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Manufacturing and Services Economics Brief

International Trade and Local Transportation Employment

by David Riker

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Executive Summary

The expansion of international trade can significantly increase the level of employment in a country's transportation sector, since exports and imports require shipping, distribution, and warehousing. However, it is difficult to disentangle the contribution of international trade from the many other factors that affect transportation employment. There is an extensive economics literature that addresses the effects of international trade on labor market outcomes. However, most studies focuses on the effects of trade on employment or wages in the manufacturing sector rather than the transportation sector.

In this economics brief, I present an econometric model that quantifies the effect of U.S. exports on the level of transportation sector employment in different parts of the United States. I construct state-level monthly international trade flows based on port-level trade statistics of the U.S. Census Bureau, and I use state-level transportation employment data from the U.S. Bureau of Labor Statistics. I measure interstate commodity flows based on the 2007 Commodity Flow Survey. I consider several alternative specifications that vary in their assumptions about the state effects, interstate commodity flows, and the role of imports.

I estimate that the expansion of U.S. exports between 2003 and 2010 added between 63,000 and 140,000 workers to the sector, with a central estimate of 101,000 workers. This positive contribution of U.S. exports to transportation sector employment offsets some of the national decline in transportation employment over this period. The 30.4 percent increase in the value of exports between 2003 and 2010 helped to limit the national decline in transportation employment to about one percent over this period.

The model can also be applied on a prospective basis, for example to project the increase in transportation sector employment that would result from doubling U.S. exports relative to 2009 levels (the goal of the National Export Initiative). This calculation indicates that a doubling of exports (in constant dollars) could increase transportation employment by approximately 270,000 to 603,000 workers nationwide, with a central estimate of 437,000 workers.

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Introduction

The expansion of international trade can significantly increase the level of employment in a country's transportation sector, since exports and imports require shipping, distribution, and warehousing. However, it is difficult to disentangle the contribution of international trade from the many other factors that affect transportation employment. Ideally, a calculation of the effect of trade on employment in the transportation sector would utilize data on the number of workers who are directly tied to the transportation of exports and imports, but to my knowledge there are no statistics that count the contributions of each transportation worker whose services facilitate international trade. The ideal data would include workers throughout the transportation network, including workers that transport the country's exports and imports between different states within the country and also workers that warehouse the goods. It should not be too narrowly limited to port workers, for example. On the other hand, simply counting all transportation and warehousing workers in the transportation network, including those far from the ports and borders, would generate an estimate that is overly broad.

As a practical alternative to the ideal measure, I estimate the contribution of international trade flows to state-level transportation employment using a statistical model that is based on variation in transportation employment and international trade flows in different parts of the United States between 2003 and 2010. By measuring the conditional covariance of month-to-month changes in state-level international trade flows and transportation employment, I identify the contribution of international trade flows to employment in the sector.

There is an extensive economics literature that addresses the effects of international trade on labor market outcomes. However, most studies focuses on the effects of trade on employment or wages in the manufacturing sector rather than the transportation sector. One branch of the literature uses cross-industry variation in national employment and wage data to estimate the contribution of trade to labor market outcomes. Examples include Beaulieu (2000) for Canada and Bernard, Jensen, and Schott (2006) for the United States. A second branch of the literature uses geographical variation in employment or wages at the state or local level, but again they focus on employment in the manufacturing sector. Examples include Leichenko and

Silva (2004), Chiquiar (2008), McLaren and Hakobyan (2010), and Martincus (2010), and Autor, Dorn, and Hanson (2011). None of these studies estimates the impact of international trade on transportation sector employment, even though the transportation sector is clearly tied to international trade and there is substantial cross-state variation in the level of employment in the transportation sector.

