The Role of NAFTA and Returns to Scale in Export Duration[*]

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Abstract

While exports within NAFTA face a lower hazard of ceasing, its onset has increased the hazard for Mexican and U.S. intra NAFTA exports. Intra NAFTA exports still enjoy a lower hazard relative to exports to non–members. While NAFTA did affect the hazard for Canada's exports in the short run, its effect on Mexican and U.S. exports is persistent. Exports of IRS manufacturing products face the highest hazard in the case of Canada and Mexico, while IRS natural resource products have the highest hazard for Mexico. The effect of NAFTA on the returns to scale product types is exporter specific.

Keywords: hazard; export survival; returns to scale; NAFTA
JEL Codes: F10, F14

1 Introduction

The North American Free Trade Agreement (NAFTA) expanded the Canadian U.S. Free Trade Agreement (CUSFTA) to include Mexico. One argument in favor of CUSFTA was the well known source of welfare gains in trade models incorporating economies of scale—namely that tariff–free access to the large U.S. market will allow Canadian firms to expand production, take advantage of economies of scale, and increase productivity resulting in welfare gains for both producers and consumers. Trefler's (2004) influential work has shown that the effect of CUSFTA was precisely as predicted by economy of scale models. CUSFTA initiated a contraction of low productivity plants resulting in a 12 percent decrease in employment, but also ushered a period of rising labor productivity increasing it by 15 percent.

Creation and expansion of free trade areas create new opportunities for firms to begin exporting their products. Little attention has been paid to NAFTA's effect on the ability of NAFTA members' firms to successfully maintain their exports to the NAFTA area. The goal of this paper is to assess the effect NAFTA has had on the hazard exports ceasing for the three member countries and to assess whether the effect of NAFTA is related to returns to scale in production, given one of the arguments in favor of NAFTA was rooted in returns to scale. I use annual exports disaggregated at the 6-digit Harmonized Schedule level between 1990 and 2007 for Canada, Mexico, and the United States.

The effect of CUSFTA/NAFTA on productivity is one aspect of the agreements to have been investigated. Trefler (2004) showed that Canadian industries that experienced the largest tariff cuts enjoyed largest productivity gains. Romalis (2007) shows that the two free trade agreements have had a substantial effect on the volume of trade, but a much smaller effect on prices and welfare. Much work has been devoted to identifying whether CUSFTA and NAFTA were trade creating or diverting. Clausing (2001) found that CUSFTA was primarily trade creating, while Trefler

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(2004) found evidence of both trade diversion and trade creation, with creation the dominant force. Romalis (2007) raised the possibility of a substantial trade diversion effect of NAFTA/CUSFTA which may be responsible for increased North American output and prices in once highly protected sectors.

Other researchers have focused on the effects of NAFTA/CUSFTA on the extensive margin. Kehoe and Ruhl (2009) found that especially in cases of thin trade relationships, such as between Canada and Mexico prior to NAFTA, trade liberalization is a key ingredient in sparking the growth of the extensive margin, an important source of new trade. Debaere and Mostashari (2010) find a small effect of trade liberalization on the extensive margin of U.S. imports for the 1989–1999 and 1996–2006 periods.

I begin by providing a descriptive analysis of the evolution of exports of NAFTA members in a novel way. As the main focus of the paper is the hazard of exports ceasing, only data on newly created trade relationships can be used to evaluate it. In the descriptive analysis I differentiate between new and old export relationships, where old are all relationships active in 1990, the first year in the data, while new are all relationships created after 1990. After the descriptive analysis of new and old export relationships, I present a simple motivating model along the lines of Melitz (2003) and then estimate the hazard of exports ceasing.

I find that exports of each NAFTA member to other members face a much lower hazard of ceasing than their exports to non-members. The onset of NAFTA itself has increased the hazard of Mexican and U.S. exports to fellow NAFTA members ceasing and had no net effect on the hazard of Canadian exports to other NAFTA members ceasing. In terms of differences across the nature or returns to scale, exports of increasing–returns–to–scale manufacturing products face the highest hazard in the case of Canada and Mexico, while in the case of the U.S. that distinction belongs to increasing–returns–to–scale natural resource products. Only in the case of Mexico are

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there significant differences in the hazard for all three product types, with increasing–returns–to–scale products having the lowest hazard.

The intra NAFTA exports of the three returns–to–scale product types are affected differently for each member by the onset of NAFTA. In the case of Canadian exports NAFTA has increased the hazard for both increasing–returns–to–scale products, but not in a statistically meaningful way. In the case of Mexico, NAFTA has had the strongest effect on the hazard of exports of IRS manufacturing products ceasing, increasing it, while it did not increase the hazard exports of IRS natural resource and CRS products ceasing in a statistically significant manner. NAFTA has had the strongest effect on every returns–to–scale type product exported by the U.S., significantly increasing the hazard of exports of such products ceasing to other NAFTA members, especially for both increasing returns to scale types. The effect of NAFTA has not been consistent over time, as it has increased the hazard in some three–year periods after its onset and not in others.

The role of returns to scale and free trade agreements in duration of exports has not been examined to date. Thus, this paper makes a contribution to the duration of trade literature in addition to making a contribution to the literature on the effects of NAFTA. Duration of trade was first examined by Besedeš and Prusa (2006a, 2006b) who noted that most U.S. import relationships are short lived and that differentiated products are exported to the U.S. in longer lasting relationships than homogeneous goods. Besedeš (2008) showed that uncertainty in international trade and its effect on relationship formation as modeled by Rauch and Watson (2003) can account for many features of duration data. Nitsch (2009) has found similar results for German imports, while Brenton, Saborowski, von Uexkull (2010) and Fugazza and Molina (2009) find similar conclusions for a larger set of countries. Cadot et al. (2011) for four African economies and Görg, Kneller, and Muraközy (2008) for Hungary reach similar conclusions for firm–level exports. Hess and Persson (2010a) examine

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duration of EU imports, while Besedeš examines how the hazard of exports ceasing of Eastern European transition economies was affected by the transition processes. Jaud, Kukenova, and Stireborny (2009) examine the relationship between financial constraints and duration of trade. Besedeš and Prusa (2010) provide a summary of the duration of trade literature.

2   Data and Preliminary Analysis

I use data on Canadian, Mexican, and U.S. export flows recorded at the 6-digit Harmonized Schedule (HS) level. Data for Canada and Mexico come from the UN Comtrade database, while data for the U.S. were aggregated from 10-digit HS level data available from the U.S. Census *U.S. Exports* CDs/DVDs. I use annual data between 1990 and 2007 for all three countries. In each year I identify new export relationships, converting annual data into spells of active exporting, and track them until they cease to be active. A spell reflects the number of consecutive years during which a relationship is active. A relationship is defined as the instance of a country exporting a 6-digit HS product to another country, such as Mexican exports of "Monumental/building stone, cut/sawn" (HS 680221) to Argentina, Australia, Belgium, Brazil, Canada, France, Italy, Japan, and the U.S. among others.

To identify the production technology and the nature of returns to scale for each product, I use the classification developed by Antweiler and Trefler (2002). They identify four types of returns to scale: increasing–returns–to–scale (IRS) manufacturing, increasing–returns–to–scale natural resources, constant–returns–to–scale (CRS), and non–robust increasing–returns–to–scale industries for which they could not establish the exact nature of the returns to scale. The latter group of industries are omitted from the analysis. The share of export volumes and export relationships of products with identified returns to scale varies across the three countries. Canada has some

22% of its volume and a half of its relationships in products with robustly identified returns to scale. Mexico has 40% of its volume and 44% of its relationships, while the U.S. has 65% of volume and 59% of relationships in such products.

		Canada	Mexico	U.S.
Annual observations	All	559,942	311,881	2,250,343
	New	416,970	253,713	1,165,839
	Fraction new	0.75	0.81	0.52
Relationships	All	140,215	71,082	356,969
	New	116,046	61,990	240,942
	Fraction new	0.83	0.87	0.68
Spells	All	231,055	124,300	621,910
	New	206,886	115,208	505,883
	Fraction new	0.90	0.93	0.81

Table 1: Data Summary

Table 1 presents summary information for products with robustly identified returns to scale for each country. Since I focus on exports created after 1990 the table presents information for all exports as well as new exports. A note on the use of the term 'new' is in order – it refers to all export volumes or relationships created after 1990. For example, in 2005 new exports and relationships would be all those created since 1990 and not only those created in 2005 alone. In all figures below old and new values are normalized by the total 1990 values. Thus, values for new exports are fractions of the 1990 value of total exports.

The U.S. has significantly more annual observations, export relationships, and spells of service than Canada and Mexico put together. Perhaps the largest difference across the three countries is in the fraction of observations in exports created since 1990. While Canada and Mexico have 75% and 81% of all annual observations created after 1990, the U.S. has almost a half of all of its observations started prior to 1990. These differences decrease as one looks at export relationships, 83% and 87% for Canada and Mexico and 68% for the U.S., and spells of service, 90% and 93% for Canada and Mexico versus 81% for the U.S.

2.1 New versus old exports

Figure 1 examines differences between exports started prior to 1990, old exports, and those started afterwards, new exports. Top panels show the total volume of both old and new exports, while bottom panels show the total number of both old and new export relationships. For every country, new exports embody a significantly lower volume, with the difference the largest for Mexico. While old exports embody more value, they also grow at a much slower rate than new exports. For Canada the 1991–2007 growth rate of the volume of old exports is 141% and 1,512% for new exports. For Mexico the corresponding figures are 727% and 2,172%, while for the U.S. they are only 13% for old exports and 1,372% for new exports. By 2007 some 15% of all Canadian, 12% of all Mexican, and 16% of all U.S. exports are embodied in relationships started since 1990.

