact on exports increases over time and is concentrated among the agreements enacted either before 1995 or after 2010 with countries that have a low real GDP per capita, a low exports-to-GDP ratio, and a medium imports-to-GDP ratio. On the other hand, the impact on imports is concentrated in the first three years following the social security agreements with middle-sized countries at the upper end of the distribution of real GDP per capita.

The results in this paper are consistent with those in Seshadri (2019) and Seshadri and Guo (2020), both of which find that the existing totalization agreements

between the U.S. and other countries reduced the U.S. exports to those countries and increased the U.S. imports from those countries, and the impacts on both exports and imports are heterogeneous across agreements/countries as well as sectors.

Together, the estimates suggest that additional totalization agreements would increase international labor mobility, reduce U.S. exports, and increase U.S. imports. The exact magnitude of these impacts depends on the characteristics of the partner countries.

Data

For international labor mobility, we use data from IPUMS-International,[4] an effort to inventory, preserve, harmonize, and disseminate census microdata from around the world. The project has collected the world's largest archive of publicly available census samples. The data are coded and documented consistently across countries and over time to facilitate comparative research. We use this data set to calculate the population born in one country but living in another, and then relate its growth to the relevant international social security agreements.

For cross-country flows of goods, we use the United Nations Commodity Trade Statistics Database (UN Comtrade),[5] which contains detailed import and export statistics reported by authorities of close to 200 countries or areas. It concerns annual trade data from 1962 to the most recent year. UN Comtrade is considered the most comprehensive trade database available with more than 1 billion records. The database

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[4] https://international.ipums.org/international/
[5] https://comtrade.un.org/data/

is continuously updated. Whenever trade data are received from the national authorities, they are standardized by the UN Statistics Division and then added to UN Comtrade. We use this data set to obtain the flows of goods between Canada and the U.S. on the one hand and countries that have a social security agreement with Canada but not the U.S. on the other.

To study whether and how the impacts of the international social security agreements vary across countries depending on their characteristics, we use data from the Penn World Tables, a set of national-accounts data developed and maintained by scholars at the University of California–Davis and the Groningen Growth Development Centre of the University of Groningen to measure real GDP across countries and over time.[6] Compared to other databases, such as the World Bank's World Development Indicators, the time period covered is larger and there is more data useful for comparing productivity across countries and over time.

Some of the variables we use include population, real gross domestic product (GDP) per capita measured in 2017 dollars, exports as a share of GDP, and imports as a share of GDP. All variables vary across countries and over time. As explained above, we focus on countries that have a social security agreement with Canada but not the U.S. For each of these countries, we use the values of these variables in the year when the agreement between the country and Canada entered into force.

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[6] https://www.rug.nl/ggdc/productivity/pwt/?lang=en

Descriptive evidence

The first row in Table 2 reports the population born in the Philippines but living in Canada in 1991, 2001, and 2011, calculated from the Canadian census samples in those three years. As a measure of growth, we also report in the parentheses the ratios of the population in 2001 and 2011 to that of 1991. The second row reports similar statistics for the population born in the Philippines but living in the U.S. in 1990, 2000, and 2010, calculated from the U.S. census samples in those three years.

Clearly, since the social security agreement between Canada and the Philippines entered into force in 1997, there has been a much larger increase in the population born in the Philippines but living in Canada than the U.S. This suggests that international social security agreements increase labor mobility, although other factors could have contributed to the differential growth, such as the Immigration and Refugee Protection Act of 2002 passed by the Canadian Parliament, which encourage more Filipinos to enter Canada. [7]

Table 2: Population born in the Philippines but living in Canada or the U.S.

	1990/1991	2000/2001	2010/2011
Canada	137,453	238,149 (1.73)	509,214 (3.70)
U.S.	1,001,476	1,455,328 (1.45)	1,898,341 (1.90)

Note: Numbers in the parentheses are ratios relative to the population in 1990/1991.

Theoretically, we would like to do the same calculations for the population born in other countries that have a social security agreement with Canada but not the U.S. In

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[7] https://explorasian.org/learn/education/filipino-canadian/

practice, this is not possible because the information on birth country is not available in relevant census samples. For example, none of the Canadian census samples available in IPUMS-International asked whether an individual was born in Antigua and Barbuda, Barbados, Bulgaria, Croatia, Cyprus, Dominica, Estonia, Grenada, Israel, Lithuania, Macedonia, Malta, Mexico, Morocco, Peru, Romania, Saint Kitts and Nevis, Serbia, Trinidad and Tobago, or Turkey. Without this information, we could not study whether and how the population born in those countries but living in Canada evolved differently from the population born in those countries but living in the U.S. Similarly, because the census samples from countries that have a social security agreement with Canada but not the U.S. have no information on whether an individual was born in Canada and/or the U.S., we could not use them to study whether and how the population living in those countries but born in Canada evolved differently from the population living in those countries but born in the U.S. As a result, we will focus on the impacts of the (missing) social security agreements on the exports and imports of goods in the rest of this paper.