In this economics brief, I present an econometric model that quantifies the effect of U.S. exports on the level of transportation sector employment in different parts of the United States. I present a theoretical framework for analyzing the relationship between transportation employment and the value of international trade flows, based on an economic model of the provision of transportation services. In the model, transportation employment depends on the value of shipments. It varies with international trade flows to the extent that the trade flows add to, and do not displace, domestic shipments in each state. The model predicts that U.S. exports have a positive effect on transportation employment, because an expansion of exports adds to total shipments within the United States. On the other hand, U.S. imports may have little or no effect on U.S. transportation employment if they displace domestic shipments. I extend the model to include the shipment of international trade across multiple states, and I address the unobservable factors that are included in the error term of the fixed effects of the econometric analysis. See the Technical Appendix for the full development of the model.

I construct state-level monthly international trade flows based on port-level trade statistics of the U.S. Census Bureau, and I use state-level transportation employment data from the U.S. Bureau of Labor Statistics. I measure interstate commodity flows based on the 2007 Commodity Flow Survey. The model includes state and month fixed effects to control for differences in the size of the transportation sector across states and over time that are independent of the variation in international trade flows. I consider several alternative specifications that vary in their assumptions about the state effects, interstate commodity flows, and the role of imports.

I use the econometric estimates to calculate the effect of exports on the level of transportation employment in each state. Overall, the econometric estimates indicate that exports from nearby ports had a significant positive effect on transportation employment. Exports from ports in the same state have the largest effect, followed by exports from ports in states that are closely connected by interstate commodity flows. I estimate that the expansion of U.S. exports between 2003 and 2010 added between 63,000 and 140,000 workers to the sector, with a central estimate of 101,000 workers. This positive contribution of U.S. exports to transportation sector employment offsets some of the national decline in transportation employment over the period. The 30.4 percent increase in the value of exports between 2003 and 2010 helped to limit the national decline in transportation employment to about one percent.

Data on Transportation Employment and Exports

In this section, I describe the monthly, state-level data that I use in the econometric analysis. The employment data are from the Employment, Hours, and Earnings State and Metro Area series published by the Bureau of Labor Statistics (BLS) Current Employment Statistics. I measure employment in each state's transportation sector based on the Transportation and Warehousing statistics. For five of the smaller states (Arkansas, Delaware, New Mexico, South Dakota, and Wyoming), I use employment data at the next highest level of aggregation, which also includes employment by utilities, because BLS does not report employment at the level of Transportation and Warehousing for these states. I estimate the sector's payroll in each state for each month using the sector's average hourly earnings from BLS. I convert current dollar values to constant 2010 dollars using the monthly All Commodities Producer Price Index from BLS.

I use monthly values of U.S. commodity exports and imports from the U.S. Census Bureau. I aggregate port-level data to the state level. The data represent the state of the port and not necessarily the state of origin of the exports. The trade dataset is available on a monthly basis from 2003 to 2010.

Table 1 reports the 2003 and 2010 transportation sector employment and average monthly values of exports from each state. In total, U.S. transportation sector employment declined by approximately 42,000 workers over the period, while the average monthly value of U.S. commodity exports increased by approximately $23.2 billion in 2010 dollars.

Table 1: Summary of Transportation Employment and Trade by State, 2003 and 2010
Employment in Number of Workers
Exports in Thousands of 2010 Constant Dollars per Month