While the top row of Figure 1 shows that new exports are significantly smaller in volume than old exports, the opposite is true for the number of export relationships which carry that volume. The number of old relationships declines over time for every country since their ranks cannot increase by definition. The rate of decline from 1991 to 2007 is similar across the three countries: 66% for Canada and 57% for both Mexico and the U.S. Both Canada and Mexico have slightly more than a half of all relationships in 1991 in old exports, while the U.S. has almost 80% of its relationships in old exports. Canada's new relationships grow by 513%, followed by Mexico at 469%, and the U.S. at 186%. While new exports account for a relatively small share of total exports in 2007, new relationships account for a significant number of all relationships in 2007: 91% for Canada, 92% for Mexico, and 68% for the U.S.

A final note on the growth in the number of relationships. The rate at which new relationships are created exceeds the rate at which new relationships are ended. This is true in almost every year for every country as the number of relationships
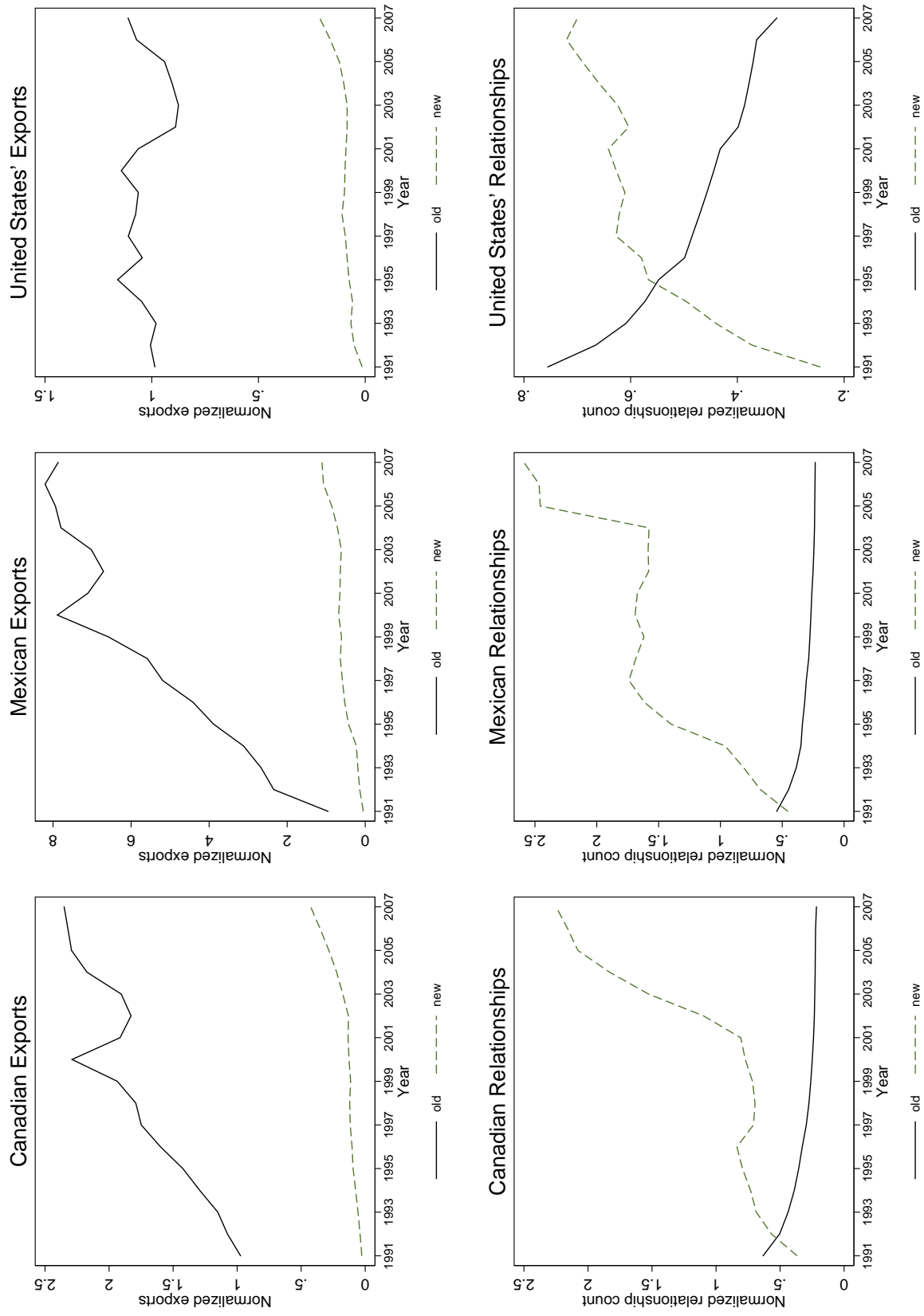
Figure 1: New and Old Exports and Relationships

started after 1990 grows in almost every year.[1] These facts are supportive of the broad conclusion of Besedeš and Prusa (2011), that, for at least some countries, the extensive margin is relatively unimportant in the sense that over time it does not account for much of the volume of exports, even though it accounts for a significant share of relationships. There is a lot of churning at the extensive margin in terms of the number of relationships, but much less in terms of the volume.

2.2 Intra NAFTA export shares

Top panels in Figure 2 illustrate NAFTA shares of export volumes and relationships embodied in old exports, while bottom panels shows NAFTA shares of new exports. In every country much of the effect of NAFTA is by far stronger in exports active in 1990. By 2000 almost 90% of Canada's volume of exports was in old relationships destined for Mexico and the U.S. The share of NAFTA destined old relationships for Canada has quadrupled from 10% to 40%. Mexico has enjoyed an even stronger dominance of NAFTA destined old exports, with the share of volume increasing to more than 95% and the share of relationships increasing to 60%. The U.S. has the most diversified structure of exports with the share of the volume of exports in old relationships destined to NAFTA members doubling from 20% to 40% and the share of relationships increasing by some two percentage points to 8%.

Patterns for new exports created after 1990 are more varied. While the share of the volume of Canadian exports destined to NAFTA members has increased by a factor of eight to 24%, the share of relationships displays an inverted U shape. For Mexico the share of the volume has increased from 5% in 1991 to just under 20% by 2007, but having increased to as much as 40% in the intervening years. The share of relationships was slightly lower in 2007 at roughly 6% than in 1991, but has increased to as much as 9% in the intervening years. The decrease in both Canadian and

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[1]The exceptions are 1996 for Canada; 1996, 1997, 2000, and 2001 for Mexico; and 1997, 1998, 2002, and 2007 for the U.S.
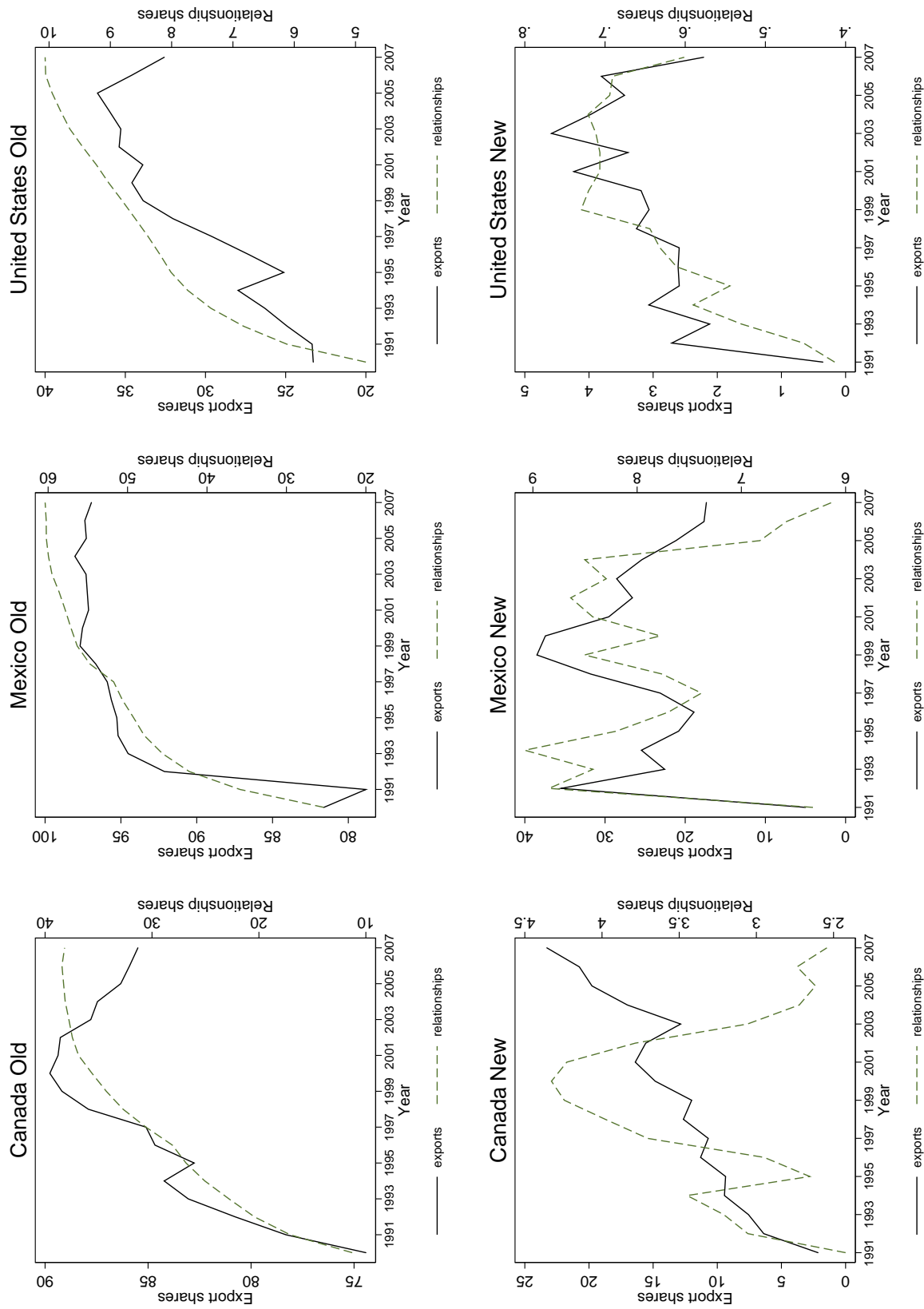
Figure 2: New and Old Exports and Relationships to NAFTA Members

Mexican exports to NAFTA members in the latter part of this period may have been caused by the displacement of trade due to the rising presence of Chinese exports in the U.S., as investigated by Iacovone, Rauch, and Winters (2010). The U.S. has had the smallest share of new exports destined to NAFTA members, a consequence of a more diversified export structure.