Figure 1 plots the Canadian and U.S. exports to six of the 29 countries that have a social security agreement with Canada but not the U.S.[8] Each panel plots the exports to one country around the time when the social security agreement between that country and Canada entered into force, the first year of which is normalized to zero. To be comparable, both the Canadian (solid blue) and the U.S. (dashed red) exports in the year before the agreement entered into force (-1) are normalized to 1. We focus on the 10 years before and 10 years after the agreement entered into force, although not all 21 years of data are available for all countries.

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[8] Figure A1 in the appendix presents the plots for all countries.

The figure reveals several important points. First, (at least some of) the international social security agreements do seem to have a significant impact on exports. For example, the first panel shows that Canadian and U.S. exports to Turkey evolved similarly in the years before the social security agreement between Canada and Turkey entered into force. However, in the first four years after the agreement entered into force, there was a much larger increase in exports to Turkey from Canada than the U.S. This suggests that the social security agreement between Canada and Turkey raised Canadian exports to Turkey, at least in the first four years after the agreement entered into force. In other words, the graph suggests that U.S. exports to Turkey could have been larger had two countries signed a totalization agreement.

Figure 1: Canadian and U.S. exports to selected countries
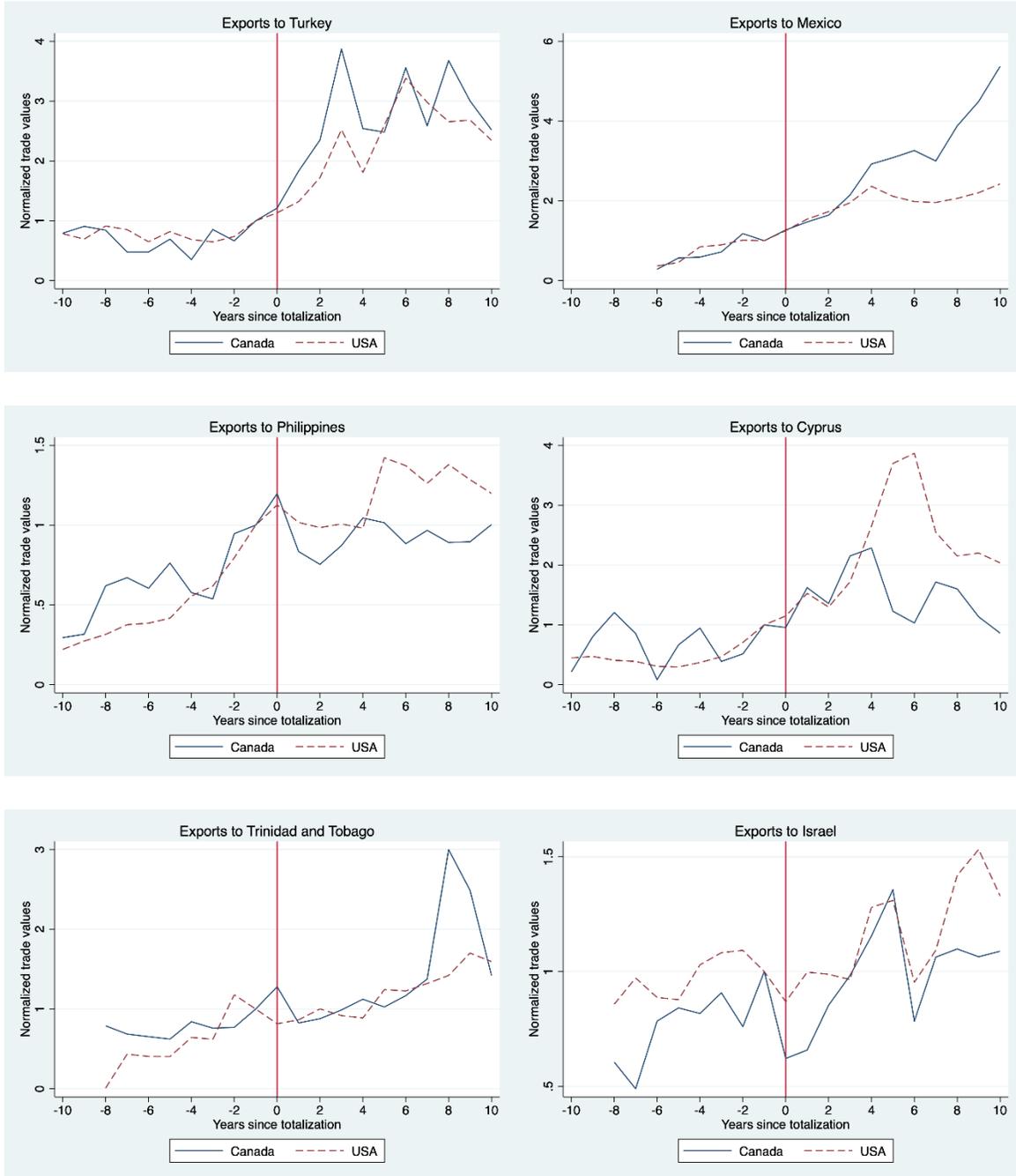
Second, the impacts of the social security agreements are quite heterogeneous. While the two panels on the top suggest that the agreements with Turkey and Mexico increased Canadian exports to the two countries, the two panels in the middle suggest