	Employment in 2003	Employment in 2010	Exports in 2003	Exports in 2010
Total	4,205,408	4,163,417	76,533,017	99,769,494
By State				
Alaska	18,808	19,100	939,733	1,202,083
Alabama	52,117	51,483	289,005	428,959
Arkansas	65,825	58,725	8,710	28,664
Arizona	65,392	68,350	556,155	733,402
California	425,192	407,258	12,596,979	14,010,690
Colorado	64,958	62,025	72,563	54,970
Connecticut	39,958	40,925	50,821	49,676
Delaware	12,725	11,867	83,706	142,363
Florida	208,700	201,800	3,607,634	6,082,747
Georgia	154,408	159,267	1,892,488	3,391,776
Hawaii	24,117	23,092	278,537	616,262
Iowa	48,633	53,300	1,664	6,525
Idaho	16,833	17,758	93,106	156,311
Illinois	229,925	228,983	2,364,726	2,987,045
Indiana	107,400	109,508	303,786	35,246
Kansas	45,158	44,633	49,144	60,883
Kentucky	80,608	81,650	94,006	72,236
Louisiana	72,392	67,758	3,613,286	5,462,339
Massachusetts	74,350	72,092	727,259	630,024
Maryland	66,883	65,983	671,212	1,226,462
Maine	16,117	15,008	299,185	315,808
Michigan	105,275	93,475	9,863,374	9,372,234
Minnesota	80,125	77,375	354,256	434,675
Missouri	92,058	82,725	14,242	24,724
Mississippi	37,775	38,958	218,603	305,833
Montana	12,583	13,608	414,317	626,493
North Carolina	110,625	101,750	195,631	432,774
North Dakota	9,742	12,442	975,037	1,751,796
Nebraska	44,492	49,817	1,546	1,351
New Hampshire	12,950	11,800	9,258	46,481
New Jersey	162,633	147,675	774,522	1,281,238
New Mexico	22,783	21,700	47,654	408,573
Nevada	36,700	45,425	29,119	27,252
New York	223,250	219,758	11,624,419	14,774,058
Ohio	161,817	160,617	1,523,419	1,999,101
Oklahoma	42,783	41,958	4,223	1,782
Oregon	50,533	47,517	361,211	351,544
Pennsylvania	196,967	209,358	710,032	1,013,543
Rhode Island	9,992	9,017	6,913	24,326
South Carolina	48,692	45,733	1,514,834	1,627,214

Table 1 (continued): Summary of Transportation Employment and Trade by State
Employment in Number of Workers
Exports in Thousands of 2010 Constant Dollars per Month

	Employment in 2003	Employment in 2010	Exports in 2003	Exports in 2010
South Dakota	11,492	12,517	97	14,007
Tennessee	135,417	127,392	114,194	180,796
Texas	339,592	370,125	12,551,702	18,699,470
Utah	39,933	42,958	23,821	611,674
Virginia	106,917	101,367	1,458,628	2,260,690
Vermont	6,775	6,667	339,598	264,295
Washington	84,492	83,383	4,745,848	5,533,380
Wisconsin	93,992	91,208	62,810	5,350
West Virginia	25,058	25,342	5	369
Wyoming	9,467	11,183	0	3

I use data from the 2007 Commodity Flow Survey to identify states that are connected by significant interstate commodity flows. For each state, I classify a second state as "closely connected" if the second state accounts for at least two percent of the inbound or outbound commodity flows of the first state. In general, the intensity of interstate commodity flows is increasing in the size of the two states and decreasing in the distance between them, as a basic gravity model of interstate trade would predict.

Estimation of the Econometric Model

Table 2 reports the econometric estimates for two versions of the specification derived in the Technical Appendix.[1] All of the models include state and month fixed effects, and they are corrected for first-order autocorrelation using the method developed in Bhargava, Franzini, and Narendranathan (1982), Baltagi and Li (1991), and Baltagi and Wu (1999). The F tests of

[1] Before estimating the coefficients of the model, I tested for unit roots in the panel data series to ensure that the monthly time series are stationary. I reject unit roots for the monthly, state-level employment and trade series using Levin-Lin-Chu, Harris-Tzavalis, and Breitung panel unit-root tests. However, there is significant first-order autocorrelation in the series.

Table 2: Fixed Effects Coefficient Estimates for the More Restricted Model
Point Estimates, with Standard Error in Parentheses
The Dependent Variable is Transportation Sector Payroll by State and Month.

Explanatory Variables	Model 1	Model 2
Exports from the Same State	2.7180 (0.3090)	2.9981 (0.3206)
Exports from the Closely Connected States		0.3146 (0.0984)
Rho Parameter for the State Panels	0.9174	0.9182
F Test for the State Fixed Effects	816.49	792.04
F Test for the Month Fixed Effects	31.11	38.81
F Test that $\gamma = 1$		75.51
R-Squared (Within)	0.4056	0.4069
Akaike Information Criterion	163194	163116
Number of Observations	4,750	4,750

parameter restrictions indicate that the state and month fixed effects account for a significant amount of the variation in transportation sector payrolls. In both versions of the model, the estimated coefficients on exports are positive and significantly different from zero. Within each model, the relative magnitudes of the coefficients are increasing in the intensity of interstate commodity flows. The Akaike information criterion and the t-test of the coefficient on exports from closely connected states indicate that Model 2 is a better fit for the data.

