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Exploring a US Immigrant–Intra-Industry Trade Link

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We extend two strands of literature: the determinants of intra-industry trade (IIT) and the effect of immigration on trade flows. Product-level (HS10) data for US trade with 62 nations spanning the years 1989–2001 are used to construct industry-level (HS6) IIT values. A positive relationship is reported between immigration and the level of aggregate IIT. Immigration also increases vertical IIT and horizontal IIT; however, coefficients are of greater magnitude for the latter measure. Examining variation across home countries, immigrants from lower income countries appear to exert a greater influence on IIT measures than do immigrants from higher income countries.
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JEL: F12; F14; F22

INTRODUCTION

A link between immigrants and trade flows has been documented for several nations; however, most researchers have used *ad hoc* approaches without departure from standard trade theory, implicitly assuming that trade arises due to differences in resource endowments. Immigrants are hypothesized to increase trade as connections to home country business and social networks decrease transaction costs. Additionally, immigrants may increase trade if they arrive possessing preferences for certain products and find neither the desired products, nor acceptable substitutes, available. Intra-industry trade (IIT) involves both final consumer goods and intermediate products and, as such, may increase through either a preference effect or a network effect. We examine this possibility and, in doing so, extend the IIT literature by considering immigration as a potential determinant. Simultaneously, the immigrant-trade literature is extended via investigation of a link between immigration and IIT.

As most IIT takes place between developed nations that have similar industrial structures and international migration frequently involves a lesser-developed home country and a developed host country, the "north–north" direction of IIT and the "south–north" direction of international migration may suggest that immigrants add little, if at all, to IIT. Many immigrants, however, maintain close ties to their home country. An NPR/Kaiser/Kennedy School [2004] poll finds that 41 percent of immigrants return to their home country at least every year or two; 37 percent regularly send money to their home country; and 30 percent want to move back to their home country someday. The maintenance of these ties underlies documented immigrant–trade links and, when considered in conjunction with potential information asymmetries or demand that is not sated, provides a rationale for immigrants to possibly influence IIT.

Gould [1994] first reports an immigrant–trade link for the US, positing that immigrants are more likely to add information related to consumer goods than to producer goods. Subsequent research has reported links between immigration and aggregate trade flows for several nations. For example, Wagner et al. [2002], Head and Ries [1998], and Helliwell [1997] each examine the Canadian immigrant–trade link. Blanes [2003], Piperakis et al. [2003], and Bryant et al. [2004] examine links for Spain, Greece, and New Zealand, respectively. A positive influence of immigrants on US state exports has also been established. Bandyopadhyay et al. [2006] provides a review of such studies. In all cases, aggregate trade flows have been used to identify immigrant–trade links.

Girma and Yu [2002], classifying trading partners based on current or past "commonwealth" status, find that immigrants from "non-commonwealth" countries are responsible for the UK immigrant–trade link. It is thought that such immigrants increase trade as their host countries are relatively dissimilar to the UK (increasing imports via the preference effect) and as a result of business and social connections (i.e. network effects) to their home countries. Examining Danish data, White [2006] reports that immigrant–trade links are of greater magnitude for trade with higher income countries and for trade in differentiated products. A similar result is reported for the US; however, immigrants from low-income countries drive the link [White 2007]. Thus, variation in immigrant–trade links also appears to exist across host countries, potentially due to cultural and/or institutional dissimilarity between host nations and immigrants' home countries.

We augment the model developed in Hummels and Levinsohn [1995] such that immigrant stocks are considered as a determinant of IIT. This follows directly from Blanes [2005], who, examining the influence of immigrants on aggregate Spanish IIT, reports that immigrants from OECD member nations increase both IIT in non-manufacturing and manufacturing goods while immigrants from non-OECD member nations increase only manufacturing goods IIT. Blanes and Martin-Montaner [2006], also using data for Spain, report variation across immigrant types in the immigrant–marginal IIT relationship. While limitations of the US data preclude analysis of immigrant characteristics, we are able to consider the effects that immigrants may have on the aggregate level of IIT and on both vertical (VIIT) and horizontal intra-industry trade (HIIT). We adopt the baseline model used in Blanes [2005]; however, as White [2007] finds that home country development level is an important determinant of US immigrant–trade links, we examine finer variation in immigrant–IIT links by including a vector of lesser-developed country (LDC) dummy variables [World Bank 2003] that are interacted with immigrant stock variables.[1]

