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STRUCTURAL ECONOMIC EFECTS THROUGH FREE TRADE AGRRIMENTS

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Abstract

International trade between US and Canada has differential flow from both sides of border. There are changes in structure of goods and services as subject of international trade between US and Canada. Standard estimates of international trade could be result of aggregate mistakes of endogenous industry location type. It has to include also no observation in product level trade.

Key words: trade; economic effect; model; estimation.

INTRODUCTION

One of the better-known empirical findings of recent years is the McCallum (1995) calculation that the gravity-adjusted volume of trade among Canadian provinces exceeds provinces trade with U.S. states by more than a facto of 20. Since then, considerable attention has been paid to the significance of border-induced changes in the level of trade. In moderately disaggregated data tracking U.S. shipments, the size of the "border effect" varies substantially across commodities.

Evidence of substantial border-induced compositional change is significant because it raises doubts about the manner in which border-induced reductions in the aggregate trade volume have been measured and interpreted. The McCallum-style estimate of the border effect in this data is 20.9. After controlling for two potential sources of aggregation bias, I find that the border reduces aggregate trade flows by a factor of 5.7 – substantially less than the McCallum-style estimate. It is quite likely that greater disaggregating would reduce the estimated border effect even further.

Aggregate calculations like McCallum's can overstate border effect because these assume that the border's removal would produce an equal-proportional increase in all state-province trade flows. The gravity regression estimates the average response of interregional trade flows to the presence of a border. McCallum's thought experiment applies this average elasticity to each province-state trade flow. Implicitly predicting a borderless US-Canada trade volume. If large bilateral trade flows are less sensitive to the border than the average province-state flow, this calculation will over predict the total borderless trade volume and so overstate the border effect.

There are two reasons to suspect that large flows might be relatively unresponsive to the border's removal.

1. The output mix in states nearest the border may include disproportionate share of goods with low border costs. Numerical simulations of standard economic geography model suggest that industries facing low border costs will locate nearest the border. Since states nearest the o\border have the largest bilateral trade flows, estimates that do not control for industry location patterns will overstate the aggregate border effect if industries locate as the model predicts.
2. The commodity level data reveal a large number of zero observations in cross-border pairs. Zero observations could occur if borders impose fixed costs of bilateral trade, for example. The border's removal reduces the number of zero observations as commodities enter the traded bundle for some state-province pairs. For large bilateral flows, like that from Michigan to Ontario, most commodities are already traded, so the border's removal induces a relatively small number of commodities to enter that traded bundle. Once again, the largest bilateral trade flows will be the least responsive to the border's removal.

The econometric procedures described below correct for these potential sources of aggregate bias. Commodity level regressions include state output at the industry level, thereby controlling for industry location patterns. A probity regression model accounts for border-induced zero observations at the commodity level. Summing over the commodity-level predictions of borderless trade flows allows an alternative estimate of the aggregate border effect. The two adjustments are responsible for reduction of the aggregate border effect estimate from 20.9 to 5.7. Similar aggregation bias might occur within commodity groups; so the true border effect could be even smaller than 5.7.

1. EVALUATION OF DATA AND THEORY SOURCES

The presence of border effect in Canada-US trade was first noted in McCallum and he proposes a simple reduced form gravity Equation[1]:

$T_{ij} = C^{\beta 0}\ Y_i^{\beta 1}\ Y_j^{\beta 2}\ D_{ij}^{\beta 3}$ exp$*$ *Home*) (a)

Where T_{ij} is the value of shipments from region "i" to region "j", C is constant, $Y_{i(j)}$ is GDP in region "i(j)", D_{ij} is the distance from "i" to "j", "Home" is an indicator that a flow occurs within national borders, and β_s are elasticity that are to be estimated in the gravity regression. In a long-linear version of (a), McCallum estimates β_4 = 3.09 in Canadian data. Applying this estimate to (a) suggests that removing the border would increase trade in each province-state pair by a factor of exp (3.09) = 22.0. Such a sizable border effect is rather surprising, given the relatively high degree of economic integration between the US and Canada. Helliwell and Anderson and Smith update McCallum's findings using later data and find the result to be reasonably robust.