that the agreements with the Philippines and Cyprus reduced Canadian exports to the two countries, and the two panels in the bottom suggest a minimal or zero effect of the agreements with Trinidad and Tobago and Israel on Canadian exports to the two countries.

Third, in addition to the sign, the timing of the impacts is also heterogeneous. The first panel suggests the agreement with Turkey had an immediate impact, but the impact was temporary and vanished after about four years. The second panel suggests the agreement with Mexico had no impact until about three years after the agreement entered into force, and the magnitude of the impact had been growing over time. Finally, the third panel suggests the agreement with the Philippines had an immediate and persistent impact.

Figure 2 plots the Canadian and U.S. imports from the six countries shown in Figure 1.[9] The graphs suggest the impacts of the social security agreements on imports are also heterogeneous. For example, the first panel suggests that the agreement with Turkey increased Canadian imports from Turkey, and the impact seems to increase over time. On the other hand, the second panel suggests that the agreement with Mexico reduced Canadian imports from Mexico, and this impact seems to be roughly constant over time.

In the next section, we will propose a difference-in-differences framework to study both the average impact of the social security agreements and how the impact varies systematically across agreements/countries. One advantage of the framework is

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[9] Figure A2 in the appendix presents the plots for all countries.

that it allows the outcome of interest to follow a country-specific trend, which is important as can be seen from Figures 1 and 2.

Figure 2: Canadian and U.S. imports from selected countries
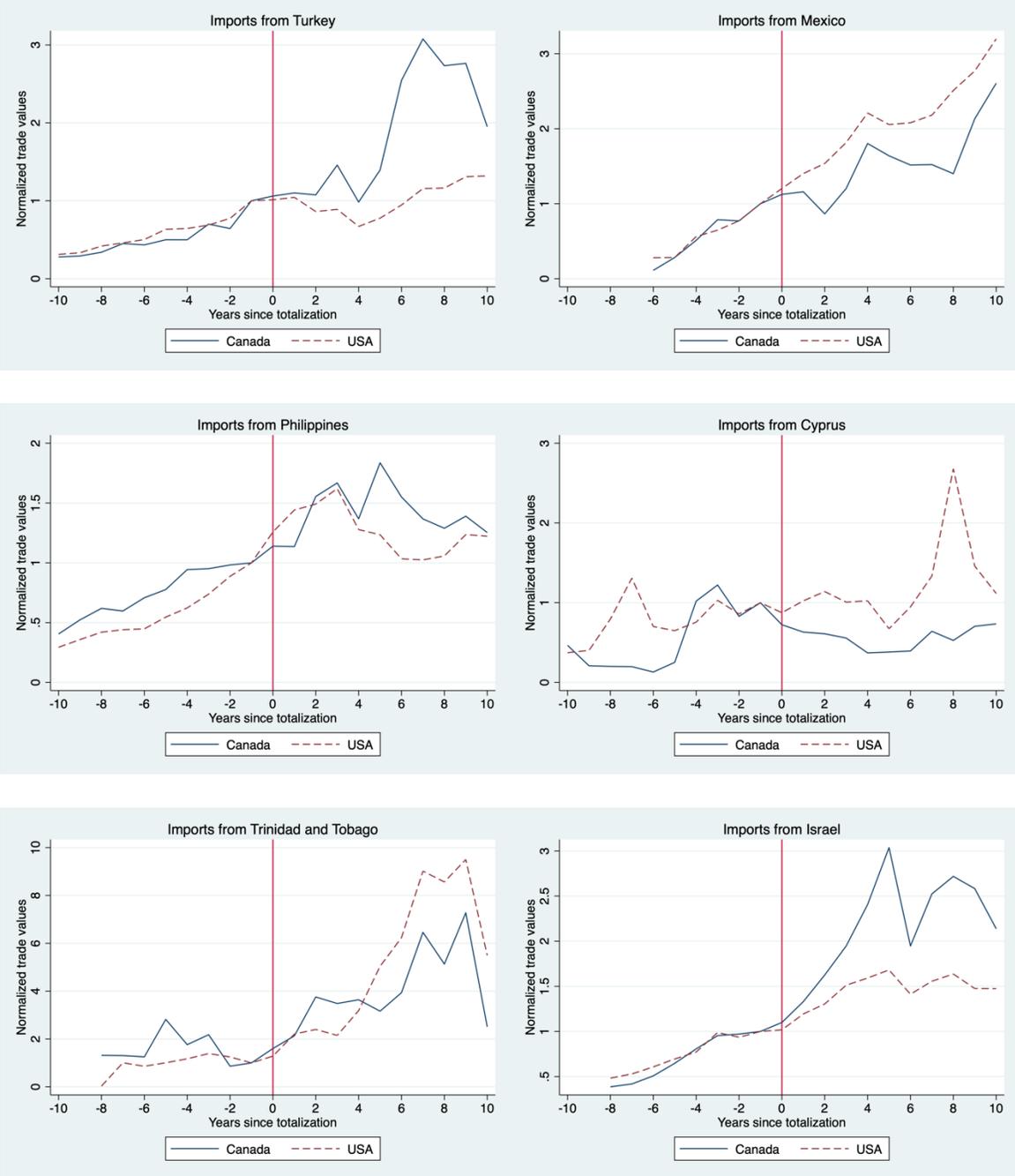
Empirical strategy