Table 3 reports the fixed effects estimates for two versions of a less restricted specification. The estimated coefficients on import flows are all negative. Since the theory indicates that these estimates will be upward-biased, it is unlikely that the coefficients on imports are equal to zero. The error terms in these models should be independent of the export values, since the specification controls for the import values. Therefore, the estimated coefficients on export values in Table 3 should be unbiased. The estimated coefficients on exports are all positive, and they are larger than their counterparts in Table 2.

Table 3: Fixed Effects Coefficient Estimates for the Less Restricted Model

Point Estimates, with Standard Error in Parentheses

The Dependent Variable is Transportation Sector Payroll by State and Month.

Explanatory Variables	Model 1	Model 2
Exports from the Same State	4.9943 (0.3456)	5.3535 (0.3589)
Exports from the Closely Connected States		0.4306 (0.1182)
Imports from the Same State	-3.4145 (0.2459)	-3.6110 (0.2632)
Imports from the Closely Connected States		-0.2240 (0.0973)
Rho Parameter for the State Panels	0.9106	0.9112
F Test for the State Fixed Effects	845.50	803.71
F Test for the Month Fixed Effects	30.44	29.55
R-Squared (Within)	0.4294	0.4311
Akaike Information Criterion	162988	162917
Number of Observations	4,750	4,750

In the next section, I use the estimated coefficients in Model 2 in Table 3 to calculate the contribution of the growth of U.S. exports to the change in transportation sector employment between 2003 and 2010. I do not calculate the effect of the change in imports over this period, since the model in Table 3 does not necessarily provide an unbiased estimate of the coefficients on imports, as I discuss in the Technical Appendix.

Employment Effects

Nationwide, transportation sector employment declined between 2003 and 2010, but the trends vary significantly across the states. Transportation employment declined in California and New York and expanded in Texas and Pennsylvania. In this section, I use the econometric model to estimate the contribution of exports to the experiences of each of the states.

First, I calculate the change in the average monthly values of exports (in the same state and in closely connected states) between 2003 and 2010. Then I multiply these changes by the estimates of the corresponding coefficients from Model 2 in Table 3 and divide by the transportation sector wage rate in 2003. By fixing the sector wage at its constant-dollar value in 2003, the calculation assumes that the supply of transportation labor was highly elastic such that shifts in transportation labor demand due to the changes in exports did not have a discernible impact on this wage. (An increase in wages would reduce the magnitude of the change in employment.) Nationwide, I estimate that the change in exports increased transportation employment by approximately 101,000 workers, with a 95 percent confidence interval that ranges from approximately 63,000 to 140,000.

Table 4 reports the modeled change in transportation employment in each of the fifty states. The largest transportation employment effects from exports were in Texas, New York, Florida, Georgia, and Louisiana. The table compares the simulated changes in the state's transportation employment to the actual (recorded) change in the state's transportation employment between 2003 and 2010.

Overall, transportation employment declined by nearly 42,000 workers (approximately 1 percent) between 2003 and 2010, despite the additional 101,000 transportation workers associated with the increase in U.S. exports. In some states like Texas the employment effect of the export expansion magnified an increase in transportation employment over the period. In other states like New York and Florida the employment effect of the export expansion offset part of the decline in transportation employment.