Hillberry uses a special tabulation of the Commodity Flow Survey to estimate the border effect from US side. Remarkably, he finds an estimate quite similar to McCallum's, β_4 = 3.04, which implies an aggregate border effect of 20,1.[2] The similarity of the two results is surprising, because the Commodity Flow Survey data measure economic activity that differs in important ways from the activity measured in the Canadian inter-provincial trade data used by McCallum. Hillberry finds the result to be robust to a series of adjustments, including the addition of remoteness and GDP per capita terms.

Anders and van Wincoop estimate a non-linear specification of the standard gravity regression is consistent with a structural model of gravity-based trade. The authors argue that border barriers induce substantial diversion of cross-border trade towards inter-provincial trade, thus raising the border effect McCallum estimates from the Canadian side of the border. By assuming a symmetric border barrier, combining US Commodity Flow data with Canadian province-state and inter-provincial trade data, and allowing "multilateral resistance" to vary significantly across regions, Anderson and van Wincoop estimate a reduced Canada-US border effect of 10.5, compared with 16.5 using the standard McCallum specification and 1993 data.

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[1] McCallum, John, "National borders matter: Canada-US regional trade patterns", American Economic Review 85, page 621.

[2] Using the same econometric specification, Anderson and van Wincoop (2001, table1, column2) estimate β_4 = 3.041 in US shipments, page 62. Given that the Anderson and van Wincoop result is estimated with the same econometric specification used in Hillberry (1998, table 1, column20, the difference between the two estimates appears to be data driven. Anderson and van Wincoop make substantial ad hoc adjustments to internal US shipments because internal US flow data measure different activities than those measured by the Canadian data. They then rely on the Canadian data to document shipments from the US to Canada. The data used here and in Hillberry come from a single source, the US Commodity Flow Survey, and they do not require ad hoc data pre-adjustments like those employed by Anderson and van Wincoop.

Balistreri and Hillberry argue that under the standard assumption of identical consumer preferences, the Anderson van Wincoop result leans heavily on implausibly large geographic variation in imputed consumer price indices.[3] Balistreri and Hillberry also calculate that the Anderson and van Wincoop estimates imply that over 45% of US and Canadian output is devoted to transport activities. Further more, it is difficult to reconcile the Anderson and van Wincoop model with the large number of zero observations in the disaggregated data. Given that the structural gravity model appears to be inconsistent with key features of the data, I proceed as if the border puzzle remains unsolved.

2. INTERPRETING COMPOSITIONAL CHANGE

The specification of the aggregate gravity model in (1) relies on an assumption that β_4 is common across state-province pairs and therefore is unrelated to the size of a given T_{ij}. Krugman notes that industries are highly agglomerated in the US, a finding that implies substantial differences in state output bundles. Put together with evidence that commodities differ in their sensitivity to borders, variation in the composition of state output bundles. Put together with evidence that commodities differ in their sensitivity to borders, variation n the composition of state output bundles suggests that state's export bundles may be more or less sensitive than the average bundle to the border's removal.

The econometric results below suggest that standard calculation overstate the aggregate border effect. The standard approach will overstate the border effect if large bilateral flows are less sensitive than average to the presence of a border. If β_4 are small when T_{ij} is large, calculations based on an average estimate of β_4 will overstate the border effect. Predicted borderless trade volumes will be too large, ant analyst will calculate an overly large border-induced reduction in bilateral trade. The numerical simulations in this section show why large bilateral flows might be less sensitive to borders; industries facing low border costs tend to locate near borders.