2.3 Export shares across returns to scale

In Figure 3 I examine the evolution of shares of export volumes and relationships across the three types of returns to scale. While the majority of Canadian exports involve IRS manufacturing products, they have experienced a fair amount of change since 1990. The creation of CUSFTA resulted in a rapid drop in the share of IRS manufacturing products from 80% of exports to 50% by 1994. The addition of Mexico to CUSFTA resulted in an increase in the share of IRS manufacturing products to 60% which has trended back towards 50% by 2007. The share of exports in CRS products more than doubled from 20% to 45% by 1994, but has trended downward ever since. The share of IRS natural resource products has increased rapidly from less than 5% of exports to almost 20% by 2007.

Mexico has had a different experience. While the share of IRS manufacturing products in exports has decreased to 55% immediately after NAFTA took effect, it has since increased to about 65%. The share of CRS products has decreased from slightly more than 40% to about 30% after an initial boost from NAFTA. The share of IRS natural resource products has increased consistently, though to a much lesser degree than for Canada. The U.S. has a more balanced distribution of exports across the three types of products. Unlike Canada and Mexico the U.S. has the largest share of its exports in CRS products. Following CUSFTA the share of CRS products decreased from 44% to 35% by 1995, followed by a sharp increase to 60% by 1999. It has decreased steadily since to about 47% in 2007. The share of IRS manufacturing
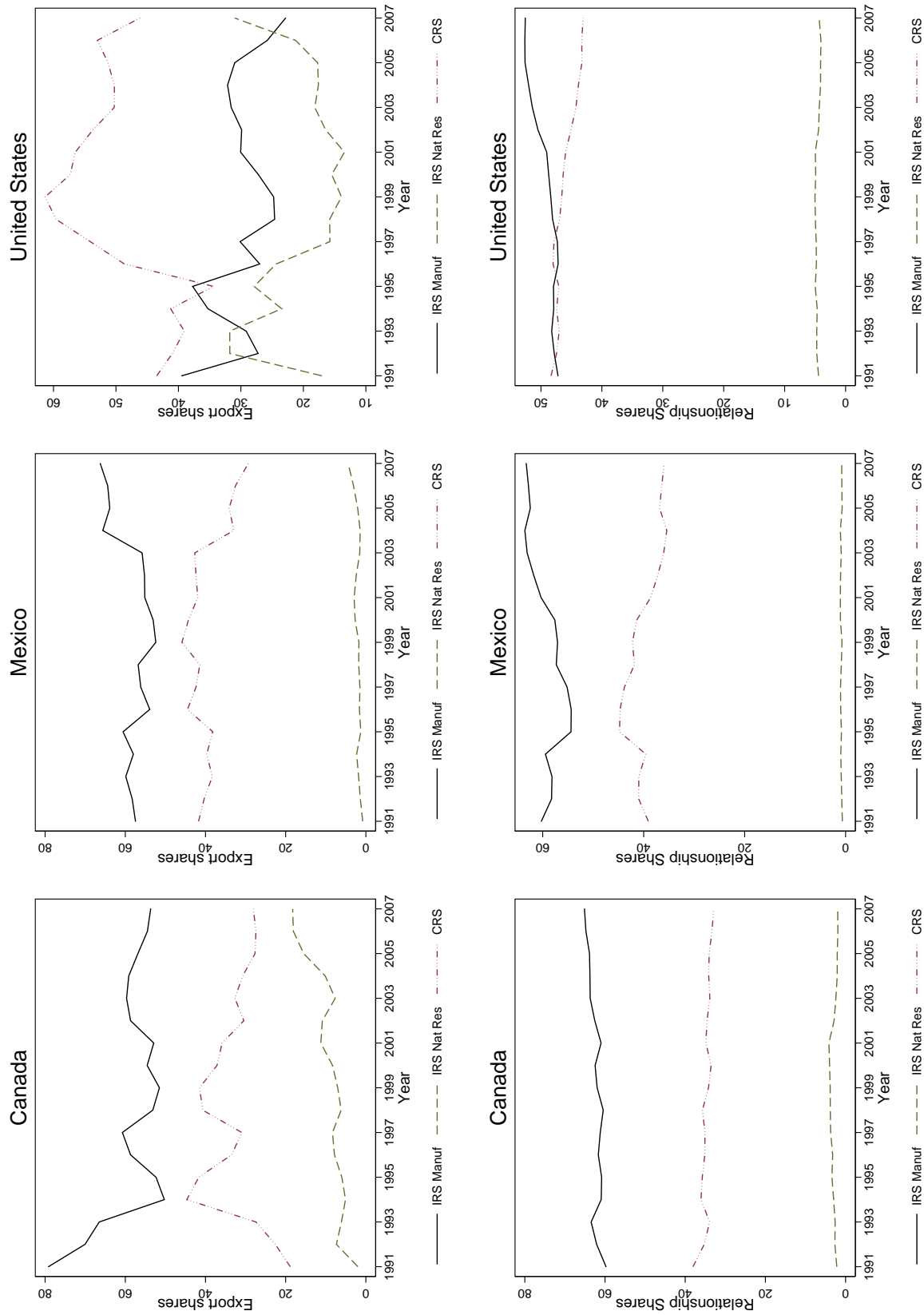
Figure 3: IRS Export and Relationship Shares

products has fluctuated from some 40% in 1991 and 1995 and has decreased to some 25% in 2007. IRS natural resource products decreased from more than 30% in 1994 to less than 15% in 2001 before increasing to roughly 30% by 2007.

NAFTA members are more similar in the distribution of relationships. In every country IRS manufacturing products account for the largest share of exports and have followed rather similar paths. For all three the share of IRS natural resources has been relatively stable over time, being the largest for the U.S. at some 5%. As a result shares of IRS manufacturing and CRS products largely look as mirror images of each other. IRS manufacturing has increased slightly in Canada, and somewhat more for Mexico and the U.S., though the total increase in the share from 1991 to 2007 is only several percentage points.

2.4   Intra NAFTA export shares and returns to scale

There are larger fluctuations in shares of exports destined for NAFTA members, as seen in Figure 4. CRS products dominate the share of exports for each country. For Canada, it has increased from some 40% in 1991 to almost 80% in 1995 before collapsing to some 20% by 2007. For Mexico their share has fluctuated between some 40% in both 1991 and 2007 and more than 60% reached on several occasions. In the U.S. their share has steadily increased from less than 40% to more than 75% by 2007.

Canada's exports of IRS manufacturing goods rapidly decreased with the formation of CUSFTA from almost 60% in 1991 to less than 20% in 1995 before rebounding under NAFTA to more than 30% in the early 2000s and settling at some 25% in 2007. The share of IRS manufacturing products in Mexico's exports to NAFTA members has decreased from 60% to around 40%, while their share in U.S. exports to NAFTA members has decreased from some 60% to around 20%. IRS natural resource products share in Canadian exports increased rapidly between 1991 and 1992, decreased as rapidly by 1995, and finally increased to more than 50%, dominating Canadian
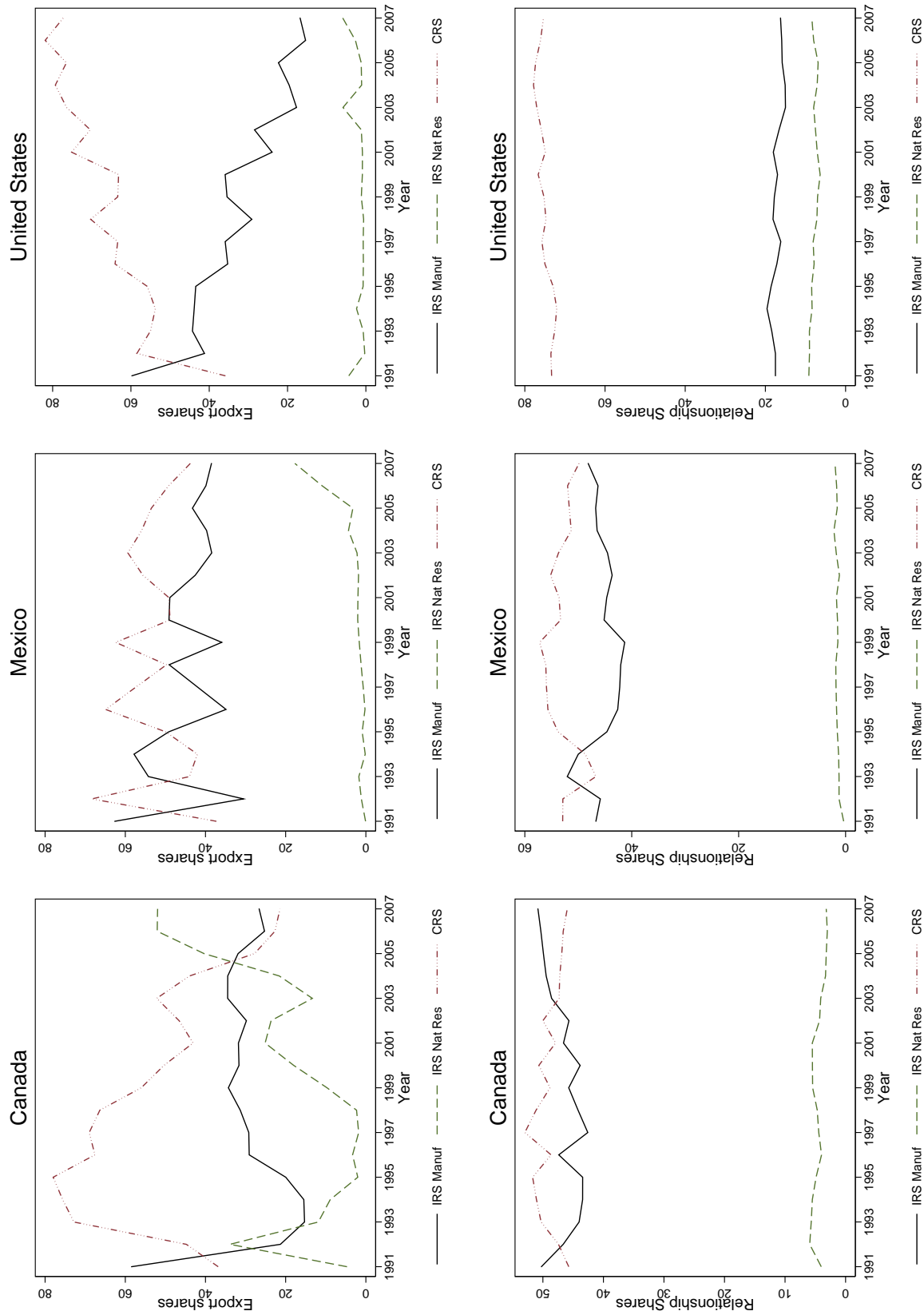
Figure 4: IRS Export and Relationship Shares in Exports to NAFTA Members

