An Investigation of U.S. States High-Tech, Low-Tech, and Total Manufacturing Export Performance in the Asian Market

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ABSTRACT. Asia is the most populous continent and has fast become one of the richest and fastest growing continents. It is thus a vital market that is likely to become even more important in the future. Using panel data of three different types of manufacturing exports including high-tech, low-tech, and total exports, this study estimates the export performance of the 48 contiguous U.S. states in the Asian export market, represented by 24 Asian countries. The study also seeks to investigate what determines whether a state under or over performs in each of the manufacturing export categories to the Asian market. Our results indicate that a state's business vitality, manufacturing union density, legal system, pollution abatement cost, employment density, and regional location significantly impact whether the state will under or over perform its potential for all the three types of exports in the Asian market. Our results also indicate that some of the variables noted above have different impacts on the state's high-tech and low-tech export performances. Further, our results show that there are regional differences in the impact of the growth of Chinese exports on U.S. state exports to the Asian region. (F10, R11)

I. Introduction

Between 1997 and 2000 total U.S. exports and total manufacturing exports as a percent of gross domestic product (GDP) trended downward. As shown in Figure 1, this downward trend was reversed after 2003. As for the three types of exports: high tech, low tech and total exports, whereas low-tech manufacturing exports as a percent of U.S. GDP has stayed fairly stable between 1997 and 2005, high-tech US exports as a percentage of U.S. GDP experienced significant volatility, which is the main driving force behind the observed volatility in U.S. total manufacturing exports as a percentage of U.S. GDP. Due to the differences in location and resources, the behavior of state level exports has differed over this same period. While some states like Hawaii,

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Montana, Nevada, Idaho, and Mississippi have experienced an increase in their share of U.S. exports, others have observed a decline in their share of U.S. goods exports.

FIGURE 1. THE U.S. EXPORTS AS A % OF REAL U.S. GDP

Further separate cursory analysis of state manufacturing exports trends for high-tech and low-tech exports show that several states experience differences in growth rates for high-tech versus low-tech manufacturing exports. For example for the period under consideration the state that experienced the most high-tech manufacturing export growth is Alabama with a growth of 253%, whereas Virginia experienced the highest average low-tech manufacturing export growth of 556%. Figure 2 indicates that the states with very high growth in both high and low-tech exports, which we will call "Growth Leaders", includes New Hampshire, Ohio, South Carolina, Texas and Wisconsin, whereas states including Connecticut, Colorado, Indiana, Illinois and Mississippi experienced the lowest growth in shares in both high and low tech exports. To paint a bigger picture for U.S. export performance, it is therefore imperative to also analyze export performance at the state level.

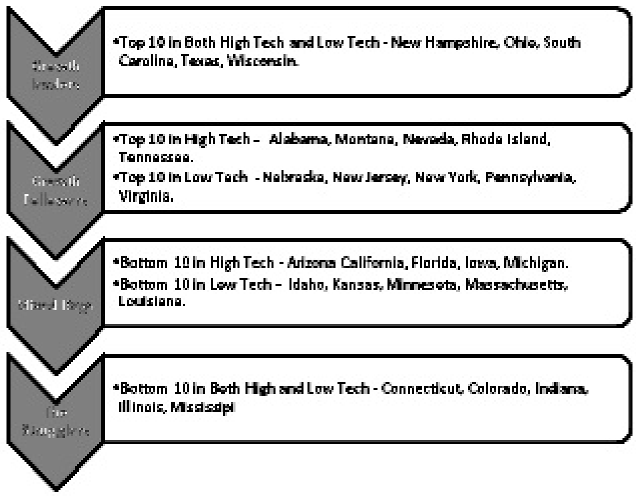

Figure 2. Top 10 And Bottom 10 U.S. Export Share By State

According to the Heckscher-Ohlin (H-O) model a country will export goods that use its abundant factors intensively, and import goods that use its scarce factors intensively. When applied to the case of U.S. states, the H-O model predicts that since states do not have the same factors of production, each state will export goods that use its abundant factors intensively. Therefore, any analysis of state exports without disaggregating the exports somewhat may be missing the big picture.

With this in mind, the goal of this study is twofold. This paper begins by estimating the high technology, low technology, and total exports performances of U.S. states in the Asian region. Second, we seek to explain why some states perform beyond their estimated ability, whereas others underperform in this region. We focus on U.S. exports to the Asian region because the region boast of being host to 60% of the world population, has the second largest nominal GDP of all continents, and has experienced an average GDP growth of 6.64% over the past decade, making it the fastest growing region of the world. Although this growth has not occurred at the same pace all over the continent, the growth of the countries within this region present both opportunities and threats to U.S. exporters. With the growth of the Asian economies have come increases in their exports to the U.S. and other markets around the world, thus, serving as competition for U.S. made goods. On the other hand, the spectacular economic growth of the most populous area of the world presents opportunities for U.S. exporters, with the growth come increases in consumption of all goods including U.S. made goods, especially in the area of high technologically embodied goods because theoretically Asian countries will be self sufficient in low technologically embodied goods since they generally have an abundance of unskilled labor. Table 1 lists the 24 Asian countries included in this study.