The analysis indicates that immigration increases the level of IIT and that, considering potential variation in immigrant–IIT links across home country income classifications, immigrants from lower income countries appear to influence IIT, VIIT, and HIIT all to a greater degree than do immigrants from higher income countries. Examining VIIT and HIIT separately, HIIT is consistently more sensitive than is VIIT to changes in immigrant stocks. This finding is consistent across all home country income classifications. VIIT is characterized as trade in products at different stages of production, while HIIT implies trade in goods at similar stages of production. The greater proportional effect of immigrants on HIIT suggests that both preference effects and network effects may be acting to influence IIT. The paper proceeds as follows: The next section presents the theoretical intuition and estimation equation. The subsequent section discusses the data and variable construction, while the fourth section presents the findings. The final section concludes.

THEORETICAL INTUITION AND ECONOMETRIC SPECIFICATION

There are two direct channels through which immigrants are hypothesized to increase trade between their host and home countries. First, immigrants may arrive in the host country with preferences for home country products to find that the goods are unavailable or that acceptable substitutes do not exist. If so, then through a preference effect immigrants may increase host country imports from the home country. Second, immigrants may increase both host country imports from and exports to the host country if the immigrants arrive with business contacts or knowledge of political or social obligations required to conduct business in their home countries [Globerman 2001]. Such social and business network connections are thought to lower transaction costs by reducing lax contract enforcement, diminishing information asymmetries regarding trading opportunities, and deterring opportunistic behavior [Rauch 1999, 2001; Rauch and Trindade 2002; Rauch and Watson 2002].

While both the preference effect and the network effect may increase IIT, whether the relationship is positive or negative remains unclear. Preference effects that increase host country imports from the home country would increase IIT if the host country is a net-exporter of the product. If the host country is a net-importer of the product, however, an immigrant-induced increase in host country imports would decrease IIT. If networks increase both imports and exports, IIT will increase as long as the increase in imports and exports does not increase the absolute value of the trade balance relative to the volume of trade.[2] As a result, with respect to IIT, it is possible that preference and network effects offset, partially or in whole, the other or possibly that each effect reinforces the other.

Similar to IIT, immigrant connections to business or social networks may increase HIIT and VIIT from both the import and export sides. Further, immigrants' preferences for home country goods are expected to increase trade in differentiated products more so than trade in homogenous goods. If a host country good is sufficiently homogeneous, then the probability that the good is substitutable for a home country good is higher than if the two goods are relatively differentiated. As horizontally traded goods are more likely to be differentiated than vertically traded goods, it may be expected that immigrants' preferences affect the host country import portion of HIIT more so than the import portion of VIIT. Since both network effects and preference effects may increase imports and because network effects may vary across imports and exports, there are no clear means by which we can decompose the influence of immigrants on trade flows into preference effects and network effects. While this inhibits the extent of our analysis, we are able to estimate the combined influence of such effects on IIT.

As mentioned, we extend the work of Blanes [2005], who modifies the model developed in Hummels and Levinsohn [1995] to include the stock of immigrants as a determinant of IIT. Equation (1) presents the estimation equation.

$$\begin{aligned}(1)\qquad ln(IIT_{ijt}/(1-IIT_{ijt})) = {} & \alpha_0 + \beta_1 ln\,IMMIGRANTS_{ijt} + \beta_2(ln\,IMMIGRANTS_{ijt} \times LDC_j) \\ & + \beta_3 ln\,DISTANCE_{ij} + \beta_4 ln\,GDP_{jt} + \beta_5 ln\,KLDIF_{ijt} \\ & + \beta_6 FTA_{ijt} + \beta_7 LDC_j + \mathbf{\Omega}_t + \varepsilon_{ijt}\end{aligned}$$