Let y_{ijt} be the value of outcome y between country i and country j in year t. In practice, i is either Canada or the U.S., j represents the countries that have a social security agreement with Canada but not the U.S., and t is the number of years the agreement between country j and Canada has been in force.

We use the following equation to estimate the impact of the social security agreement between Canada and country j on outcome y (relative to the outcome between country j and the U.S.)

$$y_{ijt} = \alpha_{ij} + \beta_j t + \gamma_j d_{t \geq 0} + \delta d_{t \geq 0, i \neq US} + \epsilon_{ijt} \tag{1}$$

where α_{ij} is a fixed effect for the pair (i, j), $d_{t \geq 0}$ is an indicator that equals one if $t \geq 0$ and zero otherwise, $d_{t \geq 0, i \neq US}$ is another indicator that equals one if both $t \geq 0$ and $i \neq US$ and zero otherwise, and ϵ_{ijt} is the error term. In our application, $i \neq US$ is the same as $i = Canada$. The notation $i \neq US$ is more general because it makes the framework applicable to other cases such as the social security agreements between the U.K. and countries that have no social security agreement with the U.S., in which case $i \neq US$ is the same as $i = UK$.

In Equation (1), β_j measures the country-specific time trend, γ_j captures any discrete change in the outcome variable following the social security agreement ($t \geq 0$) for country j irrespective of the value of i. δ is the key parameter of interest. It measures the change in the outcome variable following the social security agreement specific to Canada relative to the U.S. In other words, δ measures the difference between Canada and the U.S. after the social security agreement between Canada and country j entered

into force. Under the assumption that, had the U.S. signed a social security agreement with country j at the same time as Canada, the outcome variable for the U.S. would follow the same trend as it has for Canada, δ can also be interpreted as the average (across countries indexed by j) impact/cost of the missing totalization agreements on the outcome variable for the U.S.

One difference between Equation (1) and the standard difference-in-differences formulation is that, $\alpha, \beta,$ and γ are all allowed to vary across countries indexed by j. Given the descriptive evidence presented in Figures 1 and 2, this flexibility is necessary, and it presumably makes a causal interpretation of δ more plausible.

As suggested by Figures 1 and 2, the impacts of the (missing) social security agreements are heterogeneous both across countries and over time. To account for the heterogeneity, we start with the following specification

$$y_{ijt} = \alpha_{ij} + \beta_j t + \gamma_j d_{t \geq 0} + \delta d_{t \geq 0, i \neq US} + \pi d_{t \geq 0, i \neq US} \times z_j + \epsilon_{ijt} \qquad (2)$$

where z could be either t, the age of the social security agreement between country j and Canada measured by the number of years the agreement has been in force, or a characteristic of country j. In addition to the (calendar) year when the social security agreement between country j and Canada entered into force, other characteristics (z variables) we consider include population, real GDP per capita, exports as a share of GDP, and imports as a share of GDP, all of which are measured for the year when the social security agreement between country j and Canada entered into force.

In Equation (2), δ measures the average effect of the social security agreements, and π measures how the effect varies across countries depending on the value of z_j.

