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EFFECT OF FOREIGN PRESENCE ON DOMESTIC PERFORMANCE: THE CASES OF EDUCATION IN THE US AND MANUFACTURING FIRMS IN ETHIOPIA

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A Dissertation Submitted in Partial Fulfillment of the Requirements for the Doctor of Philosophy Degree in Economics

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DISSERTATION APPROVAL

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This dissertation studies the effects of foreign presence on the performance of domestic institutions and economic agents. We identify three types of foreign presence: international students, inward foreign investment, and exporting activities.

The first chapter investigates the impacts of international students on the graduation performance of host universities and degree completions of native students. Using the Illinois Board of Higher Education (1996 - 2010) and California Postsecondary Education Commission (1982 - 2009) data on enrollment and graduation – disaggregated by universities, programs, and types of students – we follow a two-stage method to achieve our goal. In the first stage, we estimate university 'premiums' on graduations, separately for master's and PhD degrees, and then in the second stage we examine how these premiums are affected by the graduation rates of international students. We allow for possible two-way causality in the second stage. The results reveal that, on average, one percentage point increase in the share of international master's degree and PhD recipients in the universities across Illinois increases master's and PhD graduation premiums by about 1 and 0.5 additional graduates, respectively. In California, one percentage point increase in the share of foreign degree recipients increases the master's graduation premiums by more than 0.3 graduates. Our estimates also suggest that international students generate positive externalities on the university graduation premiums among the native students.

In the second chapter, we use proportional hazards and multinomial logit models to evaluate the role of spillovers from exporting and foreign-owned firms on the export market entry and exit of local firms. Our analysis is based on the firm-level Ethiopian manufacturing survey data for the period 1996 - 2010. The results show that the backward and forward spillovers from foreign-owned exporting firms improve the probability of domestic firms to start exporting. Besides, the foreign-owned firms serving domestic markets generate horizontal spillovers that increase the export survival rates of local firms. On the other hand, the presence of domestic exporting firms increases the exporting probability of local firms in upstream sectors and export survival rates in upstream and downstream sectors.

Lastly, the third chapter examines the efficiency effects of spillovers on the local manufacturing enterprises in Ethiopia using two-stage estimations. First, we estimate technical efficiency of firms using the 'true' fixed-effects stochastic frontier analysis. Afterwards, we adopt system GMM to examine how spillovers impact the performance of domestic firms. The results show that the presence of domestic exporting firms in the same sector increases the efficiency of local non-exporting firms with a higher absorptive capacity. As to foreign-owned firms, those serving local markets produce positive backward and forward spillovers improving the efficiency of local exporting firms while negatively impacting the non-exporting enterprises. Likewise, spillovers from foreign-owned exporting firms increase the efficiency of domestic exporting firms in upstream sectors at the expense of the non-exporters.

DEDICATION

I dedicate this dissertation to my mother, Gebeyanesh Asgedom.

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CHAPTER 1

DOES THE PRESENCE OF INTERNATIONAL STUDENTS IMPROVE DOMESTIC GRADUATIONS IN THE US?

1.1 Introduction

The US has been hosting a larger number of international students than any other country in the world. Enrollment of foreign students in US universities increased rapidly from over 310,000 in 1980 to over 880,000 in 2013, with an average annual growth rate of 3.4% in the last three decades (IIE, 2014). The growth in enrollment has been positive in all years except during 2003-2005 when a strict visa application process was implemented following the 9/11 terrorist attack. Afterwards, it received a quick rebound with an average annual growth of 5.8% from 2006 to 2013. In 2013, foreign students constituted 4% of the total US higher education population, of whom 42% and 37% were enrolled in undergraduate and graduate programs, respectively (IIE, 2014). Relative to the total student population in each program, their presence is much larger in graduate schools, particularly in Science and Engineering (S&E) fields of study. Foreign students account for 16.7% of total graduate school enrollments, and 49% of engineering and 48% of mathematics and statistics graduate students (Allum, 2014).

The social and economic impacts of immigration have generated vigorous policy debate among politicians, business owners, and academicians in the US as well as other developed countries. There are many studies on the effects of unskilled immigrants, and some have analyzed the effects of skilled immigrants, including international students on labor market outcomes (Borjas, 2006; Borjas and Doran, 2012; Peri et al., 2014; Moser et al., 2014) and research production and patenting in universities and business organizations (Stuen et al., 2012; Chellaraj et al., 2008). A few studies examined the impacts of international students on native graduate school enrollment. Borjas (2004), using the Integrated Postsecondary Education Data System (IPEDS), finds an increase in enrollment of foreign students crowd out native white men from graduate schools while positively associated with the enrollments of native Asian, Black, and Latino students. In contrast, the study by Regets (2007) estimates a positive effect on the enrollments of US white and underrepresented students, but negative on Asian-American students. Most recently, Shih (2015) identifies periods of boom and bust of international graduate students in the US (1995 - 2001 and 2002 - 2005) and indicates that international students crowd in native students with a stronger effect in STEM (Science, Technology, Engineering and Maths) fields than the non-STEM fields.