The vector of dependent variables includes the three measures of IIT discussed earlier: IIT_{ijt}, $HIIT_{ijt}$, and $VIIT_{ijt}$. The subscripts i, j, and t denote country i (the US), country j (each home country), and time, respectively. Since the IIT measures range between zero and one, the use of IIT indexes as dependent variables produces inefficient coefficients [Balassa 1986]. We avoid this problem by adopting the approach of Blanes [2005], who applies a logarithmic transformation to the dependent variable series.[3] $IMMIGRANTS_{ijt}$ is the stock of immigrants from country j residing in the US. The vector LDC_j includes dummy variables classifying home nations as $UPPER\ MIDDLE\ INCOME_j$, $LOWER\ MIDDLE\ INCOME_j$, or $LOW\ INCOME_j$. $DISTANCE_{ij}$, calculated using the great circle method as miles between the capital city of country j and Washington DC, represents transport costs. GDP_{jt} is home country real gross domestic product, measured in 1995 US dollars [World Bank 2003]. $KLDIF_{ijt}$ represents variation in relative factor endowments across nations. FTA_{ijt} is a dummy variable equal to one if the home country is party to a trade agreement with the US and zero otherwise. $\mathbf{\Omega}_t$ is a vector of time dummies included to capture the effects of policy shifts that may influence either immigration or trade flows, while ε_{ijt} is an assumed i.i.d. error term.

DATA

Bilateral trade data for the US and 62 nations, at the 10-digit Harmonized Commodity Description and Coding System (HS10) level of detail, are from Feenstra et al. [2002]. The HS10 product-level data have been aggregated to the HS6 industry-level to generate measures of IIT between the US and each home country j. Specifically, $IIT_{ijt} = \left(\sum_{k=1}^{K}\left(X_{ijkt}+M_{ijkt}\right)-\sum_{k=1}^{K}\left|X_{ijkt}-M_{ijkt}\right|\right)/\sum_{k=1}^{K}\left(X_{ijkt}+M_{ijkt}\right)$, where k represents each HS6 industry [Grubel and Lloyd 1975]. VIIT and HIIT measures are derived analogously; however, we first classify HS6 industry observations as horizontal if $1-\alpha \leqslant (uv^x_{ijkt}/uv^m_{ijkt}) \leqslant 1+\alpha$ and vertical if $(uv^x_{ijkt}/uv^m_{ijkt}) < 1-\alpha$ or $(uv^x_{ijkt}/uv^m_{ijkt}) > 1+\alpha$, where uv^x_{ijkt} and uv^m_{ijkt} represent export and import unit values, respectively, for trade in industry k products between country i and country j [Greenaway et al. 1995]. Import and export unit values are given as

$$uv^x_{ijkt} = \sum_{n=1}^{N}\left(uv^x_{ijnt}\times\left(X_{ijnt}/\sum_{n=1}^{N}X_{ijnt}\right)\right) \text{ and } uv^m_{ijkt} = \sum_{n=1}^{N}\left(uv^m_{ijnt}\times\left(M_{ijnt}/\sum_{n=1}^{N}M_{ijnt}\right)\right)$$

where n represents HS10 products that aggregate to HS6 industry classifications. Effectively, the HS6 industry-level import and export unit values are import- and export-weighted averages of corresponding HS10 product-level unit values. Following Abd-el-Rahman [1991], Greenaway et al. [1995], and Aturupane et al. [1999], we initially set α equal to 0.15 and, as a robustness check, we increase α to 0.25.

Immigrant stock values from the 1980, 1990, and 2000 decennial censuses [US Census 1985; 2000; 2003] are used as benchmarks and are used in conjunction with immigrant inflow data [US INS 1996; 2003] to estimate immigrant population stocks for intra-census years.[4] Values for the years 1981–1989 are constructed as follows:

$$(2)\qquad IMMIGRANTS_{ijt} = IMMIGRANTS_{ij1980} + \sum_{1981}^{t} INFLOW_{ijt} + \delta_{j1990}$$

The final term in equation (2), δ_{j1990}, adjusts for return migration, immigrant deaths, and amnesties that occur between census years. δ_{j1990} is the immigrant stock of country j given by the 1990 census less the sum of immigrants from country j in 1980 and the corresponding inflow from 1981 to 1990 divided by 10. Equation (3) illustrates

$$(3)\ \delta_{j1990} = \left(IMMIGRANTS_{ij1990} - \left[IMMIGRANTS_{ij1980} + \sum_{t=1981}^{1990} INFLOW_{ijt} \right] \right) \Big/ 10$$

For the years 1991–1999, the immigrant stock variable is constructed similarly. Estimated 2001 immigrant stock values are constructed based on the adjustment factor derived when estimating 1991–1999 stocks.