One weakness of Equation (2) is that it assumes the impact of the social security agreement varies linearly with z_j. To allow for nonlinear effects, we use the following specification

$$y_{ijt} = \alpha_{ij} + \beta_j t + \gamma_j d_{t \geq 0} + \sum_{k=1}^{3} \delta_k d_{t \geq 0, i \neq US} \times d_{z_j}^k + \epsilon_{ijt} \tag{3}$$

where $(d_{z_j}^1, d_{z_j}^2, d_{z_j}^3)$ are three indicators such that $d_{z_j}^1$ is equal to 1 if z_j is in the bottom quartile of the distribution of z across countries indexed by j, $d_{z_j}^2$ is equal to 1 if z_j is in the second or the third quartile, and $d_{z_j}^3$ is equal to 1 if z_j is in the top quartile. As a result, δ_1 is the average effect of the social security agreements with countries in the bottom quartile of the z distribution, δ_2 is the average effect of the social security agreements with countries in the two middle quartiles of the z distribution, and δ_3 is the average effect of the social security agreements with countries in the top quartile of the z distribution. The estimates of $(\delta_1, \delta_2, \delta_3)$ are informative of whether the impact of a social security agreement varies nonlinearly with z_j.

Results

Tables 3 and 4 report the estimated impacts on exports and imports, respectively. Both exports and imports are bilateral and measured in natural logarithms from the perspectives of Canada and the U.S. As in Figures 1 and 2, we focus on the 10 years before and after each agreement entered into force, i.e., $t \in [-10, 10]$. The standard error of each estimate is reported in the parentheses. *, **, and *** indicate the estimate is statistically different from zero at the 10%, 5% and 1% significance level, respectively.

Table 3: Estimated impacts on exports

Country characteristics (z)	Mean (δ)	Slope (π)	Low (δ_1)	Middle (δ_2)	High (δ_3)
None	-0.088*				
	(0.049)				
Age of an agreement	-0.087*	-0.030***	0.001	-0.116**	-0.181***
	(0.048)	(0.009)	(0.061)	(0.055)	(0.069)
Year of enactment	-0.089*	0.005	-0.194**	0.054	-0.229**
	(0.049)	(0.005)	(0.095)	(0.071)	(0.093)
Log population	-0.088*	0.020	-0.093	-0.093	-0.075
	(0.049)	(0.019)	(0.098)	(0.069)	(0.097)
Log real GDP per capita	-0.093*	0.290***	-0.341***	-0.007	0.003
	(0.048)	(0.098)	(0.096)	(0.071)	(0.091)
Exports/GDP	-0.089*	0.516*	-0.181**	-0.074	-0.010
	(0.048)	(0.281)	(0.090)	(0.073)	(0.094)
Imports/GDP	-0.090*	-0.365	0.149	-0.240***	-0.075
	(0.049)	(0.222)	(0.091)	(0.071)	(0.096)

Note: Except for the first row, each row in the table reports the results of two regressions. The first estimates the mean (δ), which is the average effect of the social security agreements on exports, and the slope (π), which is the marginal effect with respect to the country characteristic (z) listed in the first column. The second regression estimates the effect separately for three groups of countries whose value of z are in the bottom quartile (δ_1), the two middle quartiles (δ_2), and the top quartile (δ_3) of the distribution, respectively. Standard errors are reported in the parentheses. *, **, and *** indicate the estimate is statistically different from zero at the 10%, 5% and 1% significance level, respectively.

The first row of Table 3 reports the estimate of the average effect δ using Equation (1). The estimate suggests that, on average, the social security agreements between Canada and countries that have no social security agreement with the U.S. reduced Canadian exports to those countries (relative to U.S. exports to those countries) by about 8.8% in the first 10 years. Under the assumption that, had the U.S. signed a social security agreement with those countries at the same time as Canada, the U.S. exports to those countries would follow the same trend as Canadian exports to those countries, the U.S. exports to those countries would be about 8.8% lower than what they have been. In other words, the missing totalization agreements increased U.S. exports to those countries by about 8.8%.

Table 4: Estimated impacts on imports

Country characteristics (z)	Mean (δ)	Slope (π)	Low (δ_1)	Middle (δ_2)	High (δ_3)
None	0.090				
	(0.075)				
Age of the agreement	0.091	-0.050***	0.237**	0.054	-0.087
	(0.074)	(0.014)	(0.093)	(0.084)	(0.107)
Year of enactment	0.089	0.011	-0.153	0.169	0.188
	(0.075)	(0.008)	(0.146)	(0.109)	(0.143)
Log population	0.090	0.012	-0.016	0.204*	-0.030
	(0.075)	(0.029)	(0.149)	(0.106)	(0.149)
Log real GDP per capita	0.086	0.260*	-0.167	0.123	0.267*
	(0.074)	(0.150)	(0.148)	(0.109)	(0.141)
Exports/GDP	0.089	0.150	0.025	0.133	0.090
	(0.075)	(0.433)	(0.138)	(0.113)	(0.143)
Imports/GDP	0.088	-0.261	0.216	0.077	-0.030
	(0.075)	(0.341)	(0.140)	(0.109)	(0.149)

Note: Except for the first row, each row in the table reports the results of two regressions. The first estimates the mean (δ), which is the average effect of the social security agreements on imports, and the slope (π), which is the marginal effect with respect to the country characteristic (z) listed in the first column. The second regression estimates the effect separately for three groups of countries whose value of z are in the bottom quartile (δ_1), the two middle quartiles (δ_2), and the top quartile (δ_3) of the distribution, respectively. Standard errors are reported in the parentheses. *, **, and *** indicate the estimate is statistically different from zero at the 10%, 5% and 1% significance level, respectively.