TABLE 1–List of Countries used for this Study

	Total Exports		High Tech Exports		Low Tech Exports	
List of Countries in the Sample	Top 10 countries with most zeros	# of Zeros	Top 10 countries with most zeros	# of Zeros	Top 10 countries with most zeros	# of Zeros
Afghanistan	x	118	x	133	x	179
Bangladesh	x	22	x	27	x	75
Bhutan	x	238	x	268	x	290
Brunei	x	63	x	74	x	116
Burma (Myanmar)	x	132	x	157	x	205
Cambodia	x	110	x	139	x	171
China (Mainland)						
China (Taiwan)						
Hong Kong						
India						
Indonesia						
Japan						
Republic of Korea						
Laos	x	202	x	229	x	264
Macao	x	56	x	84	x	105
Malaysia						
Mongolia	x	107	x	129	x	197
Nepal	x	85	x	104	x	168
Pakistan						
Philippines						
Singapore						
Sri Lanka						
Thailand						

Most countries are comprised of different regions, and the different regions are endowed with different types of resources. Thus, comparative advantage may differ from one region of a country to the other. This difference in comparative advantage for different regions of a country is even much more pronounced for larger and more spread out countries like the U.S. For example, the lack of reliable state level trade data has led to previous studies on U.S. export performance being more focused on national and also aggregate goods exports, with only a few studies analyzing the export performance at sub-national levels. Over the past decade only a handful of studies spearheaded by a group of researchers from the Federal Reserve Bank of St. Louis, led by Cletus Coughlin, have investigated state level export performance.

Previous studies investigating U.S. sub-national level exports can be mainly aggregated into two tracts. First, studies that investigate internal determinants of state exports, and states that incorporate external determinants like economic conditions of export partners, and trade agreements amongst others. The studies that investigate internal determinants of exports include Coughlin and Fabel's (1988) analysis of the impact of factor endowments on U.S. state manufacturing exports. They find that physical and human capital are the main sources of U.S. comparative advantage. Using shift-share analysis to investigate the difference between a state's manufacturing export growth and national manufacturing export growth between 1988 and 1998, Coughlin and Pollard (2001) find that the competitive effect, which in previous research was related to increases in human capital per worker, is the key determinant of a state's relative export performance. Furthermore, the industry mix and destination effects, which are of similar importance, are generally dominated by the competitive effect in accounting for a state's relative export performance.

The sub national studies that focus on external determinants of U.S. state exports includes Coughlin and Pollard (2000) who attempt to estimate the size of the impact of the Asian Crisis on state manufactured exports to East Asia during 1998. They find that because western states tend to be more dependent on East Asian markets for export sales, they were hit the hardest by the sharp reduction in Asian demand for U.S. produced manufacturing goods. On the other hand, Coughlin (2004), using data on U.S. state exports finds that generally the geographic distribution of state exports has changed so that trade has become more intense with nearby countries relative to distant countries. He also finds that all states, however, did not experience similar changes. Specifically, he finds that whereas 40 states experienced a declining distance of trade, 10 other states experienced an increasing distance of trade. The results point to declining transportation costs over land, the implementation of the North American Free Trade Agreement, and faster income growth by nearby trading partners relative to distant partners as the major cause of these changes. Leichenko and Coulson (1999) examine Granger causality between foreign manufacturing export growth and state manufacturing performance during the period from 1980 to 1991. Their results indicate that, at the aggregate level, there is a bi-directional Granger causal relationship between foreign exports and state manufacturing activity. Among the individual industrial sectors, their results are more mixed, however, with sectors displaying either export-led growth, reverse Granger causality, or in some instances, negative Granger causality.

None of the previous sub national studies have attempted to disaggregate state exports into high-tech and low-tech exports to investigate the possible differences in export performance. Further, apart from the study by Coughlin and Pollard (2000), which tested specifically for the impact of the Asian crisis on state manufacturing exports to East Asia, to our knowledge no other inquiry has been done to investigate U.S. states export performance in the Asian market. Our study contributes to the literature by estimating states' potential high-tech, low-tech, and total manufacturing export shares in the Asian market and comparing it to their actual export shares. We also offer explanations to why some states perform better or worse than their potential shares of these three types of manufacturing exports in the Asian market.

The rest of this study is organized as follows: section II presents the empirical methodology and data employed by this study, section III presents the results, and section V concludes.

II. Empirical Model and Data

A. ESTIMATION MODELS

The Gravity Model. - In the literature on international trade, the gravity model developed by Tinbergen (1962), Pöyhönen (1963), and Linnemann (1966) has been widely used and achieved empirical success in explaining various types of trade between economic entities. In the gravity model, the volume of trade is assumed to be an increasing function of the national income and population of the trading partners and a decreasing function of the distance between them. It is a general equilibrium model with log linear relationship.