With regard to educational achievement, Hunt (2012) examines the role of immigration in high school completion of native students in the US. She finds the positive effects that encourage high school completion of natives outweigh the discouraging effects that decrease the return to native education. On the other hand, Gould et al. (2009), using data on Jewish immigrants from the former Soviet Union in the 1990s, show that the exposure to immigrants in elementary schools decreases native Israelis' high school matriculation results. Furthermore, Seah (2014) examines the effect of immigrant peers on native students' performance on standardized tests and finds positive, zero, and negative effects in Australia, the US, and Canada, respectively.

Unlike the growing literature on immigrant peer effects on native elementary and high school achievements, there is no study concerning the effects of the large inflow of foreign students on graduate degree completions. The existing literature on the impacts of foreign graduate students on the performances of host institutions and domestic students is limited to the few studies on research production and crowding-out effects. The current study addresses this issue by examining whether foreign students influence the teaching performance of host institutions and generate externalities that affect the performance of domestic students.

The presence of international students can affect graduate school completion rates through different channels. First of all, the completion rate is higher among international students as they are highly motivated to finish their studies in order to apply for jobs in the host country. In addition, those who plan to return to their countries of origin are typically under immense pressure to complete their studies on time by their sponsoring companies, and to become better competitors in the market. Other than their self-motivation to graduate, they may also cause indirect effects towards their fellow international and native students. The indirect channel may work through peer effect, reducing resource constraint, and displacement and wage effects in the labor market.

Many foreign students come with scholarships or assistantships awarded on competitive bases. Thus, most of these students are very competent by the standards of their countries and host institutions. In addition, they are required to work hard to achieve better grades to ensure continuity of their financial support. Those with assistantship may also need to teach or hold extra sessions in classes they are assigned as assistants. Accordingly, the presence of international students in a given department increases grade competition, academic discussion, and research activities that is likely to improve the success of all students in the department.

Universities in the US charge international students not on assistantships higher tuition fees than native students. This helps the universities to relax their financial constraints to provide more funding for students, hire more professors, invest in research, and solve other financial needs in administration, which cumulatively boosts graduation and completion rates of students. Furthermore, the effect of international students and skilled immigrants in the labor market may affect the motivation of students to continue and complete their studies. Grossmann and Stadelmann (2012) and Peri et al. (2014) find significant increase in wages paid to college-educated natives as a result of international migration of high-skilled workers. On the other hand, Borjas (2006) shows that the increase in doctoral graduates induced by foreign students has a significant negative effect on the earnings of doctorates in the same field. Highly skilled immigrants may bring new skills into the market, increase productivity, and create new products and markets, which may increase the general wage level in the market including the wages of native workers. The labor market effects may also produce different reaction on natives' educational choices by causing dissimilar wage effects on their major fields of study. As a result, international graduate students may produce positive or negative effects on degree completions in host universities.

Consequently, we analyze the impacts of international students on the performance of host universities and native students using a concept of 'graduation premiums'. Our definition of premium is similar to the industry wage premium, which measures the portion of individual wages that accrues to the worker's industry affiliation after controlling for worker characteristics (Kumar and Mishra, 2008). Methodologically, the wage premium is estimated from an earnings equation that explains wage of workers as a function of observed characteristics (such as education, age, experience and others) and industry dummy indicators (Kumar and Mishra, 2008). Hence, the coefficients of industry indicators represent the wage premiums.

In this study, we define a 'graduation equation' given by the number of degrees conferred in a given discipline and university as a function of lagged enrollments and university indicators. In a way, we specify enrollment as an input in the educational process and graduation as an output. Thus, the coefficients of university indicators capture the graduation premiums that measure how many more or fewer students graduate from a given university relative to the number of graduates from an averagely performing university in the sample. We estimate master's and PhD graduation premiums among the total students in each program and separately for native students as proxies for universities' teaching performances and the performance of native students, respectively.

The premium shows the performance of a university in terms of the success of its students in completing their degrees. Graduate schools in the US are characterized by lower completion rates, particularly among native students. In addition, it takes a long time for graduate students to complete their studies. According to the Council of Graduate Schools (CGS) PhD completion project, the completion rate after students begin their doctoral study is 57% in 10 years (CGS, 2008). The rate varies considerably by fields of study and racial/ethnic background of the students. Completion rates range from 49% in humanities to 63% in engineering, with 54% for domestic and 67% for international students. Additionally, a pilot study on the completion and attrition in STEM master's programs conducted by CGS (2013) shows 60% and 66% of STEM master's students complete their study within three and four years, respectively. Furthermore, the median duration between starting and completing graduate school was 7.7 years for doctorate recipients in 2008 (NSF, 2009). Thus, our estimated premiums capture variations in degree completions across universities. Some universities may do well and achieve higher graduation rates while others may not perform as well when it comes to students' completing their degrees.

The premiums are estimated separately for each year where lagged enrollment data are available for the required lag lengths. Subsequently, the premiums are pooled together to generate panel data from which we estimate regression equations with the premiums as a dependent variable. The proportion of foreign degree recipients in total graduates is used to examine whether international students help to improve university graduation premiums and generate externalities that affect the performance of natives. This exercise is carried out separately for master's and PhD degrees.