The first row of Table 4 reports the corresponding estimate for imports. Relative to the statistically significant estimate for exports mentioned above, the estimate for imports is similar in magnitude, but has an opposite sign and is less precise and not statistically different from zero. With the caveat of the large standard error, the estimate suggests the social security agreements with Canada increased Canadian imports from those countries (relative to the U.S. imports from those countries) by about 9% in the first ten years. In other words, the missing totalization agreements reduced U.S. imports from those countries by about 9% in the first 10 years after those agreements with Canada entered into force.

The rest of Tables 3 and 4 report estimates of how the effects of the social security agreements vary with the z variables given in the first column. Specifically, for the z variable given in each row, the second and third columns report the estimates of δ and π from Equation (2), and the last three columns report the estimates of $(\delta_1, \delta_2, \delta_3)$ from Equation (3). To make the estimate of δ from Equation (2) comparable with the estimate from Equation (1), the value of each z variable is adjusted to have a mean of roughly zero.

The second row of Table 3 shows that (the absolute value of) the impact of a social security agreement on exports increases with the age of the agreement measured by the number of years the agreement has been in force. More precisely, the estimate of π suggests that the impact of a social security agreement on exports increases by 3% for each additional year the agreement has been in force. Moreover, estimates of $(\delta_1, \delta_2, \delta_3)$ in the last three columns suggest that the impact is essentially zero in the first three years (δ_1), and it increases to about 12% in years four to seven (δ_2) before reaching above 18% in years eight to 10 (δ_3).

The second row of Table 4 suggests that the impact of a social security agreement on imports decreases with the age of the agreement. More precisely, the estimate of π suggests that the impact decreases by about 5% for each additional year an agreement has been in force. Moreover, estimates of $(\delta_1, \delta_2, \delta_3)$ in the last three columns suggest that the impact is over 23% in the first three years (δ_1) before becoming smaller and insignificant afterward $(\delta_2$ and $\delta_3)$.

The third row of Table 3 shows that the impact of a social security agreement on exports varies nonlinearly with the year when the agreement entered into force. More

precisely, while the small and insignificant estimate of δ_2 suggests the agreements enacted between 1995 and 2009 have a minimal impact on exports, the significant estimates of δ_1 and δ_3 suggest that both the agreements enacted before 1995 and the agreements enacted since 2010 reduced exports significantly. On the other hand, the third row of Table 4 suggests that the agreements enacted before 1995 reduced imports, while the agreements enacted since 1995 increased imports, although none of the estimates are statistically different from zero.

The fourth row of Table 3 suggests the impact of a social security agreement on exports does not depend significantly on the population of the country that has a social security agreement with Canada but not the U.S. On the other hand, the fourth row of Table 4 suggests that, while Canada's bilateral imports are not significantly related to the social security agreements with countries at either end of the population distribution (δ_1 for countries with a population of at most 37,000, and δ_3 for countries with a population of at least 31 million), the estimate of δ_2 suggests that the agreements with middle-sized countries significantly increased Canadian imports from those countries.

The fifth row of Table 3 suggests that the impact on exports is mainly due to the social security agreements with countries whose real GDP per capita is at most $8,000 ($\delta_1$), while the fifth row of Table 4 suggests that the impact on imports is mainly due to the social security agreements with countries whose real GDP per capita is at least $18,000 ($\delta_3$).

The sixth row of Table 3 suggests that the impact on exports is decreasing in the exports-to-GDP ratio and concentrated among countries with an exports-to-GDP ratio of at most 15.5% (δ_1), while the last row of Table 3 suggests that the impact on exports is

concentrated among countries with an imports-to-GDP ratio between 27% and 57%. On the other hand, the last two rows of Table 4 suggest that neither of the two ratios is significantly related to the impacts on imports.

Together, the estimates in Table 3 suggest that the impact on exports increases over time and is concentrated among the agreements enacted either before 1995 or after 2010 with countries that have a low real GDP per capita, a low exports-to-GDP ratio and a medium imports-to-GDP ratio. On the other hand, the estimates in table 4 suggest that the impact on imports is concentrated in the first three years following the agreements with middle-sized countries at the upper end of the distribution of real GDP per capita.

Conclusion

The number of international social security agreements is much smaller for the U.S. than other countries such as Canada. To evaluate the macroeconomic impacts of the missing agreements, we estimate the impacts of the social security agreements between Canada and countries that have no social security agreement with the U.S. We find suggestive evidence that international social security agreements increase labor mobility.