Table 4: Modeled Employment Effects and Recorded Changes in Employment

	Modeled Effect of Exports on Transportation Employment	Recorded Change in Transportation Employment
Total	101,424	-41,992
By State		
Alaska	1,680	292
Alabama	1,980	-633
Arkansas	1,617	-7,100
Arizona	1,265	2,958
California	3,009	-17,933
Colorado	1,309	-2,933
Connecticut	1,736	967
Delaware	1,595	-858
Florida	5,088	-6,900
Georgia	3,814	4,858
Hawaii	889	-1,025
Iowa	946	4,667
Idaho	1,620	925
Illinois	1,926	-942
Indiana	1,395	2,108
Kansas	983	-525
Kentucky	1,466	1,042
Louisiana	3,678	-4,633
Massachusetts	1,525	-2,258
Maryland	1,557	-900
Maine	653	-1,108
Michigan	934	-11,800
Minnesota	1,659	-2,750
Missouri	1,974	-9,333
Mississippi	1,797	1,183
Montana	1,356	1,025
North Carolina	2,336	-8,875
North Dakota	2,059	2,700
Nebraska	995	5,325
New Hampshire	1,871	-1,150
New Jersey	2,547	-14,958
New Mexico	1,433	-1,083
Nevada	1,676	8,725
New York	5,832	-3,492
Ohio	2,001	-1,200
Oklahoma	994	-825
Oregon	881	-3,017
Pennsylvania	2,215	12,392
Rhode Island	1,827	-975
South Carolina	2,043	-2,958

Table 4 (continued): Modeled Effects and Recorded Changes in Employment

	Modeled Effect of Exports on Transportation Employment	Recorded Change in Transportation Employment
South Dakota	1,078	1,025
Tennessee	2,060	-8,025
Texas	9,195	30,533
Utah	1,960	3,025
Virginia	3,134	-5,550
Vermont	1,261	-108
Washington	2,339	-1,108
Wisconsin	1,228	-2,783
West Virginia	1,989	283
Wyoming	1,088	1,717

Concluding Remarks

I have estimated the contribution of exports to transportation sector employment in each state, based on an econometric model fitted to monthly, state-level employment and international trade data. The retrospective analysis indicates that the expansion of U.S. exports between 2003 and 2010 added approximately 101,000 workers to the transportation sector and offset part of the national decline in transportation employment over this period.

The model can also be applied on a prospective basis, for example to project the increase in transportation sector employment that would result from doubling U.S. exports relative to 2009 levels (the goal of the National Export Initiative). I multiply the coefficient estimates from Model 2 in Table 3 by the average monthly value of exports in 2009 and divide by the transportation sector wage in 2009. This calculation indicates that a doubling of exports (in constant dollars) could increase transportation employment by approximately 270,000 to 603,000 workers nationwide, with a central estimate of 437,000 workers. This is close to the estimate of 500,000 jobs that are supported by U.S. exports of goods in 2008, according to Tschetter (2010).

References

Autor, D.H., D. Dorn, and G.H. Hanson (2011). The China Syndrome: Local Labor Market Effects of Import Competition in the United States. Manuscript.

Baltagi, B.H. and Q.Li (1991). A Transformation That Will Circumvent the Problem of Autocorrelation in an Error-Component Model. Journal of Econometrics, 48, pp. 385-393.

Baltagi, B.H. and P.X. Wu (1999). Unequally Spaced Panel Data Regressions with AR(1) Disturbances. Econometric Theory, 15, pp. 814-823.

Beaulieu, E. (2000). The Canada-U.S. Free Trade Agreement and Labour Market Adjustment in Canada. Canadian Journal of Economics, 33, pp. 540-563.

Bernard, A.B., J.B. Jensen, and P.K. Schott (2007). Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants. Journal of International Economics, 68, pp. 219-237.

Bhargava, A., L. Franzini, and W. Narendranathan (1982). Serial Correlation and the Fixed Effects Model. Review of Economic Studies, 49, pp. 533-549.

Borjas, G.J., R.B. Freeman, and L.F. Katz (1997). How Much Do Immigration and Trade Affect Labor Outcomes, Brookings Papers on Economic Activities.

Chiquiar, D. (2008). Globalization, Regional Wage Differentials and the Stolper-Samuelson Theorem: Evidence from Mexico. Journal of International Economics, 74, pp. 70-93.

Eaton, J. and S. Kortum (2002). Technology, Geography, and Trade. Econometrica, 70, pp. 1741-1779.

Helpman, E., M. J. Melitz, and S.R. Yeaple (2004). Exports Versus FDI with Heterogeneous Firms. American Economic Review, 94, pp. 300-316.