We find that foreign degree recipients increase the graduation performance of the host universities. An increase in the share of degrees awarded to foreign students boosts the master's and PhD graduation premiums. This implies that the presence of foreign students in a given university creates an environment that increases the degree completions of students in the university. In addition, we observe that an increase in the share of master's and doctoral awards to foreign students generates positive spillover towards the graduation premiums among the native students.

The next section explains the data that we use in this chapter and compare them with other data sources of similar nature. Section 3 presents summary of the industry wage premium methodology as well as details of the graduation equations and the different estimation techniques we apply in the analysis. Section 4 discusses the results, and section 5 provides the conclusions.

1.2 Data

Our main source of data is the Illinois Board of Higher Education[1] (IBHE) who collects enrollment and graduation data through surveys of public and private institutions in Illinois for the period 1996-2010. The data provide demographic characteristics of students and identify foreign students as non-resident alien with a student visa. Fields of study are categorized by two-digit and six-digit Classification of Instructional Programs (CIP). The two-digit classification has 52 relatively broad categories of fields of study and a separate group of undeclared/unclassified students. In this study, we use the two-digit category because the enrollment and graduation data are more consistent in this category than in the six-digit category, and this acts as a control for students changing majors within the same two-digit category. Further, the undeclared/unclassified group has only enrollment figures which prompt us to remove the group from our analysis. In addition to the classification by fields of study and citizenship/residence status of students, the surveys provide further classifications of degree levels into 11 groups. Graduate degrees are grouped into post-baccalaureate certificate, master's, post master's certificate, doctoral research, doctoral professional practice, and doctoral other. Accordingly, we select the master's category and the last three categories for the analysis of master's and PhD graduation premiums, respectively.

Other than universities in Illinois, we find similar data for universities in California from the archive of the California Postsecondary Education Commission[2] (CPEC) for the period 1982 - 2009. CPEC provides graduation data for all universities in California and enrollment data for universities in the University of California and California State University systems. Since most universities in the California State University system have limited or no PhD programs, our analysis is limited only to master's programs.

The Integrated Postsecondary Education Data System[3] (IPEDS) is the largest database on higher education enrollment and graduation in the US. It collects data on

[1] http://www.ibhe.state.il.us/
[2] http://www.cpec.ca.gov/
[3] https://nces.ed.gov/ipeds/datacenter/

enrollment, graduation, employment, budget and other aspects of institutions of higher education using surveys conducted by the National Center for Education Statistics. We use the data from IPEDS on university specific variables such as research expenditure, the number of faculty, and average faculty salary. However, we did not use the enrollment and graduation data from this source for specific reasons. IPEDS collects enrollment data for only nine of the 52 two-digit discipline categories. This constrains the panel dimension of the data and limits our premium estimation for universities with graduate programs not included in the nine disciplines as well as those with only a few disciplines. In addition, the figures do not distinguish between master's and PhD enrollments and provide only total graduate enrollments. Our specification requires lagged enrollments where the lags are the range of years a student may need to complete a specific program. As a result, without separate enrollment and degree awards data for master's and PhD programs, we cannot estimate the premiums for the total graduate students by mixing the range of years required to finish master's and doctoral degrees.

Additionally, we use new assistant professors' average salaries by two-digit discipline category from the College and University Professional Association for Human Resources[4] (CUPA-HR). CUPA-HR surveys faculty salaries for four-Year colleges and universities and computes the average by discipline, rank, and tenure status. As a control for discipline characteristics, we use the salary of newly hired assistant professors averaged over the years 2008 to 2012.

The enrollment data is based on the stock of total enrollments during the fall semester of each year while the graduation data is based on the total number of degrees conferred each fiscal year. To find the flow of new students during the fall semester, we use the change in fall enrollments accounting for graduated students:

$$e_{ijt} = E_{ij,t} - (E_{ij,t-1} - G_{ij,t})$$

where e is the flow of new students, E is the gross enrollment, and G represents the number of degree recipients. The subscript i refers to discipline (instructional program),

[4] http://www.cupahr.org/

j is university, and t refers to fall year for enrollment and fiscal year for graduation. Hence, we compute the flow of new students during each fall semester as the gross enrollment in that fall semester minus students who have been enrolled in the preceding fall semester excluding those graduated in subsequent commencements.