A gravity-like trade pattern can be motivated with Krugman's model monopolistic competition. A slight modification allows a structural interpretation of gravity-like flows at the commodity level. Assume that consumer utility is Cobb-Douglas over commodity groups. With Dixit-Stiglitz style preferences over varieties within the commodity group. The Krugman model suggests that a firm in region "i" will face the following demand from region "j":

$$q_j^{kd} = \eta^{\mathbf{k}} Y_j [p_i^k D_{ij}^{\delta k} \exp(\tau^{\mathbf{k}}(1\text{-}Home_{ij})]^{-\sigma k} / (P_j^{\mathbf{k}})^{1-\sigma} \qquad \text{(b)}$$

[3] Anderson and van Wincoop note that more plausible geographic price dispersion can be generated under the assumption that consumers have non-identical preferences over regional varieties. What Balistreri and Hillberry results makes clear is that Anderson and van Wincoop cannot replicate key features of the data without such an appeal to non-identical preferences; Anderson James and Eric van Wincoop, "Gravity with gravities: a solution to the border puzzle", NBER 2001 Working Paper No. 8079., page 36.

where superscript “k” denotes a commodity group, q_j^{kd} is the quantity demanded by region “j”, η^k is the Cobb-Douglass share of commodity “k” in consumer utility, Y_j is nominal income in region “j”, p_i^k is the factory gate price of output, D_{ij} is the distance from “i” to “j”, δk the elasticity of freight cost with respect to distance, τ^k is the ad valorem border cost, $Home_{ij}$ an indicator that regions “i” and “j” are within the same border, σ^k the elasticity of substitution among varieties and P_j^k is the price index of all varieties of “k” in region ”j”. The trade flow prediction T_{ij} is derived by multiplying formula (a) by n_i^k and p_i^k:

$$T_{ij}^k = n_i^k p_i^k q_j^{kd} = Y_i^k(\eta^k Y_j)(p_i^k)^{-\sigma k} D_{ij}^{-\delta k \sigma k} \exp(\tau^k(1\text{-}Home_{ij})^{-\sigma k} / (P_j^k)^{1-\sigma} \quad \text{(c)}$$

Where Y_i^k is the value of industry “k” output in region “i”, and the other terms are as defined above. The standard gravity exercise is to estimate a reduced from of this equation in aggregate data, implicitly setting η^k to one and assuming σ^k, τ^k and δ^k are constant across commodities. Under these strict assumptions, and appropriately estimated β_4 can be decomposed into estimates of the structural

parameters σ and τ.

In this framework, there are many potential sources of border-induced changes in the composition of trade. The structural parameters σ^k and τ^k and δ are likely to vary across commodities. The simulations below suggest that n_i^k may vary across locations in an interesting way, leading states proximate to borders to have export bundles with lower than average border costs.[4] Since these states have a disproportionate share of cross-border shipments, total cross-border trade flows depend largely on the responsiveness of nearby states’ export bundles. Controlling for industry location patterns and estimating commodity-specific regressions that allow for cross-commodity variation in σ^k, τ^k and δ provides a control for these effects.

2.1. A Numerical Example

Numerical simulation of the Krugman model demonstrates that industries with low border costs locate near borders. Let there be two commodities indexed by “k”, each with a half-share in utility. Three equal-size regions – (O)ntario, (M)ichigan, and (I)ndiana – are arranged in a line, with the central region M equidistant from O and I. A border cost is imposed on O’s trade with M and I and distance costs apply to all interregional trade.

[4] Hummels considers the potential biases introduced by idiosyncratic variation of η^k over region “j”. Here has been assumed η^k constant across regions; Hummels David, “ Toward a geography of trade costs”, Chicago 1999, University of Chicago, page 122

Table 1.