exports by 2007. In Mexico's exports the share of IRS natural resource products increased modestly until 2005 when they enjoyed a rapid increase to almost 20%. Their share in U.S. exports has remained largely constant and small.

Fluctuations have been much smaller in the distribution of relationships. The share of IRS natural resource product relationships has remained steady at or below 10% for all three NAFTA members. The share of CRS product relationships in Canadian exports to NAFTA has increased from 50% to more than 60% in the late 1990s before returning to some 50%. The share of IRS manufacturing products has mirrored that of CRS products, first decreasing from 60% before returning to that level by 2007. The share of CRS product relationships in Mexican exports to NAFTA members has fluctuated around 50% and that of IRS manufacturing has fluctuated around 45%. The U.S. offers a different picture with CRS products relationships accounting for a roughly constant 75% share of relationships and IRS manufacturing products accounting for a roughly constant 18%.

3   Motivating Model

To motivate the estimation of the hazard exports ceasing consider the following extension of the Melitz (2003) model. Firms are characterized by a distribution $\mu(\phi)$ of productivity levels over a subset of $(0, \infty)^2$. In any given year firms are subject to exogenous productivity or product appeal shocks, ψ. These shocks may be positive or negative and their persistence will differ across firms. The effect of the shock is to affect the position of each firm within the distribution of productivity levels, $\mu(\phi)$. A positive shock will move the firm up in the distribution, while a negative shock will move the firm down.

The immediate effect of the shock for trade is that it will affect the firm's ability to export, depending on the firm's initial starting point and the persistence of the

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[2]As in section 2.3 of Melitz (2003)

shock. For example, for an exporting firm a temporary negative shock may cause the firm to cease exporting. Once the shock dissipates, the firm will resume its exporting activities. Such a shock accounts for the possibility that exporters exit and re–enter exporting, while never ceasing to produce for the domestic market. Clearly a large and permanent negative shock may affect the firm so drastically that it exits the industry altogether. A temporary positive shock may allow an otherwise purely domestic firm to export for a brief period before it dissipates. Clearly a permanent shock will create a permanent exporter. Depending on the nature of the shock, one can expect to observe a range of firm export behavior, from firms that never export to temporary in–and–out exporters to largely persistent exporters with short exits to finally permanent exporters.

A free trade agreement affects firms through its effect on the productivity shock ψ. Free access to a foreign market can either be attributed to a positive productivity shock or a positive product appeal shock as it reduces costs of supplying a market. NAFTA may have had a differential effect based on the nature of the returns to scale used in production. Trade models with economies of scale argue that access to a large foreign market increases firm productivity as Trefler (2004) has found for NAFTA. This would entail an increase in the productivity parameter $\mu(\phi)$, thus making it more likely firms would both start exporting and export longer, even if for some the shock is temporary. Thus, NAFTA can reduce the hazard of exports ceasing. NAFTA may have had an offsetting effect as well, as some firms may be induced to try to export, even though they should not. Some firms may be overly optimistic about their ability to successfully export and attempt to do so only to find themselves abandoning exports quickly. The overall effect of NAFTA can therefore be seen as a the balance of these two opposing forces.

4 Hazard of Exports Ceasing

4.1 Econometric methodology and specification

I estimate the hazard of exports ceasing by estimating a probit model. As argued by Hess and Persson (2010b), using a probit estimator is more appropriate for discrete duration data, as annual trade data are, and does not impose the restrictive proportional hazard assumption.[3] Unobserved heterogeneity is another reason to use a discrete–time model such as probit to estimate the hazard as it is more easily addressed in such models than in the Cox proportional hazard model. To take unobserved heterogeneity into account I estimate the random effects probit model of the hazard rate with random effects at the spell level. I model the dependence of the hazard rate on time by including a dummy for each year in the spell.

Advantages of the probit–estimated hazard model comes at the cost of a more complicated interpretation of estimated coefficients. Neither coefficients nor the associated marginal effects reveal the true effect of each covariate. Although a given coefficient may be statistically significant, whether it makes a difference for the estimated hazard depends on the standard error of every covariate, all pairwise covariances, and the distributional specification of the probit model. To ascertain whether estimated hazards for different values of covariates of interest are statistically different I plot estimated hazards with the 95% confidence interval, which is denoted with dotted line in every figure. All estimated hazards are estimated with covariates at their mean levels, with the exception of covariates of interest.

I use several country– and product–level variables to estimate the hazard of exports ceasing. The gross domestic product of the importer is expected to reduce the hazard, while distance to the importer is expected to increase the hazard. I use two

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[3]Brenton, Saborowski, and von Uexküll (2010) and Hess and Persson (2010b) show that the assumption of proportional hazards is not satisfied in annual trade data. Hess and Persson (2010b) examine several other estimators which relax the proportionality assumption and recommend that probit be used.

measures of common language; one capturing whether two countries share an official language and the other whether more than 9% of the population speak the same language. In as much as common language reduces costs, both are expected to reduce the hazard. I use two measures at the country–product level to capture information spillovers: one measures the number of products exported to the same country, while the other measures the number of countries to which the same product is exported. The former measures experience with a country, while the latter measures experience with a product. Both are expected to reduce the hazard.

A lower economic risk of the importer is expected to reduce the hazard. The volume of initial exports should reduce the hazard, reflecting the confidence exporters (or their importing partners) have in their ability to consistently export their products (Rauch and Watson 2003, Besedeš 2008). The coefficient of variation of unit values measures the extent of the variation of unit values for each product across all export destinations. It reflects the extent of product differentiation. I use a dummy to capture any colonial relationship in the past. Finally, I use dummies to capture each multiple instance of a relationship.

I use two dummies to capture the effect of returns to scale, one for IRS manufacturing products and one for IRS natural resource products with CRS products as the baseline. Since spells of export relationships created after 1990 stretch across the period prior to and after the establishment of NAFTA, it is possible to distinguish between two NAFTA related effects. Therefore, I use two dummies. One simply captures exports to NAFTA members, while the other captures whether NAFTA itself is in effect. Estimates of these four dummies are of main interest.

4.2 Basic results

Table 2 collects the basic results. Most variables have identical qualitative effects across all three exporters. Similar to other papers in the literature, the larger the

	Canada	Mexico	U.S.
GDP (ln)	-0.014***	0.045***	-0.047***
	(0.003)	(0.003)	(0.002)
Economic risk (ln)	-0.040	0.108***	-0.072***
	(0.025)	(0.032)	(0.012)
Initial exports (ln)	-0.048***	-0.086***	-0.120***
	(0.002)	(0.002)	(0.002)
Partners by product (ln)	-0.439***	-0.531***	-0.705***
	(0.005)	(0.009)	(0.007)
Products by partners (ln)	-0.269***	-0.360***	-0.437***
	(0.007)	(0.007)	(0.006)
Cov unit values (ln)	0.028***	-0.009***	0.019***
	(0.002)	(0.002)	(0.003)
Distance (ln)	0.047***	-0.092***	0.096***
	(0.009)	(0.013)	(0.006)
Common language (official)	0.006	-0.069**	-0.034***
	(0.015)	(0.028)	(0.006)
Common language (minority)	-0.021	-0.020	-0.026**
	(0.017)	(0.025)	(0.010)
Colonial relationship	0.104***	0.073***	0.023***
	(0.007)	(0.009)	(0.005)
IRS Manufacturing	-0.002	-0.107**	0.096***
	(0.018)	(0.043)	(0.010)
IRS Natural resources	-0.270***	-0.858***	-1.011***
	(0.054)	(0.066)	(0.073)
NAFTA members	-0.028*	0.058**	-0.052***
	(0.016)	(0.028)	(0.006)
NAFTA in effect	0.034	0.129***	0.168**
	(0.057)	(0.048)	(0.075)
Constant	3.549***	3.423***	7.829***
	(0.114)	(0.146)	(0.090)
Observations	187,188	168,642	667,787
Spells	103,851	81,732	292,694
Log-Likelihood	-101,025	-91,296	-376,942
ρ	0.022***	0.190***	0.204***
Year in spell FE	Y	Y	Y
Spell number FE	Y	Y	Y

Robust standard errors clustered by relationships in parentheses with *, **, *** denoting significance at 10%, 5%, and 1%.