$$(4)\qquad IMMIGRANTS_{ij2001} = \left(IMMIGRANTS_{ij2000} + INFLOW_{ij2001} \right) \left(1 + \left(\delta_{j2000} / IMMIGRANTS_{ij2000} \right) \right)$$

The final term in the above equation, the adjustment factor, is based on the difference between year 2000 raw and benchmark immigrant values. While the combination of estimated immigrant stocks for 1989, 1991–1999, and 2001 with benchmark values from 1990 and 2000 censuses produces a series of estimated annual immigrant stock values for each country over the years 1980–2001, lack of HS10 trade data prior to 1989 necessitates restricting examination of potential immigrant-IIT links to the years 1989–2001.

Since variation in factor endowments across nations would be expected to influence trade flows, the difference in the ratio of capital stock to labor force between the US and each respective home country, $KLDIF_{ijt}$, is included. Given as $ln|K_i/L_i{-}K_j/L_j|_t$, the measure is constructed as per Hummels and Levinsohn [1995]. Data from the Penn World Tables [Heston et al. 2002] are used to construct 1980 capital stock values, K_i and K_j, which are assumed to be equal to 250 percent of GDP. Capital stock values for subsequent years are estimated as the capital stock from the prior year plus investment [World Bank 2003] less depreciation. Depreciation is assumed to occur at a constant rate of 13.33 percent. L_i and Lj are measures of US and home country labor forces, respectively [World Bank 2003].

Table 1 presents descriptive statistics. While immigrant stocks from upper middle income countries are typically higher than the overall average, high- and low-income home countries have below-average mean immigrant stocks. Comparing across income classifications, the mean values for the IIT variable decrease as average income falls. This same pattern emerges with respect to HIIT and VIIT, regardless of whether α is equal to 0.15 or 0.25. As average income falls, the capital–labor differential between the home country and the US tends to rise.

ESTIMATION RESULTS

The results generated from the estimation of equation (1), exclusive of controlling for possible variation in the effects of immigrants on IIT across home countries, are presented in Panel A of Table 2. Lagrange Multiplier and Hausman tests indicate that a random effect specification is preferable to either pooled Ordinary Least Squares or a fixed-effects model. This is found regardless of the measure of IIT used. The estimation results for the random effects models are presented in Panel B. The double-logarithmic functional form of equation (1) permits interpretation of estimated coefficients as elasticities. The logarithmic transformation of the

Table 1 Descriptive statistics

Variable/sample	*All countries*	*High-income countries*	*Upper middle income countries*	*Lower middle income countries*	*Low-income countries*
$Immigrants_{ijt}$	303,396	214,867*	647,002**	271,185	196,357**
	(824,366)	(253,936)	(1,832,505)	(297,222)	(269,529)
Intra-industry $trade_{ijt}$	11.10	22.94**	7.65**	3.63**	3.18**
(Grubel–Lloyd Index)	(12.78)	(12.60)	(8.01)	(5.31)	(6.84)
Vertical Intra-Industry	9.87	20.67**	6.84**	3.06**	2.57**
$Trade_{ijt}$ ($\alpha=0.15$)	(11.52)	(10.95)	(7.50)	(4.95)	(6.27)
Horizontal intra-industry	26.02	32.76**	21.63*	20.60**	23.94
$Trade_{ijt}$ ($\alpha=0.15$)	(23.02)	(17.27)	(19.46)	(24.25)	(29.80)
Vertical intra-industry	9.09	19.38**	6.36**	2.45**	2.13**
$Trade_{ijt}$ ($\alpha=0.25$)	(10.65)	(10.17)	(7.11)	(6.18)	(4.47)
Horizontal intra-industry	26.17	31.18**	20.30**	24.32	25.00
$Trade_{ijt}$ ($\alpha=0.25$)	(22.20)	(15.76)	(17.10)	(25.77)	(28.42)
$Distance_{ij}$	7,896.77	7,994.79	7,303.65	7,251.07#	9,175.52**
(in miles)	(3,943.41)	(3,583.12)	(4,026.85)	(4,472.05)	(3,885.07)
GDP_{jt}	318,597	725,432**	156,733**	48,827**	103,285**
(millions of 1995 US$)	(755,753)	(1,142,060)	(197,505)	(53,587)	(219,828)
K/L $difference_{ijt}$	48,348	24,235**	53,543**	62,776**	67,356**
	(21,826)	(18,796)	(5,158)	(4,440)	(3,732)
Free trade $agreement_{ijt}$	0.0422	0.0909**	0.0559	0.00**	0.00**
	(0.2011)	(0.288)	(0.2306)	(0.00)	(0.00)
N	806	286	143	221	156