As argued in Chen and Wall (2005), there may be some unobserved factors that are correlated with the gravity variables and affect the level of trade. Without controlling for such heterogeneity, the gravity model will suffer from estimation bias (see Egger 2002, Coughlin and Wall 2003, and Ruiz and Vilarrubia 2007). To deal with this possible heterogeneity we follow Coughlin and Wall (2003), and Chen and Wall (2005) by using a state-country fixed effects gravity model. This also avoids the problem of choosing the appropriate measure of distance, which has been an issue in the literature (see Head and Mayer, 2001). Autocorrelation is also potentially important. Buyer-seller relationships are often locked in over long periods of time by contracts and changes can entail significant costs. Exports are also subject to persistence in government policies and other institutional factors. For these reasons, the level of exports from state *i* to country *j* in a given year is likely to depend on the level in the previous years.

To allow for the presence of correlation between unobserved state-country-pair heterogeneity and the regressors, we adopt the following dynamic fixed effects gravity equation:

$$\ln(1+x_{ijt}^{k}) = a_{ij}^{k} + a_{t}^{k}t + \beta_{1}^{k}\ln(1+x_{ijt-1}^{k}) + \beta_{2}^{k}\ln(1+x_{ijt-2}^{k}) + \beta_{3}^{k}\ln Y_{it} + \beta_{4}^{k}\ln Y_{jt} + \beta_{5}^{k}\ln N_{it} + \beta_{6}^{k}\ln N_{jt} + \varepsilon_{ijt}^{k} \quad (1)$$

where x_{ijt}^{k} is real exports of type k (high-tech, low-tech or total exports) from state *i* to country *j* in year *t*, a_{ij}^{k} is the "state-country pair" heterogeneity between the trading partners including the effects of all time-invariant variables such as distance, contiguity, language, and other immeasurable factors; a_{t}^{k} is a time-effect, t=2000,…,2005 Y_{it} is the real GSP of state *i* in year *t*, Y_{jt} is the real GDP of country *j* in year *t*, N_{it} is the population of state *i* in year *t*, N_{jt} is the population of country *j* in year *t*, and ε_{ijt} is the random error term. Equation (1) is estimated by the instrumental variable estimator for dynamic panel data models proposed by Arellano and Bover (1995) and Blundell and Bond (1998).

Because some observations of state exports are zero, we follow Eichengreen and Irwin (1998) and Coughlin and Wall (2003) and specify the dependent variable as the natural log of one plus exports. Scaled estimates are then computed by dividing the estimates by the proportion of non-zero observations, which are 0.781 for high-tech, 0.694 for low-tech, and 0.812 for total exports in our study (see Greene p.768, 2003).

Computation of Trade Potential and Probit Models.- Following Ruiz and Vilarrubia (2007) we define trade potential of exports of type *k* to be the difference between the actual export share of state *i* to country *j* and the predicted export share of state *i* for export type of *k*.

$$S_{ijt}^{pk} = \frac{x_{ijt}^{k}}{\sum_{i=1}^{50} x_{ijt}^{k}} - \frac{\hat{x}_{ijt}^{k}}{\sum_{i=1}^{50} \hat{x}_{ijt}^{k}} \tag{2}$$

where x_{ijt}^{k} is the observed exports from state *i* to country *j* of type *k* and $\hat{x}_{ijt}^{k} = e^{\ln(1+x_{ijt}^{k})} - 1$ is predicted exports of type *k* generated by the gravity equation. The export share of each state to each destination country reveals the relative export performance of different states to the same country. This can help identify state-specific but time-variant factors that may affect the exports performance together with the covariates in the gravity model.

As pointed out by De Benedictis and Vicarelli (2005), if the gravity model used to generate the predictions is misspecified, then the out-of-sample approach could still produce biased predictions and does not offer any clear advantage over in-sample predictions. For this reason, we adopt the in-sample approach to calculate the trade potential index (2) using the estimated coefficients of the gravity equation (1).

To investigate determinants of performance of high-tech, low-tech and total exports respectively, three binary response models were specified for the sign of S_{ijt}^{pk}: $S_{ijt}^{pk} > 0$ (export performance of state *i* to country *j* is better than predicted for type *k*) and $S_{ijt}^{pk} < 0$ (export performance is worse than predicted). The model assumes:

$$S_{ijt}^{pk} = \lambda_{ij}^{k} + z_{ijt}^{k}\gamma + \eta_{ijt}^{k} \tag{3}$$

where λ_{ij}^{k} is a "state-country pair" heterogeneity term, z_{ijt}^{k} is a vector of explanatory variables that includes state specific ones such as the state's Business Vitality Index (*BVIT*), and the levels of unionization (*UDEN*), corporate tax rate (*BTAX*), commercial liability index (*LIAB*), employment density (*EDEN*), and pollution abatement capital expenditures (*POLEXP*); also included are total Chinese exports, four regional dummies, and interaction terms for Chinese exports and the regional dummies. Estimates of the coefficients of these variables can help identify state policies that significantly affect the state's export performance, with implications for those states seeking to improve their export performance in the future.