The flow measure of enrollment does not account for dropouts and changes in majors. Inability to account for such changes understates the number of new enrollees. This problem coupled with some erratic jumps in the gross enrollment figures as reported in Shih (2015) causes the flow enrollment variable, e_{ijt}, to have some outlier negative values. Looking at the figures of the flow enrollment variable, we drop university-discipline combinations with values at the bottom 0.5%. Since lagged enrollment variables are used in the estimations, one such value may enter in three to six regression equations to estimate the annual master's and PhD graduation premiums. Thus, university-discipline combinations with such values are dropped altogether from the data available to estimate the premiums.[5] Finally, there are 19 universities with PhD programs and 44 universities with master's programs available in the Illinois data.[6] In the California, there are 29 universities available to analyze the master's graduation premiums. However, 2005 and 2006 enrollment data for universities in the California State University (CSU) system are not reported in the CPEC database. Accordingly, in the period 2006 - 2009, we estimate the premiums for universities only in the University of California (UC) system.[7]

1.3 Methodology

Our empirical analysis follows the industry wage premium methodology which examines wage differentials across individual workers with similar observable characteristics working in different industrial groups. Following the work of Krueger and Summers

[5] We drop university-disciple combinations, twenty for master's and nine for PhD in the Illinois data and forty-six for master's in the California data.

[6] Appendix Table A1 and Table A2 lists the Illinois universities included in each program

[7] Appendix Table A3 includes a list of the California universities in the estimations.

(1988), several studies (Katz and Summers, 1989; Kumar and Mishra, 2008; Goldberg and Pavcnik, 2005) analyze inter-industry wage differentials and observed that industry affiliation as an important factor in determining wages other than individual factors such as human capital, experience, age, and others.

The wage premium methodology involves two-step estimation procedure. The first step is a wage regression equation where the wage of workers is defined by individual characteristics and industry dummy indicators. The industry indicators capture the proportional wage difference across sectors which is not explained by individual workers' characteristics. It shows whether an affiliation to a particular industrial group pays workers more or less than the average in the market. In the second stage, the industry wage premiums (coefficients of the industry indicators) of each year are pooled together and regressed upon other variables deemed to determine why different sectors pay different wages to workers with similar characteristics. For instance, Kumar and Mishra (2008) and Goldberg and Pavcnik (2005) examine the effects of trade liberalization on the wage premiums over time in India and Columbia, respectively.

In this study, we use enrollment and graduation data to estimate university graduation premium collectively among the total student population and separately among the native students. The premium measures the efficiency of universities with the success rate of their students. It compares the number of master's or PhD degree recipients in a given university (averaged across its fields of study) relative to the average number of degrees conferred by universities in the sample. In effect, it shows the extra number of degrees that departments in a given university confer in a particular year relative to the number of graduates in an averagely performing university given the initial enrollees who might have the potential to graduate in that particular year. Thus, we estimate these premiums by running OLS regression of the number of degrees conferred on lagged enrollments, university indicators, and average new assistant professor's salary by discipline as a control for discipline characteristics.

We define graduation as a function of lagged enrollments. If all universities have the same graduation rates or the averages are the same across universities, we would not expect any university to have a premium relative to the others. However, when some universities perform better with respect to the success of students in completing their degrees, we expect the premiums to be positive and significant among such institutions. In this setup, coefficients of the university indicators capture graduation premiums of the institutions.

The first stage OLS graduation regression equation is defined as:

$$G_{ijt} = \alpha + \sum_{k=l}^{q} \beta_k e_{ij,t-k} + \beta_w w_i + \sum_{j=1}^{M} GP_{jt} U_j + \epsilon_{ijt}, \tag{1.1}$$

where G_{ijt} implies the number of degree recipients in the i^{th} instructional program ($i = 1, 2, ..., N$) of university j ($j = 1, 2, ..., M$) during the t^{th} time period ($t = 1, 2, ..., T$). Additionally, $e_{ij,t-k}$ denotes k years lagged enrollment of new students, and U represents institutional dummy indicators with the coefficients, GP_{jt}, capturing each year graduation premiums of the universities. The lag length of the enrollments ($k = l$ to q) includes 1 to 3 years for the master's and 3 to 6 years for the PhD graduation equations. These lagged enrollment variables constitute the number of students who first enrolled some years back and may have stayed long enough in their study to become a potential candidate for graduation at time t. Given the median duration of 7.7 years to complete a PhD program after having a bachelor's degree, those who have master's degree and enrolled in doctoral programs may, on average, need 3 - 6 years to complete their degree. Similarly, given the small increase in master graduation rates after 3 years of study as indicated in CGS (2013) for STEM programs, 1 - 3 years is long enough to obtain a master's degree for most students.

In addition, other than the lagged enrollments, we use average salary of new assistant professors by fields of study, w_i, as an additional control for variations that arise from discipline related heterogeneities. Furthermore, we apply similar graduation equations to estimate the premiums among the native students using their graduation and enrollment data in each program.

When using a set of dummies in a regression equation, the standard procedure is to drop one category and compare the resulting differences relative to the base category. To keep all groups in the regression and compare the premiums relative to the average, we normalize the coefficients using the universities' share of total enrollment (in each program) aggregated across all universities in the sample as a weight, i.e., the graduation premiums are expressed as deviations from the enrollment-weighted average graduation premium. The standard errors of the normalized graduation premiums will be calculated using the Haisken-DeNew and Schmidt (1997) two-step restricted least squares procedure with the weighted sum of the premiums restricted to equal zero:

$$\sum_{j=1}^{M} GP_{jt}.\lambda_{jt} = 0 \tag{1.2}$$

where the weight, $\lambda_{jt} = \sum_i E_{ijt} / \left(\sum_j \sum_i E_{ijt} \right)$ is individual university j's share in the total enrollment of all universities in the sample at time t.