Standard deviations in parentheses. See text for explanation of a. "**", "*", and "#" indicate significance from the corresponding overall mean at the 1, 5, and 10 percent levels, respectively.

dependent variable series, however, dictates that the coefficients be interpreted as the percent change in the level of IIT relative to the level of inter-industry trade, given a marginal increase in the corresponding explanatory variable. Thus, an increase in the dependent variable indicates an increase in IIT as a share of total trade.

Focusing on the results presented in Panel B, we find that immigration is positively related to IIT. We also find that, while HIIT is affected proportionally more than VIIT, both HIIT and VIIT rise significantly in response to an increase in the immigrant stock variable. Assuming a 10 percent increase in the immigrant stock variable, IIT is estimated to rise (relative to inter-industry trade) by 2.6 percent. Similarly, the results presented in columns (b) and (d) indicate that a similar increase in the immigrant stock increases VIIT (relative to vertical inter-industry trade) by 2 percent (VIIT15) to 2.2 percent (VIIT25). The similarity between results when IIT and VIIT measures are used as the dependent variable follows from most US IIT being vertical. As mentioned, estimated immigrant effects are larger when HIIT measures are used as dependent variables. The results presented in columns (c) and (e) suggest that, given a hypothetical 10 percent increase in the immigrant stock, HIIT increases (relative to horizontal inter-industry trade) by 3.9 percent (HIIT15) to 4.5 percent (HIIT25). Coefficients on GDP variables are positive and significant. This appears to reflect the general "north–north" pattern of IIT. For all specifications, the coefficient on the $KLDIF_{ijt}$ variable is negative and significant. This is expected as IIT is more likely to occur between nations of similar industrial structures.

Table 2 Immigration and IIT, without considering heterogeneity in effects across home countries

Dep. Var.:	$ln(IIT_{ijt}/(1-IIT_{ijt}))$	$ln(VIIT15_{ijt}/(1-VIIT15_{ijt}))$	$ln(HIIT15_{ijt}/(1-HIIT15_{ijt}))$	$ln(VIIT25_{ijt}/(1-VIIT25_{ijt}))$	$ln(HIIT25_{ijt}/(1-HIIT25_{ijt}))$
	(a)	*(b)*	*(c)*	*(d)*	*(e)*
Panel A: Pooled regression					
ln Immigrants$_{ijt}$	0.1168*	0.1054#	0.6685**	0.085	0.5066**
	(0.0544)	(0.0561)	(0.112)	(0.0553)	(0.1087)
ln Distance$_{ij}$	−1.0611**	−0.9692**	−1.594**	−0.8919**	−1.2566**
	(0.126)	(0.1273)	(0.2532)	(0.1256)	(0.2195)
ln GDP$_{jt}$	0.6107**	0.6373**	0.6618**	0.6589**	0.4764**
	(0.0399)	(0.0395)	(0.0841)	(0.0382)	(0.0795)
ln K/L Dif$_{ijt}$	−0.7125**	−0.7208**	−0.8226**	−0.7103**	−0.6637**
	(0.0858)	(0.0887)	(0.1407)	(0.0875)	(0.1175)
FTA$_{ijt}$	0.1966	0.1011	0.2507**	0.0895	0.2077**
	(0.3312)	(0.3274)	(0.063)	(0.3192)	(0.0478)
Constant	4.1593*	5.6365**	−3.7007	6.835**	1.7424
	(1.6773)	(1.6955)	(2.9292)	(1.6556)	(2.7833)
N	806	806	806	806	806
Adjusted R^2	0.48	0.49	0.44	0.50	0.47
Panel B: Random effects model					
ln Immigrants$_{ijt}$	0.2603**	0.2174*	0.4489**	0.1945*	0.3863**
	(0.0929)	(0.0956)	(0.1264)	(0.0946)	(0.1068)
ln Distance$_{ij}$	−0.8935**	−0.8368*	−1.3683*	−0.7716*	−0.9106*
	(0.3396)	(0.3404)	(0.6332)	(0.3342)	(0.4555)
ln GDP$_{jt}$	0.5667**	0.6064**	0.6616**	0.6411**	0.3785*
	(0.1064)	(0.107)	(0.2088)	(0.1052)	(0.1875)
ln K/L Dif$_{ijt}$	−0.2381*	−0.2366*	−0.5395#	−0.2279*	−0.4898#
	(0.1099)	(0.1136)	(0.315)	(0.1125)	(0.2895)
FTA$_{ijt}$	−0.2326	−0.144	−1.9268	−0.0427	−1.7053
	(0.1929)	(0.471)	(1.2713)	(0.4666)	(1.1646)
Constant	−11.1955**	−12.4365**	−10.7514	−13.8044**	−7.3965
	(3.8856)	(3.9149)	(7.893)	(3.8504)	(7.1055)
N	806	806	806	806	806
Adjusted R^2	0.70	0.72	0.80	0.83	0.73
Breusch-Pagan LM test (FEM/REM *vs* CR)	178.65**	220.48**	297.77**	212.47**	390.12**
Hausman test (FEM *vs* REM)	23.05	23.57	3.96	20.81	0.63