We assume that the error terms η_{ijt}^{k} are independent and identically distributed. The possible logit and probit specifications for λ_{ij}^{k} are "pooled" $(\lambda_{ij}^{k} = 0)$, "random effects" (uncorrelated λ_{ij}^{k} and z_{ijt}^{k}), and "fixed effects" (possibly correlated λ_{ij}^{k} and z_{ijt}^{k})). As is well known, fixed effects is the least restrictive but is considerably more difficult to handle for probit and logit than for the standard linear panel-data model. The probit fixed effects estimator is inconsistent, while logit fixed effects is a conditional maximum likelihood estimator that drops all observations for which the binary response does not change over time. Logit fixed effects is not suitable for our particular application, however, since it would entail dropping about 5000 observations. For this reason, estimation of (3) was confined to pooled and random effects probit models.

B. DATA

Our panel data consist of exports for 48 U.S. contiguous states to 24 Asian countries and explanatory variables over the period 1997-2005. Descriptions and sources of the variables are listed in Table 2.

TABLE 2–Data Definitions, Descriptive Statistics and Sources of Data

Variables	Description	Mean	Std. Dev	Min	Max	Source
Total Exports	Manufacturing exports value from each state to each Asian country (US$)	107761352	347354180	0	6410480734	World Institute for Strategic Economic Research
High-tech	High-tech exports (US$)	74235239.2	269007281	0	6379347798	World Institute for Strategic Economic Research
Low-tech	Low-tech exports (US$)	33526113	161663786	0	4130751639	World Institute for Strategic Economic Research
Country GDP	Domestic Product (Constant 2000 Million US $)	347402.44	844583.219	550	4205410	World Development Indicators
Country Population	Country Population	141481364	310364875	310525	1291001804	World Development Indicators
State GDP	Real GDP by state (Millions of chained 2000 US $)	232450.55	266933.851	18084	1622000	US Bureau of Economic Analysis
State Population	State Population	5845484.1	6239398.81	479602	35629666	US Census Bureau
Trade Performance	Equals 1 if the state in question has a better export performance than predicted by the model, and zero	0.7624	0.4256	0	1	Created with predicted exports from first stage and actual export data
BVIT	Business vitality index from the (Higher index denote better business vitality)	4.1143	1.4536	1	6	CFED Development Report Card

Variables	Description	Mean	Std. Dev	Min	Max	Source
UDEN	Private Manufacturing Union Membership as % of Total Manufacturing Employment	13.3563	5.5873	3.3	27.7	Unionstats.com
LIAB	State Liability Systems Index Score (Higher numbers denote better system)	57.156	9.0691	24.8	78.6	Institute of Legal Reform
BTAX	State Corporate Income Tax Rates	6.7378	4.0319	0	59.4	Tax Foundation
POLEXP	Pollution Abatement Capital Expenditures (Millions US$) 1999 data	218.95	221.07	5	947.9	US Census Bureau
EDEN	State Seasonally Adjusted Employment Levels (Thousands) Per Square Mile Land Area	88.05	125.04	0.49	823.98	US Bureau of Labor Statistics

Export Variable. - The export data are from the annual Wiser Trade Origin of Movement (OM) export dataset, the most frequently used state-level export data series. The OM series allocates exports to a state on the basis of state of transportation origin. The reliability of this series is considered to be good for manufactured exports. However, it has been criticized for overstating exports of bulk commodities, such as grain, from states with large ports. Alternatively we could have employed the Exporter Location (EL) series, which allocates exports to states on the basis of the point of sale. However, the EL series do not offer any clear advantage over the OM series because while the EL series is reliable for indicating market activity concentration, the series does little to indicate the place of manufacturing.

For this study only manufacturing exports are considered. Agricultural exports are excluded to deal with the inherent bias of the Origin of Movement state export data, which allocate most of the agricultural exports to states with large seaports even when there is no significant documented agriculture production in those states.

Using the North American Industry Classification System (NAICS), we disaggregated total manufacturing exports into high-tech and low-tech manufacturing exports. To break down the industries, we adopted the revised 2007 version of high-technology industry NAICS codes converted by The U.S. Department of Commerce and Office of Technology Policy from the list of high technology SIC codes, which was identified by The Bureau of Labor Statistics (BLS) in 1999 based on measures of industry employment in both R&D and technology-oriented occupations. The high-tech industries include petroleum refineries, electronic goods and equipment, industrial machinery manufacturing, etc. The remaining exports are classified as low-tech exports. Some of the significant industries classified as low-tech are furniture and fixtures, leather and leather products, plastics and rubber, and the apparel and other textile industries.

Independent Variables for Gravity Model. - The gross state product (GSP) of state i, the gross domestic product (GDP) of country j, and their respective populations are used in gravity equation to indicate the mass or the size of the two entities involved in trade.