Hillberry, R. and D. Hummels (2008). Trade Responses to Geographic Frictions: A Decomposition Using Micro-Data. European Economic Review, 52, pp. 527-550.

Leichenko, R. and J. Silva (2004). International Trade, Employment and Earnings: Evidence from US Rural Counties. Regional Studies, 38, pp. 355-374.

McLaren, J. and S. Hakobyan (2010). Looking for Local Labor Market Effects of NAFTA. NBER Working Paper No. 16535.

Martincus, C.V. (2010). Spatial Effects of Trade Policy: Evidence from Brazil. Journal of Regional Science, 50, pp. 541-569.

Tschetter, J. (2010). Exports Support American Jobs. International Trade Research Report no. 1, U.S. Department of Commerce, International Trade Administration.

Technical Appendix

I use a simple model of the relationship between transportation sector employment and the value of international trade flows to derive the econometric specification. The model recognizes that transportation inputs may be used more intensively when shipping relatively valuable commodities. W_{st} is the price of each unit of transportation labor in state s in month t. The total cost of the labor input in the state and month is equal to $W_{st}L_{st}$. V_{st} is the value per unit of the transported commodity if it is not lost or damaged, and $p(L_{st})$ is the probability that the shipment is not lost or damaged. Equation (1) represents the expected profit on each commodity shipment.

(1) $$E[\pi_{st}] = p(L_{st})\, V_{st} - W_{st}L_{st}$$

I assume that the probability $p(L_{st})$ is increasing in the transportation labor input, L_{st}, but at a diminishing rate. Specifically, I assume that the probability has the functional form in Equation (2).

(2) $$p(L_{st}) = \beta\ ln(L_{st})$$

In this case, Equation (3) is the transportation labor demand that maximizes expected profits.

(3) $$L_{st} = \beta\, V_{st}/W_{st}$$

The linear relationship between employment levels and the value of shipments in Equation (3) holds for individual shipments and also for aggregates of these shipments. It holds when the shipments contain an assortment of commodities with different unit values, because the transportation labor input increases in proportion to the unit value of each commodity. The applicability of Equation (3) does not depend on the product composition of the shipments.

The total value of shipments is related to international trade flows and aggregate consumption by two accounting identities. Equation (4) states that the value of shipments through the U.S. transportation system is the sum of the value of U.S. exports from state s (X_{st}), U.S. imports into state s (M_{st}), and domestic shipments in the state (D_{st}).

(4) $$V_{st} = X_{st} + M_{st} + D_{st}$$

Equation (5) states that the value of total domestic consumption (C_{st}) is the sum of imports and domestic shipments.

(5) $$C_{st} = M_{st} + D_{st}$$

Equations (4) and (5) imply Equation (6).

(6) $$V_{st} = X_{st} + C_{st}$$

Imports do not enter the right-hand side of Equation (6) except as a component of total domestic consumption C_{st}.

Next, I extend the model to include the shipment of exports and imports across multiple states. I use the parameter γ to represent the share of the value of international trade through a state's ports that is also shipped through the states that are closely connected by interstate commodity flows (for example Oklahoma and Texas, are closely connected, as are Oregon and California). I estimate the magnitude of γ in the econometric analysis below. I expect that γ is significantly less than one but greater than zero.[2]

Together, Equations (3) and (6) imply that the transportation sector payroll in state s in month t depends on the value of exports from ports in state s and in connected states.

(7) $$W_{st}\, L_{st} = \alpha_t + \beta\, X_{st} + \beta\, \gamma\; X_{cc,st} + \delta_s + \varepsilon_{st}$$

The variable X_{st} represents the value of U.S. exports from ports in state s in month t. $X_{cc,st}$ represents the value of U.S. exports from ports in states that are closely connected to state s by interstate commodity flows. If the international trade flows through a state's ports are *not* shipped through multiple states, then $\gamma = 0$ in Equation (7). The variable ε_{st} is the error term of the model, which I discuss below.