Heteroskedastic-consistent robust standard errors in parentheses. Time dummies were included in each specification. Statistical significance is noted as follows: "**", "*", and "#" indicate significance from zero at the 1, 5, and 10 percent levels, respectively.
Time dummies were included in each specification. Statistical significance is noted as follows: "**", "*", and "#" indicate significance from zero at the 1, 5, and 10 percent levels, respectively.

Table 3 presents estimation results where dummy variables have been used to control for variation in immigrant–IIT links across home countries by average income. Inclusion of the dummy variables and associated interaction terms permits examination of potential variation in immigrant effects across development classifications. Coefficients on immigrant stock variables can be considered base

Table 3 Immigration and IIT, by world development indicators income classifications

Dep. Var.:	$ln(IIT_{ijt}/(1-IIT_{ijt}))$	$ln(VIIT15_{ijt}/(1-VIIT15_{ijt}))$	$ln(HIIT15_{ijt}/(1-HIIT15_{ijt}))$	$ln(VIIT25_{ijt}/(1-VIIT25_{ijt}))$	$ln(HIIT25_{ijt}/(1-HIIT25_{ijt}))$
	(a)	*(b)*	*(c)*	*(d)*	*(e)*
Random effects model					
ln Immigrants$_{ijt}$	0.043#	0.0383#	0.0847*	0.0309	0.0776#
	(0.0225)	(0.0203)	(0.0419)	(0.0218)	(0.0415)
Upper middle income$_j$ × *ln* Immigrants$_{ijt}$	0.0959#	0.1483#	0.1119*	0.1345#	0.1041*
	(0.0533)	(0.0796)	(0.0522)	(0.0756)	(0.0499)
Lower middle income$_j$ × *ln* Immigrants$_{ijt}$	0.0867#	0.1548*	0.1815*	0.0997	0.1748*
	(0.0525)	(0.0633)	(0.0783)	(0.0677)	(0.0852)
Low income$_j$ × *ln* Immigrants$_{ijt}$	0.166**	0.1885*	0.2624**	0.1514#	0.2454**
	(0.0602)	(0.0797)	(0.0902)	(0.0784)	(0.0889)
ln Distance$_{ij}$	−0.7541*	−0.6802*	−0.9768#	−0.627*	−0.9589#
	(0.3077)	(0.3096)	(0.5653)	(0.3035)	(0.5427)
ln GDP$_{jt}$	0.0409**	0.0903**	0.0742**	0.1342**	0.3487**
	(0.0127)	(0.0129)	(0.0248)	(0.0142)	(0.0269)
ln K/L Dif$_{ijt}$	−0.0723	−0.0649	−0.1194*	−0.0587	−0.0524#
	(0.1108)	(0.1153)	(0.0526)	(0.1144)	(0.0309)
FTA$_{ijt}$	0.1516*	0.0972*	0.3362*	0.0307*	0.2459
	(0.0684)	(0.0486)	(0.1615)	(0.0125)	(0.158)
Upper middle income$_j$	−2.8746	3.0032	−3.1847	−2.7898	−0.843
	(2.7531)	(2.8199)	(6.109)	(2.7816)	(5.8411)
Lower middle income$_j$	−10.7318**	−10.3936**	−15.8041*	−9.7951**	−7.6677
	(2.8511)	(2.9147)	(6.1942)	(2.8732)	(5.9247)
Low income$_j$	−13.9102**	−12.2576**	−36.3064**	−11.7445**	−31.9713**
	(2.4307)	(2.4932)	(5.5096)	(2.4606)	(5.2645)
Constant	0.1705	−1.9956	7.8607	−3.6838	8.002
	(3.7828)	(3.82)	(7.3789)	(3.7496)	(7.0666)
N	806	806	806	806	806
Adjusted R^2	0.7166	0.7182	0.7855	0.7281	0.8879
Breusch–Pagan LM test (FEM/REM *vs* CR)	484.08**	529.32**	571.81**	530.05**	708.92**
Hausman test (FEM *vs* REM)	6.16	7.19	10.34	5.42	18.13