New economic geography (NEG) models which allow for monopolistic competition, increasing returns to scale and transport costs, suggest the existence of "local market effect," which may lead to economies of scale. This means that larger economies will experience cost reductions and, thereby, obtain a comparative advantage resulting in higher exports. Following Krugman (1991b) we hypothesize that the size of the market will have much more impact on industries with high economies of scale and also labor intensive manufacturing industries such as the low-tech ones. For the exports from capital intensive and low economies of scale industries such as the high-tech ones coefficient estimates for state GDP and population may be negative or insignificant.

Dhar and Panagariya (1994) show the possibility for a state's GDP growth to have a negative effect on trade. If foreign demand for the state's exports is sufficiently low, an increase in output may lead to a decline in market prices of export goods causing a reduction in the trade value even with rising quantity of exports.

In gravity models the impact of the population of exporting state and importing country can be negative or positive. Large economy may promote division of labor and large economies of scale in production which will lead to a comparative advantage and increased exports. On the other hand, however, a large domestic economy may have a large domestic market, which leads to higher level of self-sufficiency and less trade (see Martinez-Zarzoso and Nowak-Lehmann (2003)).

The country level GDP and population data are from the World Development Indicators. The data on gross state product (GSP) and population are obtained from the Bureau of Economic Analysis (BEA) and the Census bureau respectively. We use 6 dummies for the years from 2000 to 2005 to capture the time trend in exports.

Independent Variables for Probit Model - Many studies have shown that the business and political environment of an economy has a significant effect on its growth. Helliwell (1994) finds that democracy and personal freedoms have a positive effect on production and growth. It is assumed that export performance is also affected positively by a favorable business environment. For this study we proxy business environment with state's business vitality index procured from the CFED Development Report Card. This index grades the climate for business in states, including establishment of new businesses, industrial diversity and business closings. Higher index for a state indicates better business vitality. We hypothesize that better business vitality leads to higher productivity and overall performance by firms based in that state. Further, higher business vitality, which signifies a good business environment may attract higher quality companies to states, leading to even further productivity gains and, consequently, competitive advantage in export markets.

Other control variables include the level of unionization of a state (*UDEN*), the corporate taxation rate as a percentage of their profit (BTAX), levels of commercial liability (*LIAB*), and pollution abatement capital expenditures(*POLEXP*) as a proxy for cost of pollution clean up by state. We also include Employment density (*EDEN*), which measured as employment per square mile.

Over the past three decades several economic analyses indicate that labor unions negatively impact the ability of American companies to compete in the global market place. The main argument is that unions causes compensation to rise faster than productivity, thus cutting into firm profits and eroding firms ability to be price competitive (see Griswold (2010), Hirsch (2008a) and Lee and Mas (2009)). In spite of this evidence, other studies including Bennett and Kaufman (2008) and Doucouloagos and Laroche (2004) argue that unions are associated with higher productivity, lower employee turnover, improved workplace communication, and a better-trained workforce, thus reducing costs and improving the competitiveness of unionized firms in the global market place. In view of the inconclusiveness of the results from previous studies we cannot a priori determine the impact of unions on state export performance.

The results of empirical studies on the impact of state/local business taxes on plant location, manufacturing productivity, and economic performance in general are mixed. One group of studies including Bartik (1991) concludes that state and local business taxes are cost burdens for firms, reducing their revenues substantially, and thus serve as a deterrent for firms to locate in states with high business taxes. On the other hand, the opponents argue that the after federal tax treatment the differences in local business tax burdens are very small relative to the other costs of conducting business so that firms are not likely to move from one state to another because of local business tax differentials. They also suggest that taxes are not just burdens, but also provide the financial support for public services that can reduce costs for businesses.

Berkowitz et. al (2005) indicate that strong institutions, in particular, legal systems capable of enforcing commercial contracts and impartial formulations and implementations of government economic policy contribute significantly to a country's trade growth because they are the final option for enforcing a claim against a party in the event of a breach of contract. Other studies argue that the nature of litigation system may increase the costs (tort cost) of doing business and add uncertainty, and as such serve as an implicit international competitive disadvantage. We posit that differences in the quality of state commercial liability system will lead to differences in the export performance of states.

The impact of pollution abatement cost on export performance has become a major topic of discussion. One camp of research points to pollution abatement cost leading to increase in production cost, decreasing firm profits and, thus, serving as a deterrent for firms to locate in places with high abatement cost. This strand of thinking argues that if free trade occurs between countries with different environmental standards, the countries with lower standards will over a period of time develop a comparative advantage in environmentally sensitive industries. Contrarily, others argue a positive impact of stringent pollution abatement rules on industry performance. As argued in Porter and Van der Linde (1995) "environmental standards can trigger innovation that may partially or more than fully offset the costs of complying with them."