Industry location, proximity and border effects in interregional trade[5]

Parameterization	Number of industry I firm in region			(T_{MI}/T_{MO})	$T_{MO}/(T_{IO}+T_{MO})$
	I	M	O		
$\tau^1=0.5$ $\tau^2=0.5$	227	227	227	2.72	0.5960
$\tau^1=0.45$ $\tau^2=0.55$	225	227	230	2.71	0.5961
$\tau^1=0.4$ $\tau^2=0.6$	223	226	232	2.67	0.5964
$\tau^1=0.25$ $\tau^2=0.75$	218	225	238	2.46	0.5987
$\tau^1=0$ $\tau^2=1$	209	226	246	1.87	0.6074

In the baseline simulation, border costs are set to 0.5. Subsequent simulations introduce variance in τ^k constant. As border costs diverge, firms producing goods with low border costs move to be proximate to the border. The border effect in Michigan's trade falls, even as its share in cross-border trade rises.

Table 1 Reports results from the simulations. The first three columns note the number of industry "I" (the industry with low border costs) firms in each region. Column four reports the border effect in "M" exports, which is calculated by dividing its exports to "I" by its exports to "O". This is the conceptual equivalent of the border effect estimated in aggregate data, because "o" and "I" are of equal size and equidistant from "M". The final column reports "M" share of US exports, which rises in the variance of border costs. As the variance in border costs rises, the border effect in "M" falls, while it ships a larger share of total exports.

The simulations are meant to illustrate the idea that cross-commodity variation in border costs induces compositional change, both in regions' output and export bundles and in regions' shares of cross-border trade. The model does not capture another key source of border-induced compositional change. Econometric evidence reported below shows that the border induces some goods to drop out of the traded bundle altogether. If there are fixed costs of bilateral trade, goods included in "M" shipments to "O" may not be included in "I" shipments to "O", even if the good is produced in "I". Structural models like that of Krugman understate the size and significance of compositional change, for

[5] Baseline parameterization: $\sigma=3$, $\delta=0.3$, $\eta^k=1/2$. $L_0=L_M=L_I=1000$. The fixed unit labour requirement is 1.1, and the marginal unit labour requirement is 1.

such models cannot account for the large number of zero observations present in the data.

3. DATA

The data used in the econometric analysis that follows re from a special tabulation of the 1993 Commodity Flow Survey (CFS). The CFS was designed to estimate and report shipment characteristic of freight movements among US states. The value of shipments for origin destination pairs was derived from surveys of stratified sample of establishments in the US. Publicly available CFS data report bilateral commodity flows for internal US shipments at the two-digit commodity level detail[6] and separates exports from international shipments. The Census Bureau reports export shipments for state of origin and port of exit at the three-digit level of commodity of detail.

It is this information that serves as the basic input into the data used below. In order to allow comparisons between internal and external shipments, export shipments were aggregated across ports of exit to produce estimates of the bilateral commodity flows between states of origin and provinces of entry. Because only land-based exports can be reliably assigned to a specific province of entry, only shipments traveling by truck and/or rail were used in the regression analysis below.

Two important caveats should precede the use of these data. First, the Census Bureau never intended to report export figures in 1993 CFS, so the export data are a by-product of the data collection effort. As a result, the procedures used to extrapolate survey data to produce aggregate estimates of total shipments were not designed to fit the value of export shipments recorded in official trade figures. Second, the tabulation did not report the country of destination for export data, so construction of the state-to-province-of-entry flows relied on inferences based on the location of the port of exit[7]. Export traveling through US ports of exit other than those on the immediate contiguous border could not be assigned to Canada because the destination country was not obvious. It is quite likely that some Canada-bound shipments were missed.

Put together, these two limitations lead the special tabulation to produce a substantial underestimate of total US exports to Canada. Official US figures report approximately $92 billion in 1993 cross-border goods trade. The value reported in CFS figures cannot be reported but understates official trade figures by a factor of 2.

[6] Commodities are classified according to the Standard Transported Commodity Classification (STCC) a commodity classification that is quite closely concorded with the US SIC.

[7] Each port of exit was assigned to the province directly across the border in Canada. Ports of exit were assigned to provinces by the author, not by Census Bureau.