In the second stage, we pool the university graduation premiums over time to form a panel dataset. Then, we define a regression equation for the premiums as a function of the share of degrees conferred to foreign students and other university specific variables. The equation is:

$$GP_{jt} = \alpha + \gamma \mathrm{IR}_{jt} + Z'_{jt}\beta_z + U'_j\beta_u + e_{jt} \tag{1.3}$$

where IR_{jt} is the share of international students in the total graduates of university j at time t. It is computed as the percentage of foreign degree recipients aggregated by the discipline categories included in each year university graduation premium estimations. The vector Z_{jt} represents university-level characteristics such as research expenditure, average faculty salary, faculty to graduate student ratio, and public ownership of universities; and the vector U_j captures university fixed effects.

In this regression, our variable of interest is the share of degrees granted to international students (IR). We want to assess how the degree completions of international students affects the university graduation premiums as well as the premiums among the native students. Thus, we are looking for contemporaneous effects where foreign graduates at time t affect the premiums during time t. This is because, as mentioned in the introduction, foreign degree awardees are more likely to affect the university graduation premiums during their stay as a student through their peer effect towards each other and other students in the same batch. They may also affect the premiums at the time they graduate directly by increasing the number of degrees conferred during that particular year.

The dependent variable in the second stage regression is compiled from the first stage estimations. The measurement error due to standard errors of this variable does not affect the consistency of the second-stage coefficients, but introduces additional noise to the model which increases the variance of the coefficients (Goldberg and Pavcnik, 2005). To account for this noise, we adopt a variance weighted least squares (VWLS) using the inverse of standard errors of the premiums as weights. This gives more weight to the premiums with smaller variances and less weight to those with higher variances so as to reduce the noise.

The fixed effects model controls for time-invariant individual heterogeneity. However, it fails to account for unobserved time-varying factors that may affect both the dependent and, at least, one of the independent variables. In our second stage regression, endogeneity problem can arise if there exist unobserved time-varying heterogeneities that may affect both the graduation premium and the proportion of foreign degree recipients. Higher graduation rate is an indicator of a universities' success in terms of the degree completion of its students, which in turn motivates the university to put more human and financial resources to improve its graduation rate. The higher the graduation rate and quality of the university, the more students from home and abroad apply for an admission to the universities' academic programs. This will increase the presence of foreign students as well as their share of total graduates of the university. Thus, quality indicators, other than the ones we account for, may create an endogeneity problem that needs to be addressed through other techniques.

To address the possibility of endogeneity that may arise from unobserved factors that affect graduation premium and the presence of foreign students, we use instrumental variables (IV) regression and difference generalized method of moments (DGMM). The challenge in our IV regression is to find suitable instruments for the share of foreign degree recipients. One potential instrument that we consider is faculty diversity. A more diverse faculty appeals to different groups of potential students that may increase the flow of foreign students. Particularly, the presence of Asian and African descent faculty members attracts students from Asia and Africa; regions with fast-growing economies and young student population aspired to study abroad. Based on the available data, we measure faculty diversity by the share of foreign faculty members. An additional instrument that we consider is the lag of the dependent variable - graduation premium. Recent success in graduation due to more students pursuing their studies and completing their degrees motivates other students to do the same. In universities with higher enrollments of foreign students, this may increase the proportion of foreign graduates who are actively looking to integrate with the host economies' labor market and apply for jobs. However, the graduation premium in recent years may not affect the current premium directly, but by increasing the degree completions of foreign and native students.

The difference generalized method of moments (DGMM) proposed by Arellano and Bond (1991) recognizes the difficulty of finding appropriate and strong instruments. This method tries to control endogeneity using internal instruments from within the model by taking the first difference of the regression equation and use lagged values of the level endogenous variables as instruments. DGMM is designed for dynamic panel models where lagged values of the dependent variable are included as regressors, which creates "dynamic panel bias" in the model. In our case, we are applying DGMM as an alternative to the instrumental variables regression. Although our model is static, the DGMM can also apply in cases where there are limited instruments for the endogenous variables.

1.4 Results and Discussion

1.4.1 Estimation of graduation premiums among Illinois universities

In the first stage regressions, we estimate university master's and PhD graduation premiums separately for the total student population and the native students. The regression equation (1.1) specifies the number of graduates in a given year as a function of new students who started studying in each program some years back and university fixed effects. Coefficients of the university indicators capture the graduation premiums. Besides, we include average salary of new assistant professors by 2-digit discipline category as a control for discipline induced variations in graduation.

Estimation results of equation (1.1), partially presented in Table 1.1, show large and significant coefficients of the lagged new enrollments in determining the number of graduates. For master's, the 2-year lagged enrollment has the largest coefficient followed by the 3-year and 1-year lagged enrollments. This, as we expect, implies that master's degree takes on average 2 years to graduate. Similar trend is also observed for PhD where we find that the lagged enrollments are important determinants of the number of doctoral degree recipients. The three and four years lagged enrollment variables are always significant, whereas the five and six year lags are significant in some equations.