We use employment density, which is measured as state total employment divided by land area as a measure of the distribution of jobs across space. As a proxy for the underlying spatial process that relates employment density to productivity growth, employment density can contribute to the export performance by boosting productivity through industrial clustering (Marshal, 1920). Further, Jacobs (1969) proposes that through externalities accruing from urbanization, different industries locating near one another confer advantages to all. However, extremely high employment density can have negative impact through congestion effects such as increases in the prices of factors of production, and other external diseconomies. In other words, while agglomeration provides advantages in the development of the industrial core region, it eventually may work against the core through increased costs and congestion and lead to a movement away from the core to the periphery. This phenomenon has led to some studies to suggest an inverted U shaped relationship between industry location and agglomeration (See Arauzo-Carod (2005) and Viladecans-Marsal (2004)). Therefore, the impact of employment density on state export performance can be significantly positive or negative, or insignificant.

The New economic geography" (NEG) literature argues that the uneven distribution of industrial activities across space is a natural result of market processes, understood in terms of agglomeration, dispersion, and regional integration , meaning that there can be regional differences in export performance. While the investigation of the impact of decreased distance-related costs on the spatial economy have been made on a national level (Bairoch, 1997), NEG is designed to operate on a sub-national or regional level, with special reference to interregional relationships. We include 4 regional dummies in our second stage model to investigate if there are regional similarities in export performance. Finally we include total Chinese exports as a proxy for the increasing importance of China in the world trade arena (CEXP) and its impact on U.S. state's export performance. The data definitions and sources, and summary statistics are presented in Table 2.

III. Results

A. GRAVITY EQUATION

Table 3 reports the Arello-Bover-Blundell estimates of equation (1). The results do not greatly differ from our expectations: for the three types of exports the two lagged dependent variables significantly impact the current state's exports, which imply that the autocorrelation is an important issue to consider in the empirical study of state exports. The coefficients for the GDP of importing country are positive and statistically significant for all three types of exports with largest magnitude in the *high-tech* exports model, which suggests that the countries with higher income have stronger demand for imports especially the *high-tech* products. However, the coefficients for the population of the importing country are not significant for either type of exports with negative values for the *high-tech* and total export and positive value for the *low-tech* export, which may hint a "self-sufficiency" effect as discussed in Martinez-Zarzoso and Nowak-Lehmann (2003).

In contrast, the coefficients on the GDP and population of states for all three types of exports are not significant, which implies that state size is not crucial to the exporting ability. This result may also be due to the fact that American exports are largely not labor intensive or because they are not from industries with very high economies of scale. Further, this result may be indicative of a "mixed bag" situation, where some larger states are not exporting much because they are self-sufficient. After controlling for the dynamic effects in the models no significant time trends are found in the three types of exports with negative coefficient in *high-tech* exports and total exports and positive coefficient in the *low-tech* exports. Our focus, however, is not the individual coefficient estimates but rather the trade potential and export performance implied by them. We therefore turn our attention to the panel probit estimates of equation (3).

TABLE 3–Dynamic Fixed Effects Regression with State-Country Dummies
Dependent Variable: Log of (1+state-to-country exports)

Independent Variables	Coefficients		
	High TECH	Low TECH	Total EXP
Shared intercept	31.588 (71.143)	18.573 (40.548)	33.586 (68.497)
Log of (1+Exports$_{t-1}$)	0.052* (0.027)	0.074*** (0.024)	0.046* (0.027)
Log of (1+Exports$_{t-2}$)	-0.128*** (0.023)	-0.069*** (0.023)	-0.125*** (0.022)
Log of country GDP	4.928*** (1.268)	2.801* (1.497)	4.667*** (1.409)
Log of country population	-1.725 (1.903)	0.355 (2.294)	-1.872 (2.741)
Log of state GDP	1.698 (2.978)	1.849 (3.198)	2.501 (2.955)
Log of state population	-4.082 (4.379)	-4.353 (3.962)	-4.442 (3.752)
2000	-0.143 (0.207)	-0.006 (0.212)	-0.136 (0.207)
2001	-0.209 (0.246)	0.125 (0.225)	-0.161 (0.221)
2002	-0.140 (0.288)	0.335 (0.279)	-0.001 (0.257)
2003	-0.260 (0.352)	0.207 (0.349)	-0.257 (0.319)
2004	-0.214 (0.427)	0.404 (0.448)	-0.138 (0.399)
2005	-0.300 (0.525)	0.303 (0.546)	-0.285 (0.495)

Notes: ***, **, and * indicate significance at p<0.01, p<0.05, and p<0.1 levels, respectively. The number in parenthesis is the Huber/White heteroscedasticity robust standard error.

B. PROBIT MODEL-DETERMINANTS OF EXPORT PERFORMANCE

Table 4 presents the estimated marginal effects of our random effects probit models for the three types of exports. Overall, the estimates revealed are broadly similar.