The degree to which to special tabulation understates the actual trade volume would be quite distressing were it my purpose in this paper to provide a definitive measure of an aggregate border effect and to interpret it. The purpose is however to demonstrate that the composition of trade changes at borders and that this effects the way the aggregate data predicts the “borderless” trade flows necessary to infer a border effect. Because the data are internally consistent (i.e., state-province flows ate the commodity level sum to aggregate state-province flows), they are suitable for purpose. The analysis requires internally consistent data measuring both internal and cross-border flows at the disaggregated commodity level. The special tabulation used here appears to be the only available data set that encom-passes that set of needs.

4. ESTIMATION PROCEDURE

The typical approach to estimating border effects regress the natural log of T_{ij} on a home dummy variable and logged values of exporter and importer size and geographic distance. More recently, Anderson and van Wincoop have proposed a structural estimation approach that uses a non-linear estimator to account for the presence of trade diversion in a model similar to (b). Neither of these techniques suggests an obvious treatment of either disaggregated data or the large number of zero, observations presents in these data. Since the purpose here is to show, in a straightforward and transparent manner, that compositional change is an important feature of the data, there is used a simple reduced-form econometric specification within the two-part estimation framework proposed by Cragg[8]. The derivation and estimation of suitable structural model is left to future work.

In the two-part model, probity and level regressions are estimated independently. The probity model determines the impact of the gravity variables on the probability that trade occurs in a giver “ijk” triplet. The second regression is truncated regression model that estimates gravity-induced changes in the level of trade, given that trade is observed. This truncated regression model is a maximum likelihood procedure that puts a lower bound on the error distribution to account for threshold effects in bilateral commodity flows affect estimates of the conditional impact of borders on the level of trade[9].

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[8] Cragg John, “Some statistical model for limited dependent variables with application to the demand for durable goods”, Boston 1971, Econometrica 39, pages 833.

[9] This differs from a Heckman procedure, which carries information from the probity regression into second stage. Leung and Yu show the Heckman-like procedures can introduce estimation bias when the number of zero observations is large, as it is in these data. The intuitive explanation for the Leung and Yu result that a large number of zero observations leads the Heckman procedure to rely to heavily on the information contained in the zero observations when fitting the sample of non-zero observations in the level regression. The two-part model relies only on positive flows to estimate the level effects of the gravity variables.

In the two-part gravity model used below, the independent variables are those in (a), along with dummy variables denoting within-state shipments and shipments among adjoining states[10]. The controls are useful because the data include wholesale shipments, which might be more likely among local shipments. In commodity-specific regressions, exporter size is measured by industry value added in region "i", rather than origin-state GDP, to control for industry location patterns. The independent variables enter into both the probity and the truncated regression model.

Calculation of the border effect is somewhat more involved in the two-part model than in standard practice. In the two-part model, a border has two effects on trade. First, it reduces the probability that trade occurs in a given "ijk" triplet. Second a border reduces the level of trade, given that trade does occur. In order to account for the two effects in counterfactual that removes the border, has been turn to Monte Carlo simulation[11]. The Monte Carlo considers the effect of setting Home=1 for cross-border pairs. This is a thought experiment that asks: What would cross-border trade be if the border did not exist?

The Monte Carlo exercise uses the data from the right-hand side of the regression, the estimated probity and truncated model coefficients, and measured standard error terms as inputs. One hundred random error terms are drawn for each "ijk" triplet in each of the two regression equations. Each of the 100 runs of the Monte Carlo exercise predicts (a) whether there will be trade in each "ijk" triplet, and (b) a fitted value of the "ijk" trade flow, given that the probity equation predicted that trade occurs. In each run, the value of cross-border trade is evaluated with and without the presence of borders, and summed over province-state pairs. The average of the predicted T_{ij}^{k} over the 100 runs is taken as the expected value of cross-border trade. Commodity-specific border effects can be calculated by summing these predictions over "k" and dividing the borderless trade volume by the border-impeded flow.