Table 2: Hazard Estimates

GDP of the importer the lower the hazard for both Canadian and U.S. exports. The effect of importer's GDP on the hazard of Mexican exports is positive – Mexican exports to larger economies face a higher hazard. To the extent that Mexican exports to larger and more developed economies are potentially of lower quality may result in them experiencing a higher hazard than exports to smaller economies.

The economic risk variable offers a somewhat puzzling result. With higher values indicating a riskier economy, a negative coefficient implies that U.S. exports to riskier economies face a lower hazard, rather than a higher one as one might expect. This result highlights the presence of uncertainty in international trade as modeled by Rauch and Watson (2003) and empirically investigated by Besedeš (2008). It is possible exports to highly uncertain economies are undertaken only once the exporter is relatively certain its exports will be long lived and will generate a profit. Such a strategy minimizes costs associated with exporting especially in situations where there is uncertainty as to whether exports will be profitable. Economic risk has no significant effect on Canadian exports, while Mexican exports face a lower hazard when destined for less risky markets, as expected.

The volume of exports at the start of a relationship has a significant negative effect for all three countries resulting in longer lived spells for relationships starting with a larger volume. Information spillovers have large negative effects – the more products exported to a country or the more countries a product is exported to, the lower the hazard. Both of these results are consistent with Cadot et al. (2011) and Besedeš (2011). The more variable are the unit values for Canadian and U.S. exports the higher the hazard. The effect for Mexican exports is the opposite, with more variable unit values resulting in a lower hazard.

To the extent that distance reflects transportation costs, the further away the export markets are the higher the hazard of Canadian and U.S. exports, as expected. For Mexico the effect is the opposite – hazard is lower for exports destined for markets

further away from Mexico. Official common language has a significant negative effect for Canadian and U.S. exports resulting in a reduced hazard. Mexican exports to countries with Spanish as the official language face a higher hazard. The minority common language has a statistically significant negative effect for Mexico and the U.S., indicating longer duration and lower hazard, while it has no effect on Canadian exports. Exports to countries with which Canada and Mexico share a colonial history are no different form exports to other countries, while in the case of the U.S. such exports face a lower hazard.

The relative importance of unobserved heterogeneity is reflected by estimates of ρ, which can be interpreted as the fraction of individual spell variation due to variation in unobserved factors. There are large differences in unobserved heterogeneity between Canada on one side and Mexico and the U.S. on the other. While unobserved heterogeneity plays a statistically significant role in all three cases, the magnitude of ρ is almost an order of magnitude larger in the case of Mexico and the U.S. (0.190 and 0.204 versus 0.022).

4.3   Effects of NAFTA

Exports to a NAFTA member face a significantly lower hazard for all three countries, with the effect strongest for the U.S. and weakest for Canada. Surprisingly, the establishment of NAFTA increased the hazard of Mexican and U.S. exports destined to NAFTA markets, while it has no effect on Canadian exports. To properly evaluate whether NAFTA has had a significant effect, I plot the estimated hazard of exports ceasing for non–NAFTA members and for NAFTA members both in the absence and presence of NAFTA in Figure 5. I include the 95% confidence interval around the estimated hazard for non–members and members in the absence of NAFTA. If the estimated hazard for members in the presence of NAFTA lies outside the confidence interval, then NAFTA has had a significant effect.
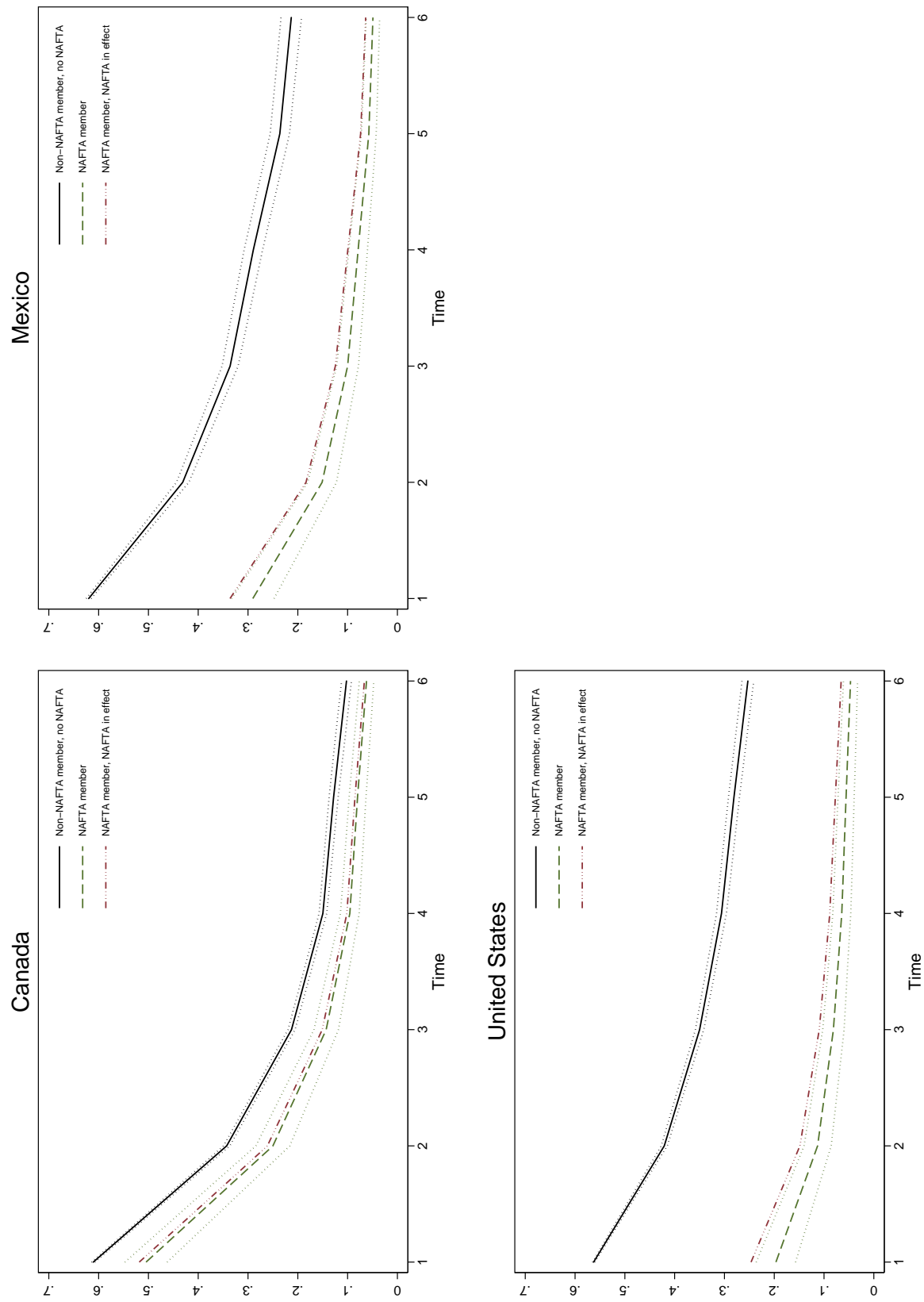
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Figure 5: The Effect of NAFTA on the Estimated Hazard

The hazard of exports to NAFTA members ceasing is lower than to non-NAFTA countries for all three members with differences statistically significant. The difference between the hazard of exports ceasing to NAFTA members and non–members is the largest for Mexico and the U.S. The pure effect of joining NAFTA is slightly positive for Canada, increasing the hazard, but is not statistically significant. The enactment of NAFTA has a much larger effect for Mexico and the U.S., increasing the hazard of exports to NAFTA members ceasing. In addition, the estimated hazard for exports ceasing to NAFTA members with NAFTA in effect lies outside the 95% confidence interval (dotted lines) for the estimated hazard for exports ceasing to NAFTA members, with the difference larger for U.S. exports.

The onset of NAFTA has increased the hazard of exports to member countries ceasing in the case of Mexico and the U.S. In neither case is this increase sufficiently large to offset the lower hazard associated with exporting to a NAFTA member. One explanation for the NAFTA effect is that its establishment may have induced too many firms to try to take advantage of new opportunities created by NAFTA, thus resulting in more failures. Essentially, NAFTA may have induced some firms who otherwise would not export to do so, only to quickly realize they cannot compete in the foreign market.

4.4 Effects of returns to scale

In terms of returns to scale, exports of increasing–returns–to–scale manufacturing products face a higher hazard than constant–returns–to–scale products for Canadian, Mexican, and U.S. exports. U.S. exports of increasing–returns–to–scale natural resource products face a higher hazard, while Mexican exports of IRS natural resource products face a significantly lower hazard than their exports of CRS products. There are no differences between the two types of products in the case of Canadian exports.