TABLE 4–Probit regression results: Dependent Variable $P_{ijt} = I(S_{x^{p}_{ijt}} > 0$

Independent Variables	High TECH		Low TECH		Total EXP	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
BVIT	0.037*** (0.004)	0.036*** (0.004)	0.037*** (0.005)	0.036*** (0.004)	0.030*** (0.005)	0.030*** (0.004)
UDEN	0.031*** (0.002)	0.026*** (0.002)	0.028*** (0.002)	0.021*** (0.002)	0.031** (0.002)	0.022*** (0.002)
LIAB	0.002*** (0.0006)	0.002*** (0.001)	-0.0006 (0.0007)	-0.001 (0.0007)	-0.00001 (0.0007)	-0.001 (0.0007)
BTAX	-0.0007 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	0.0002 (0.0014)	0.0003 (0.001)
POLEXP	0.002*** (0.0001)	0.002*** (0.0001)	0.001*** (0.0001)	0.001*** (0.0001)	0.001*** (0.0001)	0.001*** (0.0001)
EDEN	0.0008*** (0.0001)	0.001*** (0.0001)	0.0006*** (0.0001)	0.001*** (0.0001)	0.0007*** (0.0001)	0.001*** (0.0001)
Northeast	0.111 (0.384)	-0.369*** (0.025)	0.360 (0.405)	-0.239*** (0.022)	0.608 (0.428)	-0.361*** (0.024)
Southeast	1.427*** (0.393)	0.268*** (0.026)	2.104*** (0.410)	0.330*** (0.021)	1.916*** (0.408)	0.267*** (0.022)
Midwest	0.826** (0.404)	0.092*** (0.016)	1.150** (0.418)	0.202*** (0.016)	0.914** (0.424)	0.137*** (0.016)
Southwest	1.134* (0.595)	0.313*** (0.019)	1.667*** (0.596)	0.273*** (0.022)	1.738*** (0.614)	0.261*** (0.022)
LnCHINA	0.112*** (0.023)	-	0.155*** (0.024)	-	0.159*** (0.025)	-
China*NE	-0.037 (0.030)	-	-0.047 (0.031)	-	-0.076** (0.033)	-
China*SE	-0.088*** (0.031)	-	-0.136*** (0.032)	-	-0.125*** (0.032)	-
China*MW	-0.058* (0.031)	-	-0.075** (0.033)	-	-0.062* (0.033)	-
China*SW	-0.062 (0.046)	-	-0.106** (0.047)	-	-0.112** (0.048)	-

Notes: Model 1 and 2 refer to the RE Probit models with or without variables of China Export and those interaction terms of China Export and Regions. White-corrected standard errors in parenthesis; ***, **, and * indicate significance at p<0.01, p<0.05, and p<0.1 levels, respectively.

The pooled probit was tested against the random-effects probit model using Hausman test. The test rejects the pooled probit at the 1% significance level. We also estimated models with and without the influence of the growth of Chinese exports, and the results are similar. We therefore will focus on the random effects probit model with internal and external effects as Chinese exports has significant impact on the state's performance of three type exports.

As hypothesized business vitality and dynamism significantly contributes to the state's export performance in the three types of exports. Specifically, we find that a 1 point improvement in a state's business vitality and dynamism will increase the probability that it outperforms its estimated manufacturing exports potential by 3.7 % for the high-tech and low-tech exports and 3% for the total exports, respectively. These positive coefficients give credence to the argument that the business environment of states does matter for its export performance. A state can promote the export performance of the firms located in that state by fostering better business climate to improve firms' productivity and overall performance and attract higher quality companies to states.

Similar to Bennett and Kaufman (2008) and Doucouloagos and Laroche (2004), our results indicate that unionization of a state's manufacturing labor force has a positive impact on state's export performance. Specifically we find that with a 1% increase in the percent of a state's manufacturing union membership, the probabilities of that state outperforming its estimated exports potentials to the Asian region will increase by 3.1% for *high-tech* and *total* exports and 2.8% for the *low-tech* exports. The reduced costs due to the higher productivity, lower employee turnover, improved workplace communication, and a better-trained workforce associated with unions, improve the competitiveness of unionized firm in the global market place especially for the *high-tech* firms.

The impacts of the state's liability system on its exports performance are mixed. It contributes significantly to a state's *high-tech* exports performance but has no significant impacts on its *low-tech* and total export performances. Specifically, our results suggest that a 10 points improvement in a state's liability systems will increase the probability that it outperforms its estimated high tech manufacturing exports potential by 2%, which is consistent with the findings in Berkowitz et. al (2005). One possible explanation is that for *high-tech* firms secure litigation environment is critical for their participation in international trade and performance because of the patent and copy right issues but not so important for the low tech firms. A state can encourage *high-tech* firms' participation in international trade and contribute to their performance by providing stronger legal system.

Similar to the claim that the state corporate tax burdens do not influence economic performance of states as argued by Mead (2001) and Lynch (2004), we find that state's corporate tax rate does not matter for either type of its export performances. After federal tax treatment local business tax differentials are very small relative to the other costs of conducting business so that firms are not likely to move from one state to another because of those differentials.