Moreover, we find that, on average, the social security agreements between Canada and countries that have no social security agreement with the U.S. reduced the Canada's bilateral exports to those countries (relative to the U.S. exports to those countries) by about 8.8% in the first 10 years. As the same time, the agreements also increased the Canada's bilateral imports from those countries (relative to the U.S.

imports from those countries) by about 9%, although the estimate is not statistically different from zero due to a large standard error.

Finally, we find the impacts on both exports and imports are heterogeneous. In particular, the estimates suggest that the impact on exports increases over time and is concentrated among the agreements enacted either before 1995 or after 2010 with countries that have a low real GDP per capita, a low exports-to-GDP ratio and a medium imports-to-GDP ratio. On the other hand, the impact on imports is concentrated in the first three years of the social security agreements with middle-sized countries at the upper end of the distribution of real GDP per capita.

The results in this paper are consistent with those in Seshadri (2019) and Seshadri and Guo (2020), both of which find that the existing totalization agreements between the U.S. and other countries reduced U.S. exports to those countries and increased U.S. imports from those countries, and the impacts on both exports and imports are heterogeneous across agreements/countries as well as sectors.

Together, the estimates suggest that additional totalization agreements would increase international labor mobility, reduce U.S. exports, and increase U.S. imports, The exact magnitude of these impacts depends on the characteristics of the partner countries.