These calculations produce a distribution of commodity-specific border effects. Subsequent calculations include a simple average of commodity-specific border effects, a US-output-weighted average border effect, and a median commodity-specific border effect. Summing over predicted trade volumes at the commodity level and taking the ratio of total predicted borderless trade to total border-impeded trade produce an alternative estimate of the aggregate border effect.

One difficulty in cross-commodity aggregation arises because the Census Bureau suppresses production data when reporting a figure would reveal

[10] Mileages within states were calculated as the distance between two largest cities.
[11] Alternatively, one might consider the marginal effects of the border dummy coefficient on (a) the probability that trade occurs and (b) the level of trade given that trade occurs. There are two reasons to prefer a Monte Carlo exercise. First, the ranges of the independent variables vary across the two regressions, complicating the choice of a point at which to evaluate the marginal effects. Second, the non-linear transformation of the marginal effects in the second regression will be biased when the marginal effects are estimated with error.

activities of a particular firm. The "ijk" triplets are dropped from the regression when state "i" production of "k" is omitted. The cross-commodity aggregation necessary to calculate the alternate aggregate border effect requires and adjustment so that commodities with omitted production data are not underrepresented in the aggregate figures. The solution is to scale the predicted trade flows in each commodity group by the inverse of the share of national output that is omitted by Census.

This procedure is potentially problematic, given that threshold effects are important in the data. Suppressions are more likely when industry output is small, and so the regressions may understate the importance of threshold effect in determining trade flows. The border effect is calculated with fitted trade flows, however, and shipments from states with small output shares would likely be unimportant in cross-border trade. Any biases due to suppression would not be important unless the suppressed states' exports responded differently to borders than those of the states with reported production did[12].

Table 2.

Regression results[13]

	Aggregate flows		STCC 011 – Field crops		STCC 371 – Motor Vehicles and equipment	
	Probity	Truncated regression	Probity	Truncated regression	Probity	Truncated regression
Constant	-27.73*	-30.81*	-22.28*	-0.07	-22.01*	22.85*
	(5.01)	(0.80)	(1.47)	(2.77)	(1.88)	(1.57)
$\ln Y_i^k$	0.66*	1.03*	0.63*	0.05	0.47*	0.85*
	(0.11)	(0.02)	(0.05)	(0.10)	(0.03)	(0.03)
$\ln Y_j$	0.88*	1.11*	0.48*	0.61*	0.74*	1.10*
	(0.16)	(0.02)	(0.32)	(0.06)	(0.06)	(0.05)
$\ln D_{ij}$	-1.22&	-0.92*	-0.62*	-0.34*	-0.92*	-1.00*
	(0.27)	(0.03)	(0.06)	(0.10)	(0.10)	(0.08)
Home	2.62*	3.07*	1.01*	0.59	2.45*	1.33*
	(0.32)	(0.06)	(0.11)	(0.31)	(0.14)	(0.24)
δ'_ϵ	1	1.07	1	2.05	1	1.88
Observations	2640	2590	2200	1088	1925	1545
Presudo-R^2	0.98		0.75		0.91	

[12] A well-known feature of industry location patterns in the US is that industries are highly agglomerated. If fixed costs of trade are paid on regional basis, or if knowledge about cross-border trade opportunities spills across local state borders, exports from states with suppressed data would not respond differently to the borders removal than would exports from other states in the agglomeration.

[13] A well-known feature of industry location patterns in the US is that industries are highly agglomerated. If fixed costs of trade are paid on regional basis, or if knowledge about pressed data would not respond differently to the borders removal than would exports from other states in the agglomeration.

5. RESULTS

Regression results from the two-part model for both aggregate trade and for selected commodities of general interest – Field Crops (STCC011) and Motor Vehicles and Equipment (STCC371) – are reported in Table2. All variables enter with the expected sign, and most all are highly significant. The "Home" dummy coefficient is significantly positive in all three binomial probity regressions; so the Monte Carlo exercise described above is needed to account for border-induced zero observations. The Monte Carlo produces border effect estimates of 21.7 aggregate shipments, 2.7 for Field Crops and 4.1 for Motor Vehicles and Equipment[14]. Each of these is slightly higher than the McCallum calculation would suggest, because the border's removal allows trade in some state province pairs that have no border-impeded trade in that commodity.