See Table 2, Panel B.

Proportional immigrant effects

	$ln(IIT_{ijt}/(1-IIT_{ijt}))$	$ln(VIIT15_{ijt}/(1-VIIT15_{ijt}))$	$ln(HIIT15_{ijt}/(1-HIIT15_{ijt}))$	$ln(VIIT25_{ijt}/(1-VIIT25_{ijt}))$	$ln(HIIT25_{ijt}/(1-HIIT25_{ijt}))$
High-income home countries	0.043#	0.0383#	0.0847*	0.0309	0.0776#
	(0.0225)	(0.0203)	(0.0419)	(0.0218)	(0.0415)
Upper middle income home countries	0.1389	0.1866#	0.1966#	0.1654	0.1817#
	(0.1101)	(0.1026)	(0.1175)	(0.1144)	(0.1023)
Lower middle income home countries	0.1297#	0.1931*	0.2662**	0.1306	0.2524**
	(0.0693)	(0.0978)	(0.0759)	(0.0877)	(0.0757)
Low-income home countries	0.209#	0.2268*	0.3471**	0.1817#	0.323#
	(0.1259)	(0.1078)	(0.1342)	(0.1014)	(0.1852)

Standard errors presented in parentheses. *T*-statistics used to test for statistical significance of interaction effects are derived as

$$t = (\hat{\beta}_A + \hat{\beta}_B)/\sqrt{VAR(\hat{\beta}_A) + VAR(\hat{\beta}_B) + 2COVAR(\hat{\beta}_A, \hat{\beta}_B)}$$

where $\hat{\beta}_A = \hat{\beta}_{IMMIGRANT}$ and $\hat{\beta}_B = \hat{\beta}_{INTERACTION}$.

effects that apply to US IIT with all home countries, while coefficients on interaction terms represent a deviation from observed base effects. For example, in column (e), the coefficients reported on the immigrant stock variable and the variable that interacts with the lower middle income dummy and the immigrant stock variable are equal to 0.0776 and 0.2454, respectively. The base effect, 0.0776, represents the proportional influence immigrants from high-income countries have on HIIT25. Summation of the base effect and the deviation from the base effect yields the effect of immigrants from low-income countries (equal to 0.323) on HIIT25.

Testing for significance of the associated immigrant effect requires comparing 0.323 to the corresponding standard error.[5] The resulting *t*-statistic is 1.74, indicating that the effect on HIIT25 with low-income countries is statistically significantly at the 10 percent level. Proportional immigrant effects are presented below the estimation results in Table 3. The corresponding proportional effects of immigrants from upper middle and lower middle income countries on HIIT25 are equal to 0.182 and 0.252, respectively.

Across classifications, proportional immigrant effects are of the greatest magnitude for immigrants from low-income countries and the weakest for immigrants from high-income countries. In response to an assumed 10 percent increase in the immigrant stock variable, the ratio of US-low income home country IIT to inter-industry trade increases by approximately 2.1 percent. An identical increase in immigrants from high-income countries increases the ratio by only 0.43 percent. A similar pattern emerges across home country income classifications when comparing across measures of VIIT and HIIT. Striking differences are reported, however, with respect to the proportional immigrant effects on HIIT and VIIT. An assumed 10 percent increase in the immigrant stock leads to proportional immigrant effects that are of a greater magnitude for HIIT, regardless of home country income classification.