Figure 6 illustrates estimated hazard for the three types of returns to scale for
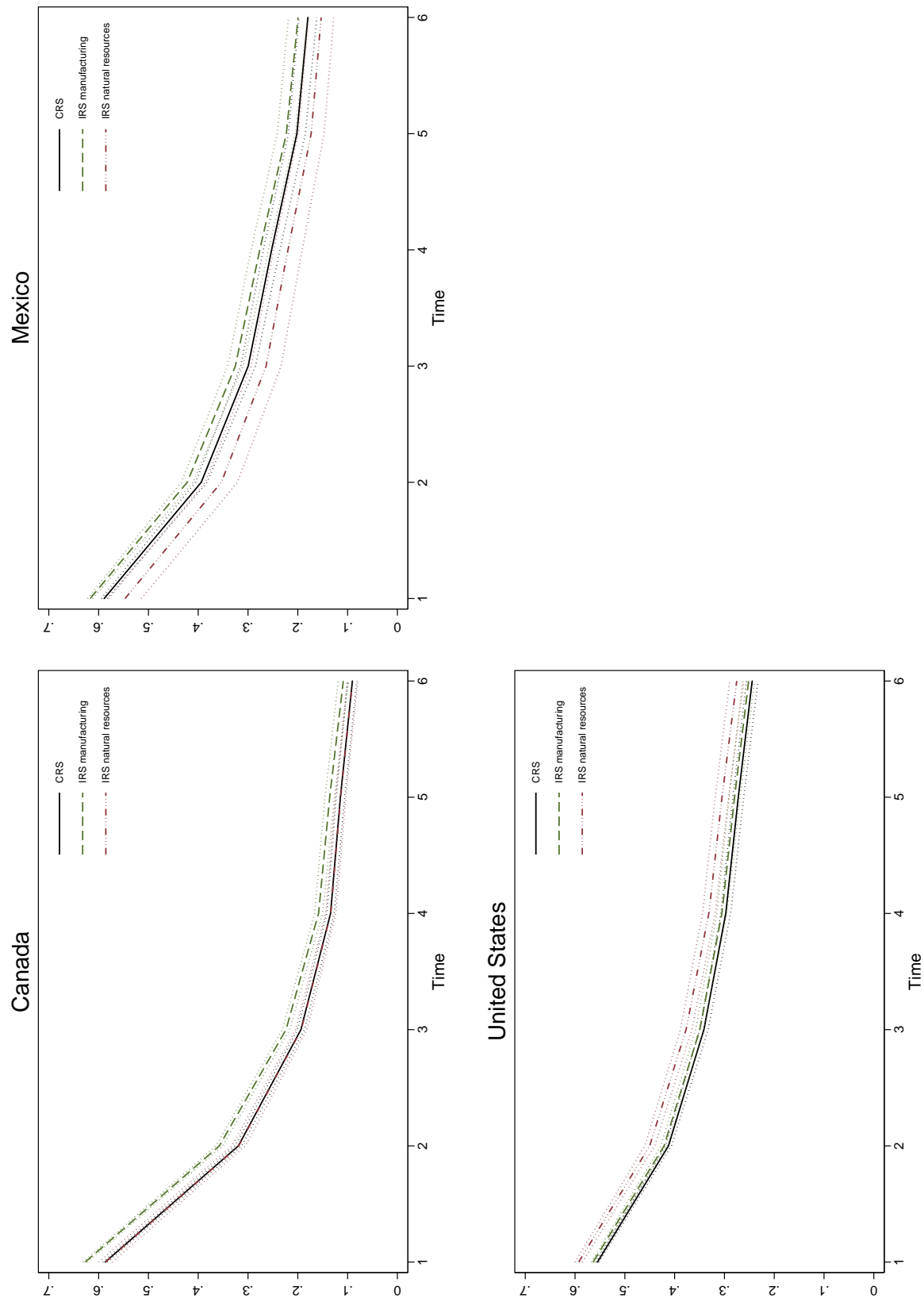
Figure 6: The Effect of Returns to Scale on the Estimated Hazard

each country, along with corresponding 95% confidence intervals. There are virtually no differences between CRS and IRS natural resource products for Canada, while its exports of IRS manufacturing products face a statistically different and higher hazard. In the case of Mexico, IRS manufacturing products also face a statistically significantly different and highest hazard of exports ceasing. Mexican exports of IRS natural resource products face the lowest hazard. Differences between the three returns to scale type products for Mexico are statistically different, especially for the first few years in a spell. The ordering of estimated hazards is different for the U.S. with IRS natural resource products facing the highest hazard of exports ceasing, which is statistically different from the other two types. While IRS manufacturing products exported by the U.S. face a higher hazard, it is not statistically different from that for CRS products.

4.5 The effect of NAFTA over time

To better understand the nature of the effect of the implementation of NAFTA on the hazard of exports ceasing, Table 3 shows the results with the NAFTA–in–effect variable having a time–dependent effect, for three–year intervals starting in 1994. It is possible NAFTA has had a different effect over time as firms adjust to it and since some of its provisions were phased in over a period of time.[4] Since the coefficients for other variables are virtually unchanged, I only present the coefficients for the time–dependent NAFTA–in–effect variable.[5] These four dummies indicate in which years did the existence of NAFTA affects the hazard.

While the onset of NAFTA has no net effect on Canadian exports, the time–dependent coefficients indicate that the onset of NAFTA did increase the hazard of Canadian exports to the other two NAFTA members immediately after the onset

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[4]Baier and Bergstrand (2007) show in a gravity framework that the full effect of free trade agreements on the partners' trade volume takes ten years to accrue.

[5]Full results are available on request.

	Canada	Mexico	U.S.
NAFTA members	-0.267***	-0.858***	-1.012***
	(0.055)	(0.066)	(0.073)
NAFTA in effect 1994–1996	0.201***	0.021	0.170**
	(0.071)	(0.055)	(0.086)
NAFTA in effect 1997–1998	-0.058	0.171***	0.067
	(0.074)	(0.054)	(0.086)
NAFTA in effect 2000–2002	-0.063	0.241***	0.320***
	(0.067)	(0.055)	(0.084)
NAFTA in effect 2003–2005	0.050	0.111**	0.107
	(0.061)	(0.055)	(0.086)
ρ	0.0228***	0.184***	0.204***

Robust standard errors clustered by relationships in parentheses with *, **, *** denoting significance at 10%, 5%, and 1%; year in spell and spell number fixed effects included.

Table 3: Time–Dependent NAFTA Effect

of NAFTA and had no effect after 1997. The opposite holds for Mexico: there is no effect in the first three years of Mexican participation in NAFTA, while in every subsequent three–year period exports to other NAFTA members face a significantly higher hazard. U.S. exports to NAFTA members face a higher hazard consistently since the onset of NAFTA, with the exception of the three–year period between 1997 and 1999.

Figure 7 plots the estimated hazard for exports to NAFTA members in absence of NAFTA with the 95% confidence interval along with estimated hazards for the four subperiods. In the case of Canada, the effect of NAFTA between 1994 and 1996 is outside the confidence interval indicating that during those three years NAFTA did indeed increase the hazard of Canadian exports to NAFTA members ceasing. In the case of Mexico, the effect is statistically significant between 1997 and 2002, while the effect between 2003 and 2005 lies just inside the 95% confidence interval. In the case of the U.S., NAFTA had a statistically significant effect immediately upon its inception, between 1994 and 1996, and again between 2000 and 2002 when it increased the hazard significantly (by almost ten percentage points at the start of a spell).
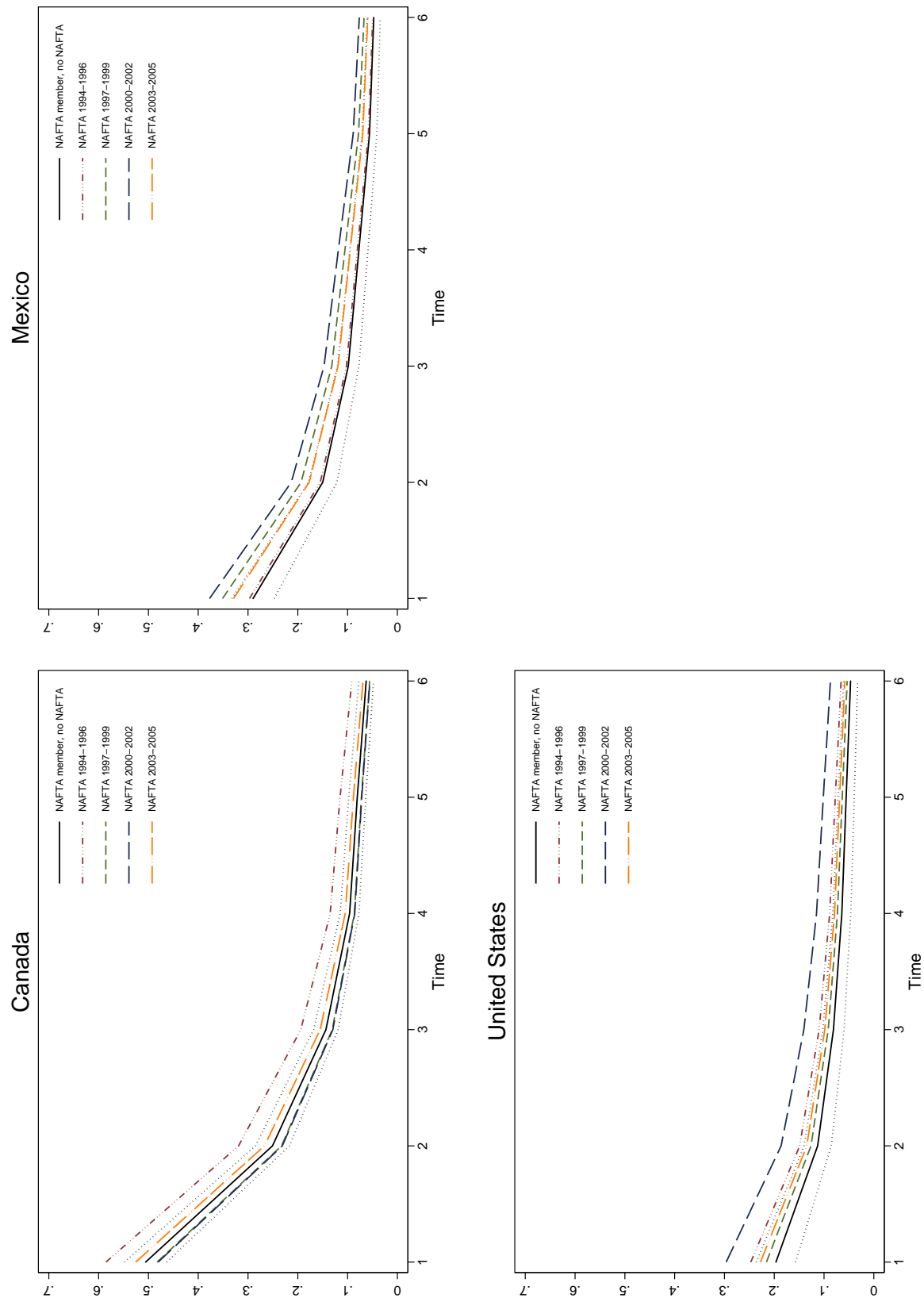
Figure 7: The Effect of NAFTA across Time