Similar to Porter and Van der Linde (1995) we find that pollution abatement cost significantly strengthens the global competitiveness of U.S states with the largest impact on the state's high-tech exports performance. Our results suggest that a 10 million dollar increase in the pollution abatement cost will increase the probability of the state outperforming its estimated *high-tech, low-tech* and total manufacturing exports potentials by 2%, 1%, and 1%, respectively. For industries that are environmentally sensitive, pollution abatement cost serves as a trigger for innovations, which increases the productivity, which in turn offsets the cost of complying with the strict environmental standards and puts them at advantage in the global market.

Similar to Combes (2000) we find that a 10 thousands per square mile increase in a state's employment density leads to a 0.8%, 0.6%, and 0.7% increases in the probabilities the state will outperform its estimated *high-tech, low-tech* and *total* export shares, respectively. It indicates that positive agglomeration effect from employment density dominates negative congestion externalities for U.S. states especially for those with many *high-tech* firms. They boost productivity through industrial clustering and the advantage conferred between firms from different industries locating near one another through externalities accruing from urbanization, strengthen their global competitiveness.

Our results indicate that geographical location of states affects the likelihood of a state exceeding its expected export share of U.S. exports to Asia as argued in the literature of New Economic Geography. Relative to the states in the western region, it is significantly more likely for the southeastern, mid-western and southwestern states to perform better than their expected *high-tech, low-tech* and *total* exports potentials with the larger difference in the *low-tech* exports performance after controlling for the state business environment variables. Specially, the results indicate that southeastern states are 142.7%, 210.4%, and 191.6% more likely to outperform their *high-tech, low-tech* and *total* export potentials respectively. For the states in the Midwest the possibilities for them to outperform their *high-tech, low-tech* and *total* export potentials are 82.6%, 115%, and 91.4% higher than the western states respectively. And the southwestern states are 113.4%, 166.7.4%, and 173.8% more likely to perform better in their *high-tech, low-tech* and *total* exports respectively than expected. The southeastern, mid-western and southwestern states have relative comparative advantage in the *low-tech* exports over the western states possibly due to the lower labor cost. Although western states are geographically closer to Asia, they did not perform well in the Asian market as expected. The mid-western and southwestern states, which are peripheral geographically to the western states, however, are not adversely affected in terms of their export performance as discussed in Porter (1990).

In the case of external impacts, the results indicate that surprisingly, the increase in the Chinese exports to the rest of the world including countries in the Asian region significantly increases the likelihood of all states performing better than their estimated potential. A 1% growth in the Chinese exports brings 11.2%, 15.5%, and 15.9% increases in the probabilities of U.S. states performing above their *high-tech, low-tech*, and *total* export potentials. On the other hand, the interactions of the Chinese exports with the U.S. regional dummies provide some interesting results. The results show that compared to western states, as Chinese exports grow by 1%, the probabilities of southeastern states performing above their *high-tech, low-tech* and *total* export potentials fall from 142.7% to 133.9%, 210.4% to 106.8%, and 191.6% to 179.1%, respectively whereas for Midwestern states they fall from 82.6% to 76.8%, 115% to 107.5%, and 91.4% to 85.2%, respectively thus bridging the gap in export performances of this region vis-à-vis that of the western region. This result indicates that the rise of China, as a major player in the world and Asian export markets in particular, has a more disparaging impact on the export performance of western states as opposed to states in other parts of the country. This result is very similar to Coughlin and Pollard (2000) who found that because western states tend to be more dependent on East Asian markets for export sales, they were hit the hardest by the sharp reduction in Asian demand for U.S.-produced manufactured goods.

IV. Conclusions

The goal of this study has been to investigate why some U.S. states perform better than expected exporting to the Asian market. We investigate this using a dynamic gravity model to estimate expected high-tech, low-tech and total exports shares for each U.S. state and compare them to their actual shares of these three types of U.S. exports to Asia.

We find that good business vitality, good legal systems, high unionization rates, high pollution abatement cost, and high employment density improve state's three types of export performances. Our results thus indicate that states can improve their export performance by providing better business environment and stronger legal systems. The positive and significant impact of union density on the export performances of states may indicate that the advantages associated with union such as higher productivity, lower employee turnover, and improved workplace communication dominate the possible higher compensations for the unionized workers strengthen the export competitiveness of firms in the state. Union is not a hurdle for the export oriented firms, especially for the high-tech firms. The positive and significant coefficient of the employment density implies that for many larger states with higher employment density are at their optimal scale for the agglomeration effect through industrial clustering to outweigh the possible negative congestion effects. Furthermore, state level environmental regulations may impact firm location decisions, and thus only the high quality firms stay in the states with stricter and more costly environmental regulations. On the other hand, those regulations may trigger innovations that may boost the productivities of the remaining firms thus fully offset the increased environmental costs, which is especially true with the high tech firms.

Our results indicate that surprisingly the growth of the Chinese exports significantly improves the export performance in all U.S. states in the Asian market as opposed to the common impression of the impact of Chinese exports on U.S. exports. Its positive impact is significantly stronger for the southeastern and mid-western states than the western U.S. states.

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