The estimated graduation premiums,[8] shows large dispersion across universities and time. The joint F-statistics of the premiums implies that they are jointly significant at one percent level in all years and many of them are individually significant as well. The figure below (Figure 1.1) shows the trend of PhD graduation premiums of University of Chicago (UC), Northwestern University (NWU), University of Illinois at Urbana/Champaign, University of Illinois at Chicago (UIC) and Southern Illinois University Carbondale. These premiums normalized by dividing to their standard errors

[8]Tables A4, A5, A6 and A7 in the Appendix contains the estimated master's and PhD premiums separately for the total and native students in each program

Table 1.1: First stage regressions for master's and PhD graduation equations (selected years) of universities in Illinois

	Master's						PhD					
Dependent Var.:	Total			Native			Total			Native		
Degree granted	2010	2007	2004	2010	2007	2004	2010	2007	2004	2010	2007	2004
New Enroll.												
L1.	0.31***	0.26***	0.08**	0.29***	0.21***	0.12***						
	(0.04)	(0.07)	(0.03)	(0.04)	(0.07)	(0.04)						
L2.	0.40***	0.53***	0.59***	0.42***	0.57***	0.43***						
	(0.05)	(0.06)	(0.06)	(0.05)	(0.07)	(0.05)						
L3.	0.30***	0.19***	0.34***	0.29***	0.24***	0.42***	0.35**	0.39***	0.37***	0.45**	0.44***	0.37***
	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)	(0.04)	(0.15)	(0.04)	(0.07)	(0.19)	(0.09)	(0.07)
L4.							0.48***	0.18***	0.12***	0.27	0.26***	0.30***
							(0.15)	(0.05)	(0.04)	(0.18)	(0.06)	(0.09)
L5.							0.14	0.38***	0.16	0.21	0.27***	0.15
							(0.15)	(0.06)	(0.13)	(0.15)	(0.08)	(0.14)
L6.							0.07	0.08	0.33**	0.11	0.07	0.19**
							(0.11)	(0.06)	(0.13)	(0.11)	(0.06)	(0.08)
Ass. Prof Salary	0.07	0.02	0.35**	0.04	0.11	0.19*	-0.02	-0.09	0.09	0.01	-0.07	0.17
	(0.11)	(0.16)	(0.14)	(0.1)	(0.12)	(0.11)	(0.14)	(0.07)	(0.13)	(0.13)	(0.07)	(0.1)
Obs.	405	387	361	405	378	361	126	121	116	124	123	118
Adju. R2	0.99	0.98	0.99	0.99	0.98	0.98	0.98	0.99	0.97	0.99	0.99	0.99
Joint F-stat for Prem.	95.03	728.5	8.94	130.2	4013.5	4.4	3.72	9x10^4	24.75	6.51	15.17	66.99

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

fluctuates around zero, which is the average premium across all universities. The figure reveals two scenarios: (i) the premiums of these universities seem to move together, and (ii) none of the universities maintained negative nor positive premiums through out the period.

The co-movement may arise from economic conditions such as the availability of jobs and financial support, which may have different effects on enrollment and graduation of different universities. For instance, when the economy is in a recession the enrollment at some universities with higher tuition fees may go down, whereas it may increase in other institutions with cheaper tuition fees. Also, social and political factors may cause opposing changes in enrollment and graduation across different groups of universities. The drop in the enrollment of foreign students that happened in 2002 - 2005 is one instance of such cases which mainly affects universities with a large community of foreign students. Finally, similar to the PhD graduation premiums, Figure 1.2 reveals high fluctuation and co-movements in the master's graduation premiums.