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Appendix

Figure A1: Exports by Canada and the U.S. to countries that have a social security agreement with Canada but not the U.S.
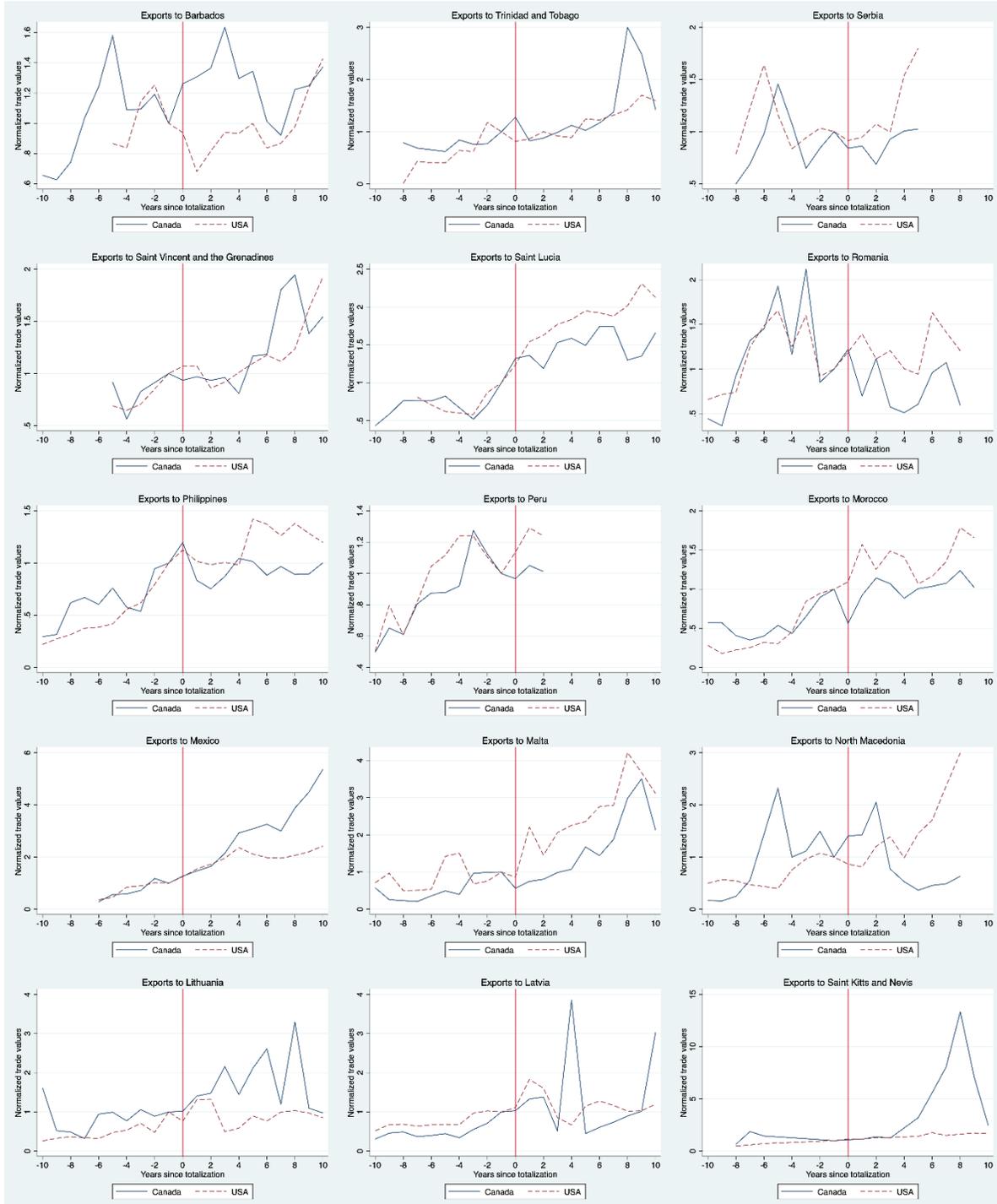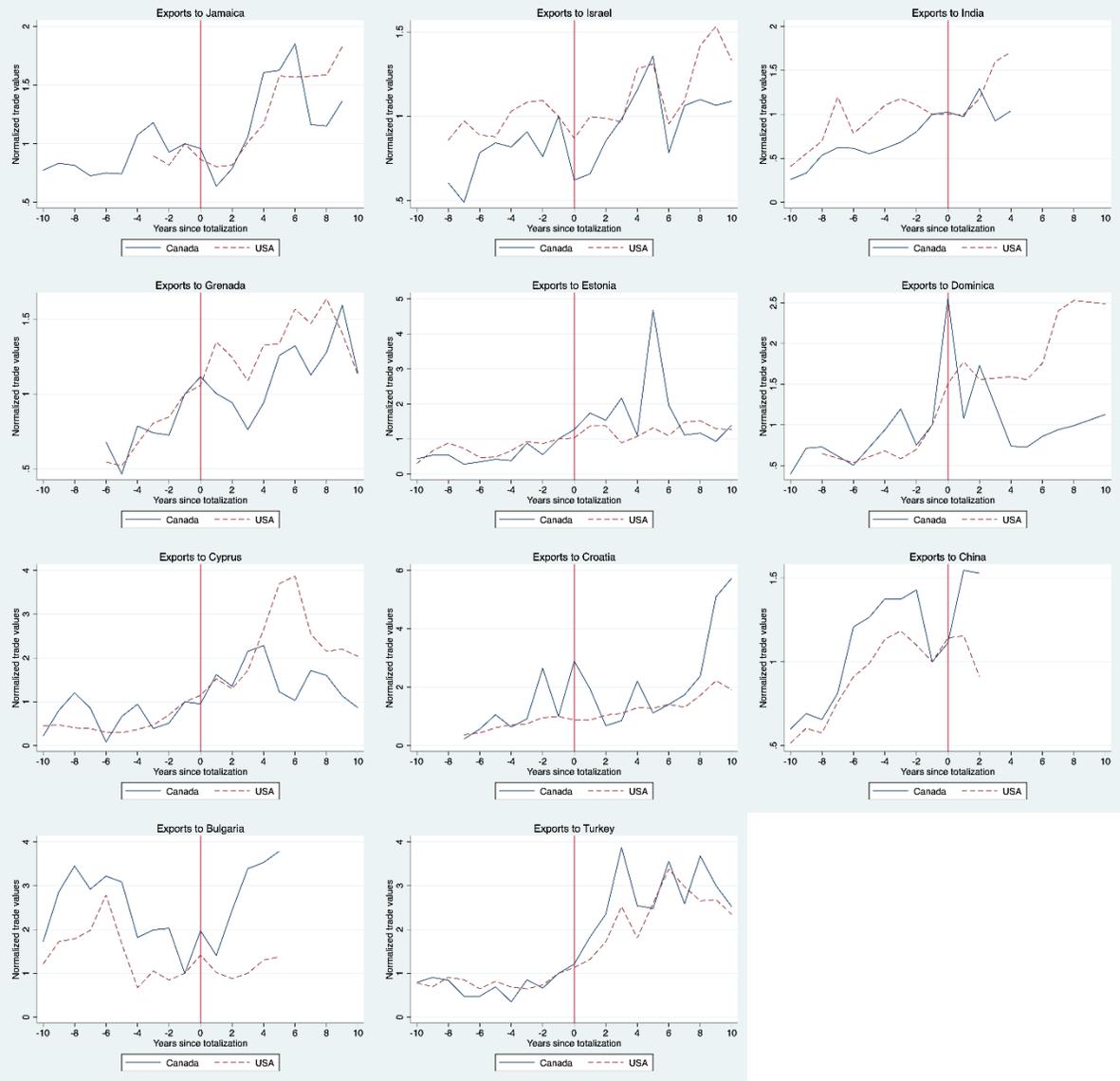
Figure A2: Imports by Canada and the U.S. from Countries that Have a Social Security Agreement with Canada but not the U.S.

Imports from Israel

Imports from India

Imports from Grenada

Imports from Estonia

Imports from Dominica

Imports from Cyprus

Imports from Croatia

Imports from China

Imports from Bulgaria

Imports from Barbados

Imports from Turkey