In Table 2, coefficients on the $KLDIF_{ijt}$ variable are negative and significant; however, in Table 3 this significance is generally lacking. This is intuitive as the LDC_j dummy variables in Table 3 serve as proxies for variation in industrial structures between home countries and the US. Coefficients on the FTA_{ijt} dummy variables are positive and generally significant, as expected. Similarly, coefficients on the GDP_{jt} variables are positive and significant in both tables. This is indicative of a tendency for larger economies to engage in more IIT (VIIT, HIIT, and IIT) with the US relative to smaller economies. That the coefficients diminish in magnitude and yet remain significant even when income classification dummy variables are included in the specification is indicative of the strength of the "north–north" IIT relationship.

CONCLUSION

The analysis presented here extends the IIT literature such that immigrant stocks are identified as a determinant of US IIT. The immigrant–trade literature is extended as a positive US immigrant–IIT link is first reported here. In addition to examining a possible link between immigrants and IIT, the relationships between immigration and both HIIT and VIIT are also considered. Using World Bank income classifications, we find considerable variation in the influence of immigrants on IIT across home countries classified by relative level of development. We find positive links between immigration and our measures of IIT across all home country income classifications. Immigrants from low and lower middle income countries, generally speaking, however, drive the immigrant–IIT link. Assumed 10 percent increases in immigrant stock levels generate increases in IIT relative to inter-industry trade ranging from 0.43 percent (for immigrants from high-income countries) to 2.1 percent (for immigrants from low-income countries). Similarly, the effect of a similar increase in the immigrant stock variable is estimated to increase the VIIT share by as much as 2.3 percent and to increase the HIIT share by as much as 3.5 percent

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Notes

1. Countries are classified as low income if 1995 Gross National Income per capita (GNIC) is less than \$785; lower middle income if \$785 < GNIC < \$3,035; upper middle income if \$3,035 < GNIC < \$9,385; and high income if GNIC > \$9,385. A listing of countries in the data set, classified by average income, is provided in the appendix.
2. Hamilton and Kniest [1991], Brulhart [1994], and Blanes and Martin-Montaner [2006] each provide a discussion of the relationship between the trade balance and marginal IIT.
3. The HS6 intra-industry trade value is equal to zero in 5.26 percent of all cases. For these observations, the IIT measure was set equal to 0.0001 before applying the logarithmic transformation.
4. Immigrant stock values are estimated using documented immigrant inflows and decennial census of population counts. Immigrants who entered the US illegally are not included in the inflow data. Additionally, such immigrants may not be included in census counts. The resulting implication for this study is that any understatement of immigrant stocks may bias upwards the estimated coefficients on immigrant stock variables.
5. Immigrant effects for home country income classifications other than the null classification (high-income countries) are equal to the sum of base and interaction effects. Testing for statistical significance requires consideration of the variance of each estimated coefficient and their covariance. The relevant test statistic is given as

$$t = (\hat{\beta}_A + \hat{\beta}_B)/\sqrt{VAR(\hat{\beta}_A) + VAR(\hat{\beta}_B) + 2COVAR(\hat{\beta}_A, \hat{\beta}_B)}$$

where $\hat{\beta}_A = \hat{\beta}_{IMMIGRANT}$ and $\hat{\beta}_B = \hat{\beta}_{INTERACTION}$.

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Appendix

COUNTRY LISTING/DEVELOPMENT CLASSIFICATIONS

High-income countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Republic of Korea, Singapore, Spain, Sweden, Switzerland, United Kingdom.

Upper middle income countries: Argentina, Brazil, Chile, Costa Rica, Hungary, Malaysia, Mexico, South Africa, Trinidad and Tobago, Uruguay, Venezuela.

Lower middle income countries: Bolivia, Colombia, Dominican Republic, Ecuador, Egypt, El Salvador, Guatemala, Indonesia, Iran, Jamaica, Jordan, Morocco, Panama, Peru, Philippines, Syrian Arab Republic, Thailand.

Low-income countries: Bangladesh, China, Ghana, Haiti, Honduras, India, Kenya, Nigeria, Pakistan, Senegal, Sierra Leone, Sri Lanka.