Equation (7) is the first specification in the econometric analysis. The parameter α_t is a month fixed effect that absorbs any time-varying factors that are common across states, including

[2] Hillberry and Hummels (2008) uses micro-data from the Commodity Flow Survey to demonstrate that shipments within the United States usually travel only short distances.

the downward national trend in transportation sector employment as well as aggregate business cycle fluctuations.[3] The parameter δ_s is a state fixed effect that absorbs any state characteristics that are fixed over the seven-year period. For example, some states have a significantly larger transportation infrastructure, and this factor explains some of the large differences in the level of transportation employment across the states independent of the variation in international trade flows.

Finally, I consider the components of the error term ε_{st} to determine whether it is reasonable to assume in the econometric analysis that ε_{st} is independent of the value of the export flows. Based on Equations (3) and (6), the error term in Equation (7) includes C_{st}, the total domestic consumption in state s and any other states served by transportation workers in state s in month t. It may also include random measurement error in the payroll data. It is common in industry-level models of international trade to assume that the value of total domestic consumption for the industry as a whole is a constant share of aggregate expenditures in the country. Prominent examples of trade models that include this assumption include Eaton and Kortum (2002), Helpman, Melitz, and Yeaple (2004), and Bernard, Redding, and Schott (2007). Under this assumption, total domestic consumption (C_{st}) depends on aggregate expenditures in the United States but not on fluctuations in the relative price competitiveness of U.S. imports. In contrast, the value of U.S. exports (X_{st}) depends on aggregate expenditures in foreign markets, international shipping costs, and the relative price competitiveness of the countries. U.S. exports should not be correlated with total domestic consumption in the United States, except in an indirect way through economy-wide resource constraints.

In Equation (7), the value of U.S. imports does not affect transportation employment for a given level of total domestic consumption. However, this is not the case if the β coefficients on the import values are different than the coefficients on domestic shipments. To allow for this possibility, Equation (8) is a generalization of Equation (7) that allows for differences in the β coefficients for exports, imports, and domestic shipments.

[3] The month effects are a more flexible functional form than a linear trend.

(8) $$w_{st}\, L_{st} = \alpha_t + \beta_X\big(\, X_{st} + \gamma\ \ X_{cc,st}\big)$$

$$+\,(\beta_M - \beta_D)\big(\, M_{st} + \gamma\ \ M_{cc,st}\big) + \delta_s + \varepsilon_{st}$$

The variable M_{st} represents the value of U.S. imports through ports in states s in month t. $M_{cc,st}$ represents the value of U.S. imports through ports in states that are closely connected to state s by interstate commodity flows. The last term in Equation (8) is the error term, and it is again proportional to total domestic consumption, C_{st}. Equation (8) is identical to Equation (7) if $\beta_M = \beta_D$ and $\beta_X = \beta$.

I expect that imports will be positively correlated with total domestic consumption, since both are increasing in aggregate expenditures in the United States, and I expect that exports will not be correlated with total domestic consumption, for the reasons discussed above. If $\beta_M = \beta_D$ then estimates of the coefficients on the export values based on the specification in Equation (7) will provide an unbiased estimate of β_X. If $\beta_M < \beta_D$, then the estimates of the coefficients on exports in Equation (7) will provide a downward-biased estimate of β_X, since the error term will include omitted import terms as well as a term for total domestic consumption, and U.S. exports and imports are positively correlated in the monthly, state-level data. The advantage of the specification in Equation (8), which controls for the value of state and month import flows, is that it provides an unbiased estimate of β_X even when $\beta_M \neq \beta_D$.

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The Office of Competition and Economic Analysis (OCEA), a part of the International Trade Administration's Manufacturing and Services unit, provides industry and policy decision makers with information on the impacts of economic and regulatory policies on U.S. manufacturing and services industries. Its staff of specialists perform in-depth industry analysis on the effects of both domestic and foreign policy developments on U.S. business competitiveness. For more information, or to access other OCEA reports, visit *www.trade.gov/mas/ian*, or contact the office at (202) 482-5145.

The International Trade Administration's mission is to create prosperity by strengthening the competitiveness of U.S. industry, promoting trade and investment, and ensuring fair trade and compliance with trade laws and agreements.

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