Table 3.

Summary statistics for the distribution of commodity-specific border effects[15]

McCallum-style estimate of the aggregate border effect	20.9
Monte Carlo estimated of the border effect in aggregate data	21.7
Median commodity-specific estimate	6.6
Minimum (STCC 237, Fur Goods)	0.03
Maximum (STCC286, Gum and Wood Chemicals)[a]	263.7
Simple average commodity-specific border effect[b]	21.9
Output weighted average[bc]	11.5
Alternative estimate of the aggregate border effect	5.7

The relatively small measured border effect in Field Crops and Motor Vehicles and Equipment are not atypical. Most commodities have border effects far below the aggregate figure. The median border effect is 6.6 and 123 of the 142 commodities have border effect below 21.7. Commodities with border effects that exceed the aggregate border effect include Cigarettes, Dairy Products, Livestock, various Leather Products and Guided Missile or space Vehicle Parts. All these

[14] Commodity-specific estimates of the border coefficients for all 142 commodities are available I an earlier version of this paper, which is available at ft;://usitc.gov/pub/reports/studies/EC200104B.PDF.

[15] a – In six commodities, no cross-border flow was reported. The reported figure is the maximum for commodities with at least one cross-border flow.

b – Commodities with no reported flows were assigned the maximum finite value, 263.7 for the purposes of this calculation.

c – Commodity-specific border effect weighted b 1992 value added in associated SIC categories.

commodities might be expected to face large border costs[16]. Large border effects might also occur in commodities where the elasticity of substitution among varieties (δ^k) is large. Dairy Product and Livestock might have especially large elasticity of substitution.

Table 3 reports a series of summary statistics for the distribution of commodity-specific border effects. The McCallum-style estimate of the aggregate border effect is 20.9. The Monte Carlo method, which accounts for zero observations in aggregate trade, produces an estimate of 21.7 in aggregate data. The range of commodity-specific border-effect estimates is large. Fur goods have a border effect of only 0.03, while Gum and Wood Chemicals have a border effect of 263.7[17]. A small number substantial outliers pull up the simple average border effect to 21.9. Weighting border effects by the commodities' share in US production brings down the average commodity-specific border effect to 11.5. The median border effect is 6.6. Summing over predicted trade volumes in all commodities, as described above, produces an alternative estimate of the aggregate border effect. This estimate, which is conceptually similar to an average border effect, weighted by bilateral pairs' share in cross-border trade is only 5.7.

The Monte Carlo Method described above allows an answer to question of further interest: How significant are zero observations in estimates of the border effect? As Haveman and Hummels point out, standard CES models of gravity like do not predict a substantial role of zero observations. A simple calculation allows an estimate of the share of border-impeded trade that occurs because the figure is calculated in the Monte Carlo by evaluating the commodity-specific probity equations at Home=1 and the truncated regression at Home=0, summing over predicted trade flows as before, and comparing the figure the estimate when Home=0 in both equations. Zero observations are important part of the border effect. Of the aggregate border effect estimate 40% is due to border-induced zero observations at the commodity level.

5.1. Caveats

The purpose of this research is to show that the composition of trade changes at borders, not to provide a comprehensive model of sub national economic geography at the three-digit commodity level. As such, the results here rely on a particular framework for estimating commodity-specific gravity regressions. The magnitude of compositional change estimated here might be

[16] The notable surprise was a calculated border effect of 46.7 in Optical Equipment. Given the high value to weight ratios of optical equipment, it is quite likely that this commodity group is frequently shipped by air. Since only land shipments are available for this exercise the estimates of border effects for commodities that are frequently air shipped may be somewhat misleading and may be biased upward if cross-border shipping more frequently uses air transport.