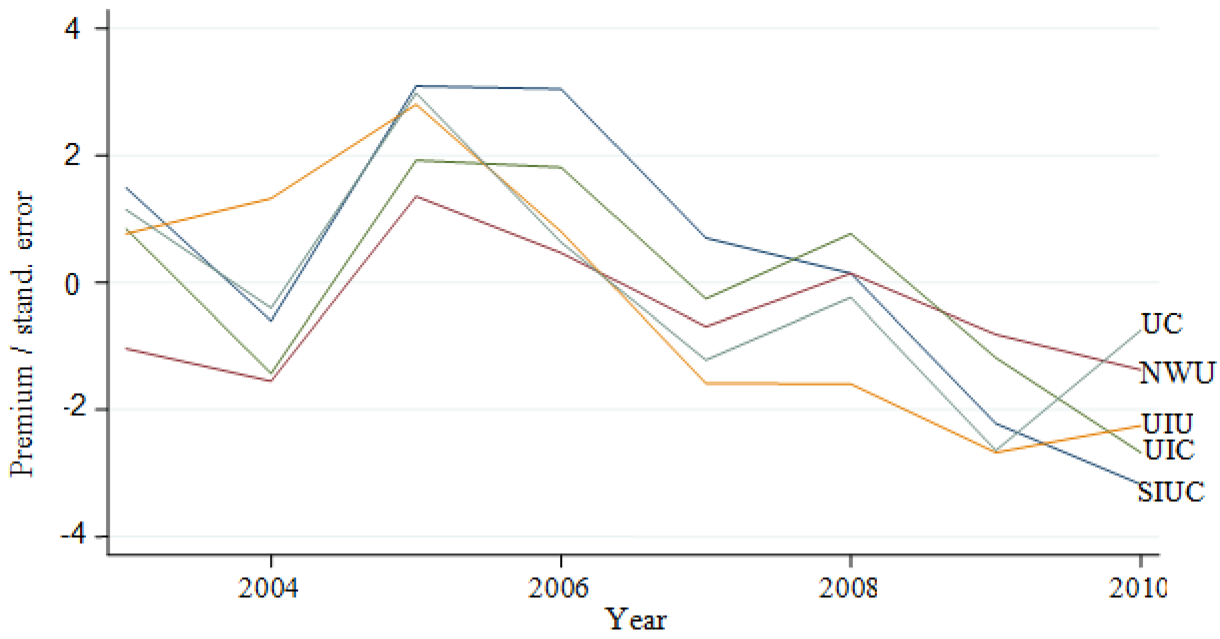

Figure 1.1: PhD graduation premiums of selected Illinois universities

The two figures also reveal that there is weak or no correlation between the master's and PhD graduation premiums. For instance, while the PhD graduation premiums of the selected universities were relatively higher in 2006, the master's premiums were falling in that same year. To look closely how the premiums are correlated to each other, Table 1.2 presents a correlation matrix of the four premiums. The premiums that are estimated for the total and the group of native students in each program are highly positively correlated. This implies that when more students of a given university complete their study as compared to the students from other universities, the number of native graduates of that particular university also increases. This suggests that factors, such as the presence of foreign students or other institutional influences, which may increase the graduation premiums among the total students might also increase the performance of native students, thereby increasing the graduation premiums estimated among the native students. However, the correlation between the graduation premiums of the two programs, master's and doctoral, is almost non-existent. This observation may arise because some colleges and universities are designed mostly to produce master's graduates, while other research oriented universities invest more on their doctoral programs. Thus, depending on their focus, universities and colleges may have

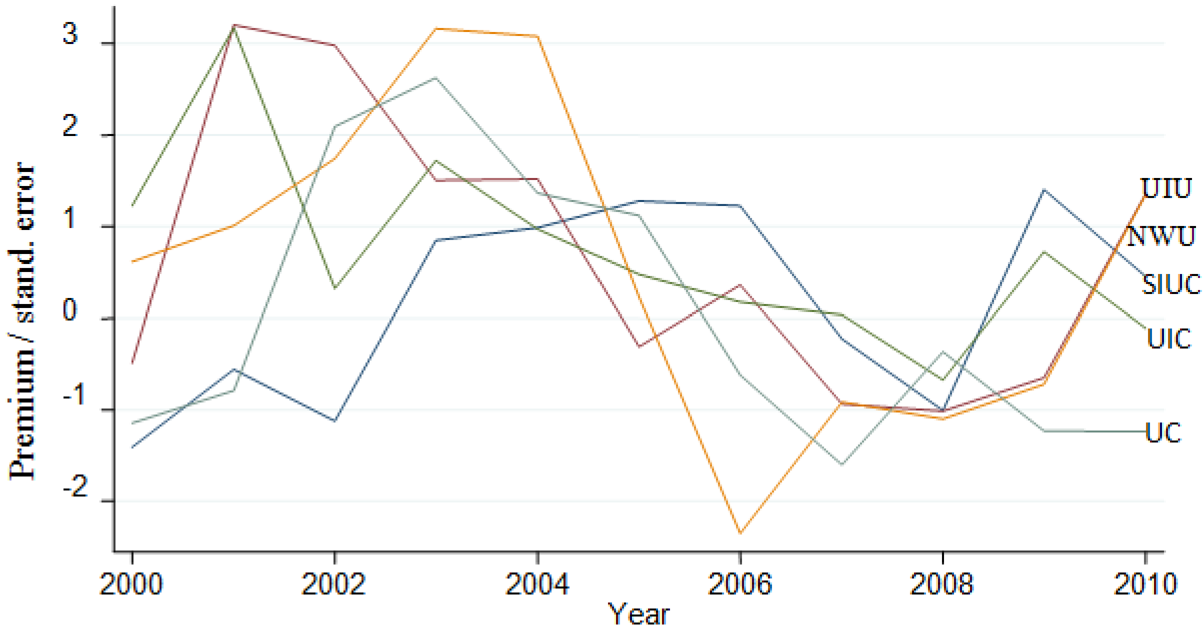

Figure 1.2: Master's graduation premiums of selected Illinois universities

Table 1.2: Correlation matrix of master's and PhD premiums of universities in Illinois

		Master's premium		PhD premium	
		Total student	Native	Total student	Native
Master's Premium	Total Student	1			
	Native	0.96	1		
PhD premium	Total Student	-0.08	-0.01	1	
	Native	-0.11	-0.05	0.95	1

higher premiums in master's and lower in PhD programs or vice-versa.