4.6 NAFTA and returns to scale

I have argued above that one might expect the hazard of exports ceasing for increasing–returns–to–scale manufacturing products to be the lowest when destined to NAFTA markets given advantages offered by access to larger markets. The above results that IRS manufacturing products face the highest hazard are potentially indicative of the opposite holding. However, the appropriate examination of such a hypothesis entails comparing the hazard of exports to NAFTA members ceasing for each returns–to–scale product separately, to which I now turn. Rather than introducing a number of interacted variables to examine whether the effect of NAFTA is different for different returns–to–scale products, I estimate the hazard of exports ceasing for each of the three returns–to–scale types of products, focusing on the NAFTA–in–effect coefficients, and compare the fitted hazards for each country. In order to conserve space I only present coefficients relevant to NAFTA.[6] Table 4 collects the results.

Intra–NAFTA exports of all three countries in all three returns–to–scale types face a lower hazard. In the case of Canada, the onset of NAFTA has no significant effect on the hazard of exports increasing–returns–to–scale manufacturing and constant–returns–to–scale products ceasing, and only marginally increases the hazard for increasing–returns–to–scale natural resource products. In the case of Mexico, the net effect of NAFTA which was to increase the hazard associated with exports to NAFTA members (see Table 2) seems to be driven by its effect on increasing–returns–to–scale manufacturing products. The other two types are not affected by the onset of NAFTA. In the case of the U.S., the onset of NAFTA increases the hazard for all three types of returns to scale.

Figure 8 shows the estimated hazard of exports to NAFTA members ceasing for the different types of returns to scale and the effect of NAFTA on the estimated hazard. I include the 95% confidence interval for the estimated hazard of exports to
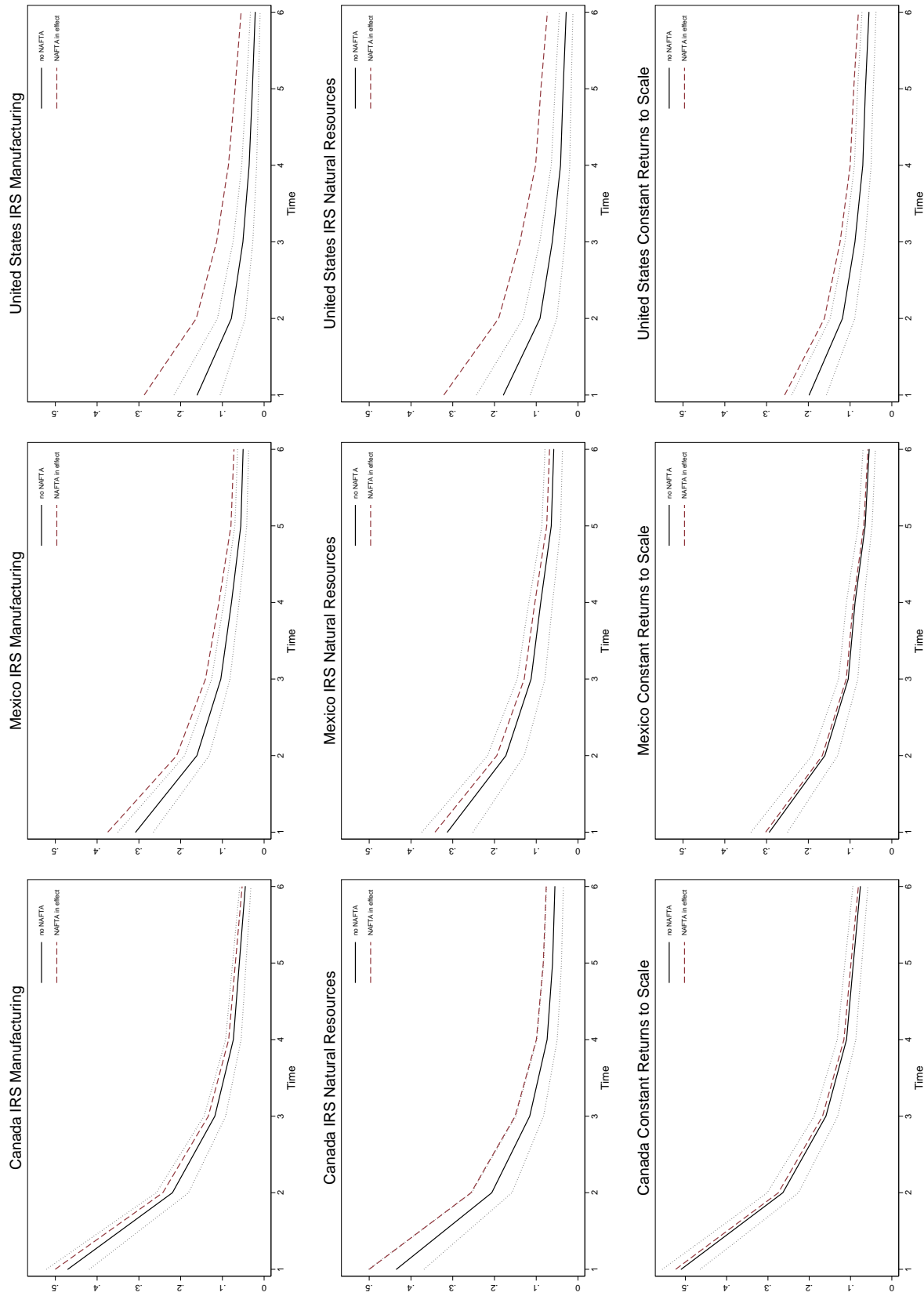
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[6]Full results are available on request.

Figure 8: The Effect of NAFTA and Returns to Scale on the Estimated Hazard

	Canada		
	IRS Manufacturing	IRS Natural Resources	CRS
NAFTA members	-0.263***	-0.274***	-0.176***
	(0.066)	(0.086)	(0.059)
NAFTA in effect	0.076	0.164*	0.033
	(0.069)	(0.089)	(0.061)
ρ	0.0315***	0.0259***	0.0299***
	Mexico		
	IRS Manufacturing	IRS Natural Resources	CRS
NAFTA members	-0.703***	-0.624***	-0.773***
	(0.063)	(0.090)	(0.067)
NAFTA in effect	0.182***	0.082	0.025
	(0.049)	(0.071)	(0.049)
ρ	0.161***	0.174***	0.203***
	United States		
	IRS Manufacturing	IRS Natural Resources	CRS
NAFTA members	-1.097***	-1.042***	-1.029***
	(0.116)	(0.126)	(0.076)
NAFTA in effect	0.431***	0.457***	0.195***
	(0.120)	(0.130)	(0.078)
ρ	0.119***	0.135***	0.239***

Robust standard errors clustered by relationships in parentheses with *, **, *** denoting significance at 10%, 5%, and 1%; year in spell and spell number fixed effects included.

Table 4: The Effect of NAFTA across Returns to Scale

NAFTA members ceasing. The top panels examine increasing–returns–to–scale manufacturing products, the middle panels increasing–returns–to–scale natural resource products, and the bottom panels constant–returns–to–scale products. In the case of Canadian exports, despite the fact that the effect of the onset of NAFTA is estimated as significant, the estimated hazard for the onset of NAFTA is not statistically significantly different from that for exports to NAFTA members, with the possible exception of IRS natural resource products.

In the case of Mexico NAFTA does not have a significant effect of the hazard for IRS natural resource and CRS products, as the two estimated hazard are within the 95% confidence interval. However, the effect of NAFTA is statistically significant for IRS manufacturing products. The largest effect that NAFTA has had on the hazard of

exports ceasing is for U.S. products across the full spectrum of returns to scale. In the case of each returns–to–scale product type, the difference between exports to NAFTA members in the absence of NAFTA and after its onset is statistically significant. Thus, NAFTA has increased the hazard of U.S. exports to NAFTA members ceasing, by almost ten percentage points at the start of a spell in the case of IRS products and some five percentage points in the case of CRS products.

Table 5 contains the time–dependent effects of NAFTA for each returns to scale type, shedding more light on the exact nature of the effect of NAFTA on the hazard of exports ceasing. For Canada, NAFTA has increased the hazard of IRS manufacturing and CRS products only during its first three years, while the hazard IRS natural resource products was higher in the first three years as well as between 2003 and 2005. This is confirmed by plots in Figure 9 where the estimated hazard during these periods is outside the 95% confidence interval.