[17] Six commodities have no reported cross-border trade. Because a positive trade flow is predicted in the borderless scenario, these are infinite border effects. For the purposes of calculating cross-commodity averages, they are assigned the maximum finite value of 263.7.

sensitive to alternative specifications of the commodity-specific regression. It is unlikely, however, that an alternative estimation strategy would overturn the finding that borders substantially affect the composition of interregional trade.

Most new economic geography models suggest a role for price indices in determining trade patterns. Hummels[18] and Anders and van Wincoop[19] offer estimation techniques that control for changes in the price index $\acute{P}_j$. Unfortunately, Hummels's technique requires a universe of data that is not available. Further more, the technique, which uses region-specific fixed effects is difficult to use with probity regressions because the econometric model frequently over determines the probability that trade occurs in a given "ij" pair.

Anderson and van Wincoop argue for structural estimation of gravity equations based on specific model of aggregate trade. In this research has been only made the point that composition is important, leaving an explicit structural interpretation of border-induced compositional change to later work. Since the presence of zero observations and significant compositional change contradicts existing approaches to modeling gravity, such and effort is beyond the scope of this research.

Finally, while the Commodity Flow Survey is the most comprehensive available data source that consistently documents both domestic and international flows, the Census Bureau's data collection procedures were not ideal for this type of research. Forthcoming versions of the Commodity Flow Survey promise greater detail on cross-border shipments. It is likely that more comprehensive data will verify the finding of significant border induced changes in the composition of trade.

6. CONCLUSION

Borders affect the composition of trade. This is not surprising, but evidence of considerable border-induced compositional changes has important implications for thinking about the economic significance of borders. This point has been raised indirectly in Haven and Hummels and Hillberry and Hummels research, but its implications for the estimation and interpretation of aggregate effects have not been fully explored. It appears that the size the aggregate border effect estimate depends on industry location and the border-induced reductions in the number of traded commodities.

Border-induced compositional change in the traded bundle is important. Most commodities have border effects far below the aggregate estimate. The median commodity-specific border effect is 6.6, and the output-weighted average

[18] Hummels David, " Toward a geography of trade costs", Chicago 1999, University of Chicago.
[19] Anderson James and Eric van Wincoop, "Gravity with gravities: a solution to the border puzzle", NBER 2001 Working Paper No. 8079.

border effect is 11.5. These smaller numbers contrast with the McCallum-style estimate of the aggregate border effect, which are 20.9 in this data.

If states proximate to the border produce goods with low border costs, an aggregate estimate can overstate the border effect by predicting to large an increase in large cross-border flows. Since standard models predict that states proximate to Canada ship a disproportionate share of Canada-bound exports, and economic geography models suggest that industries with low border cost locate proximate to borders, this bias can lead an average border elasticity to overstate the expected change in cross-border trade when the border is removed. After controlling for the location of output, variation in commodities' responsiveness to borders, and border-induced changes in the number of traded commodities, in this research has been founded that the aggregate border effect estimate of 21.7 is reduced to 5.7. Since available data offer only moderate desegregations, it is possible that similar aggregation bias occurs within commodity groupings. It appears that gravity models that use aggregate data as inputs substantially overstate the size of the border effect.

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STRUKTURALNI EKONOMSKI UČINCI KROZ SPORAZUME SLOBODNE TRGOVINE

Sažetak

Međunarodna trgovina između SAD-a i Kanade odvija se različitim tempom s obje strane granice. Postoje promjene u strukturi dobara i usluga kao subjekta međunarodne trgovine između SAD-a i Kanade. Standardne procjene međunarodne trgovine su rezultat složenih pogrešaka endogene industrije prostornog tipa. Morala bi sadržavati i promatranje trgovine proizvodne razine.

Ključne riječi: trgovina; ekonomski učinak; model; procjenjivanje.

JEl classification: F14