For Mexico, NAFTA has increased the hazard for IRS manufacturing products consistently ever since it was enacted, though the effect has declined in magnitude after 2002. The effect is statistically significant for the 1997 to 2002 period, and only marginally so for the other two periods (Figure 9). NAFTA has increased the hazard for IRS natural resource products only between 2000 and 2002, which is statistically significant as illustrated in Figure 9. NAFTA's effect on the hazard of Mexican exports of CRS products is the most varied. It has initially reduced it with the estimated hazard right on the lower bound of the 95% confidence interval, and then increased it between 1997 and 2002, a statistically significant effect. NAFTA has had no effect since 2003.

NAFTA's effect on the hazard of U.S. exports to NAFTA members is the most consistent one, having increased the hazard for every type of product in almost every year. Exports of CRS products have a higher hazard of ceasing in a statistically meaningful manner only for the 2000–2002 period. Exports of IRS natural resource

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	Canada		
	IRS Manufacturing	IRS Natural Resources	CRS
NAFTA members	-0.260***	-0.271***	-0.173***
	(0.066)	(0.086)	(0.059)
NAFTA in effect 1994–1996	0.283***	0.371***	0.192**
	(0.086)	(0.112)	(0.077)
NAFTA in effect 1997–1998	0.006	0.110	0.022
	(0.088)	(0.114)	(0.079)
NAFTA in effect 2000–2002	-0.093	-0.065	-0.103
	(0.079)	(0.104)	(0.072)
NAFTA in effect 2003–2005	0.110	0.227**	0.048
	(0.072)	(0.095)	(0.066)
ρ	0.0318***	0.0259***	0.0306***

	Mexico		
	IRS Manufacturing	IRS Natural Resources	CRS
NAFTA members	-0.703***	-0.626***	-0.774***
	(0.063)	(0.090)	(0.067)
NAFTA in effect 1994–1996	0.110*	-0.040	-0.136**
	(0.056)	(0.082)	(0.057)
NAFTA in effect 1997–1998	0.214***	0.088	0.044
	(0.056)	(0.080)	(0.056)
NAFTA in effect 2000–2002	0.325***	0.289***	0.196***
	(0.057)	(0.080)	(0.056)
NAFTA in effect 2003–2005	0.098*	0.004	0.021
	(0.057)	(0.082)	(0.057)
ρ	0.159***	0.168***	0.193***

	United States		
	IRS Manufacturing	IRS Natural Resources	CRS
NAFTA members	-1.092***	-1.041***	-1.035***
	(0.116)	(0.126)	(0.076)
NAFTA in effect 1994–1996	0.525***	0.463***	0.135
	(0.137)	(0.151)	(0.090)
NAFTA in effect 1997–1998	0.244*	0.500***	0.115
	(0.138)	(0.148)	(0.089)
NAFTA in effect 2000–2002	0.637***	0.610***	0.385***
	(0.134)	(0.147)	(0.087)
NAFTA in effect 2003–2005	0.270*	0.232	0.146
	(0.139)	(0.152)	(0.089)
ρ	0.118***	0.135***	0.238***

Robust standard errors clustered by relationships in parentheses with *, **, *** denoting significance at 10%, 5%, and 1%; year in spell and spell number fixed effects included.

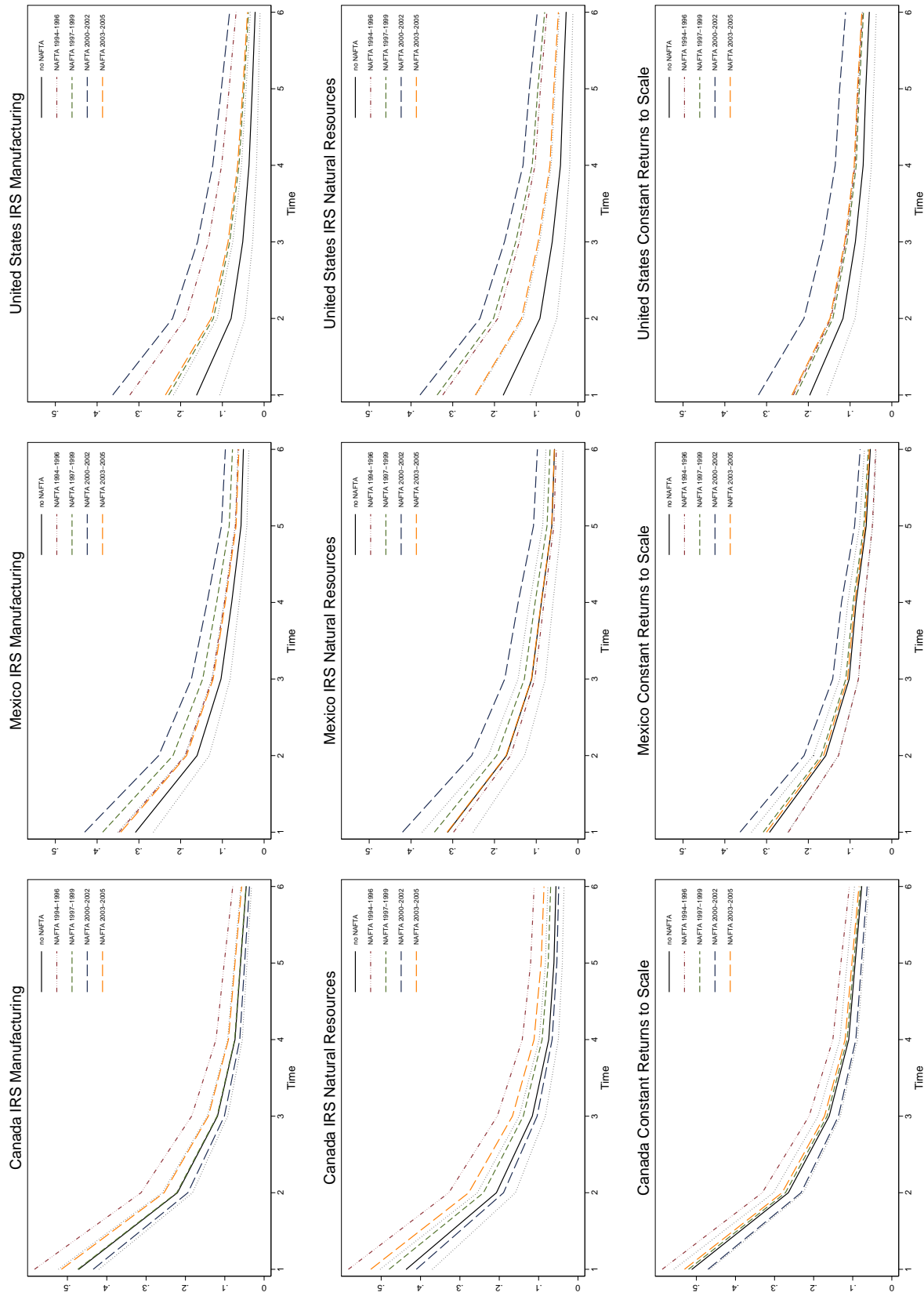Table 5: Time–Dependent Effect of NAFTA across Returns to Scale

Figure 9: The Effect of NAFTA and Returns to Scale Differences

products have had a higher hazard in every period, with differences statistically significant, though only marginally for the 2003–2005 period. Exports of IRS manufacturing products had a statistically significant higher hazard in every period, with the effect stronger immediately after NAFTA's onset and between 2000 and 2002.

5   Conclusion

In this paper I investigate how the North American Free Trade Agreement has affected the members' hazard of exports ceasing and how differences in returns to scale manifest themselves in the hazard of exports ceasing for the three members: Canada, Mexico, and the United States. NAFTA itself has not had a beneficial effect on the hazard of exports ceasing. Rather, the effect has been negative for the U.S. and Mexico, with the hazard of their exports ceasing to NAFTA members increasing with the enactment of NAFTA. However, the said increase was not large enough to offset the much lower hazard of exports ceasing to NAFTA members enjoy due to the geography of the free–trade area and proximity of the members to each other. Canada, Mexico, and the U.S. enjoy a significantly lower hazard on exports to each other without the presence of NAFTA. Given the particular geography of NAFTA, the effect of common borders between the members, a well known positive force in international trade, is largely indistinguishable from the effect of NAFTA. The nature of the geography of NAFTA makes it difficult to broadly conclude that free trade agreements increase the hazard of exports between the members ceasing, calling for an investigation of the effect of free trade agreements with less restrictive geographic characteristics, or a broader set of such agreements.

The effect of NAFTA is much stronger once one scratches below the surface, in terms of evaluating its effect on each returns to scale type. It has had the most consistent effect on U.S. exports of all three types, particularly in the case of both

increasing returns to scale product types. In addition, it has had different effects during different subperiods since its inception, likely reflecting the ability of firms to adjust to new conditions and the fact that some of its provisions were phased in over time.

I presented the first evidence of the effect of a free trade agreement on the hazard of exports ceasing. While NAFTA increases the hazard, further investigation is needed with free trade agreements among countries which are not as geographically clustered as the NAFTA members are. Mercosur and the European Union are two free trade areas which offer a different geography which could shed additional results on the role of a free trade agreement. In addition, I presented the first evidence on the effect of the returns to scale on the hazard of exports ceasing. Unlike differences along the product differentiation dimension, which are largely consistent across a number of countries, the identified effects of returns to scale are exporter specific. Since these results are based on three exporters only, additional investigation of other countries is warranted.

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A   Data Appendix

Data used in this paper are available from public sources.

Data	Source
U.S. exports	U.S. Census Bureau, U.S. Imports CDs and DVDs
Canadian and Mexican exports	UN Comtrade
GDP	World Bank's World Development Indicators
Distance, contiguity, common language and colonial history	CEPII http://www.cepii.fr/anglaisgraph/bdd/gravity.htm
Returns to Scale classification	Antweiler and Trefler (2002)
Economic Risk	International Risk Guide http://www.prsgroup.com/ICRG.aspx