1.4.2 University graduation premiums and foreign students in Illinois

In the second stage regressions, we apply variance weighted least squares (VWLS), instrumental variable regressions (IV) and difference generalized method of moments (DGMM) on equation (1.2). The independent variables used to explain the premiums include the share of foreign students in total graduates of each program (IR), research expenditure (Res. Exp.), average 9-month equivalent faculty salary (Facu. Salary), ratio of faculty to total graduate students (Facu._Grad), dummy indicator for public universities, and university fixed effects. We use the standard errors of the estimated premiums as weights to give more emphasis to the significant premiums than the insignificant ones.

The results show that master's and PhD graduation premiums are positively related to the share of international students in total graduates. Estimated coefficients of the degrees share of foreign students are positive in all regressions regardless of the technique we use, and many of them are significant. However, the magnitude of the coefficients is different for the master's and PhD programs and varies across the different estimation techniques. With respect to the externalities that foreign graduates may generate, we indicate that the share of foreign degree recipients is positively related to the graduation premiums among the native students. This suggests that international students not only increases university graduation premiums among the total student population, but also generates positive externalities that increase the premiums among the native students.

1.4.2.1 Variance weighted least squares estimation of the premiums

The VWLS estimation results for the master's graduation premium are presented in Table 1.3. The dependent variable is the graduation premium among the total master's students in columns 1 - 4 and among the native master's students in columns 5 - 8. Similarly, Table 1.4 presents the VWLS estimation results for the PhD graduation premiums. In both tables we use research expenditure (in columns 1, 2, 5, & 6) and average faculty salary (in columns 3, 4, 7, & 8) as time varying controls for quality, focus, and interest of universities. Faculty to total graduate student ratio and dummy control for public universities are also included in columns 2, 4, 6, and 8.

The results in Table 1.3 suggests that one percentage point increase in the share of foreign master's degree awardees increases master's graduation premium among the total students by about 0.3 graduates; average of the 0.35 and 0.27 graduates when using research expenditure and average faculty salary, respectively, as university quality measures. This implies that the extra number of master's degrees a department in a given university confers - relative to the average number of degrees conferred by a department in an average performance university - increases by 0.3 in response to the one percentage point increase in the share foreign master's recipients. Similarly, PhD graduation premiums (in Table 1.4) increase by about 0.13 as a result of one percentage point increase in foreign students share of PhD recipients. Increasing share of degrees awarded to international students may require increased admission of foreign students relative to natives or admitting highly qualified foreigners with a higher ability to successfully finish their studies. Neither of these may require reducing admissions to native students.

The number of new foreign students required to achieve one percentage point increase in the share of degrees conferred to them depends on their current enrollment size. The bigger their current size the higher the number of new students required to achieve one percentage point increase in their enrollment and degree shares. In our setup, the fixed coefficient on the share of foreign degree recipients implies that one percentage point increase in the share of foreign graduates impacts the premiums by the fixed coefficient, irrespective of the size of foreign graduates. This may suggest that adding one more foreign student produces more premium when the current size of foreign students is rather small which favors diminishing marginal effect of foreign students on the graduation premiums.

With regard to the externalities that foreign students generate towards their native counterparts, we find positive effects of international students on PhD (Table 1.4) graduation premiums among the native students. One percentage point increase in the share of foreign doctoral recipients increases PhD graduation premiums among the native students by more than 0.17 graduates. This suggests that the presence of foreign students in a given department may create an environment that increases the effort of students and competition among each other. As a result, both foreign and domestic

Table 1.3: VWLS results for the master's graduation premiums

	Total graduation premiums				Native graduation premiums			
	1	2	3	4	5	6	7	8
IR	0.360***	0.360***	0.269***	0.270***	0.002	0.003	-0.069	-0.068
	(0.058)	(0.058)	(0.066)	(0.066)	(0.050)	(0.050)	(0.056)	(0.056)
Res. Exp.	-0.041***	-0.041***			-0.024***	-0.024***		
	(0.011)	(0.011)			(0.009)	(0.009)		
Facu. Salary			-0.412***	-0.412***			-0.361***	-0.360***
			(0.037)	(0.037)			(0.035)	(0.036)
Facu._Grad		-0.003		-0.003		-0.004		-0.006
		(0.009)		(0.009)		(0.009)		(0.009)
Public		-5.379***		.261		-0.107		4.692**
		(1.790)		(1.922)		(1.726)		(1.839)
Univ. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	480	480	438	438	480	480	438	438
Model $\chi 2$	3026	3026	2431	2431	3082	3081	2361	2360

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

We include dummy control for Trinity International University in the years 2000-2003 where the share of foreign graduates (IR) show very large fluctuations. But, the results are similar to those without this control.

students may become successful in completing their studies on time. Hence, the presence of foreign students generates peer effect that increases the degree completion of native students.

University quality indicators, research expenditure and average faculty salary, impacts the master's and PhD graduation premiums differently. While both variables influence the master's premium negatively, their effect is positive on the PhD graduation premium. Universities with rigorous research activities and higher pay for faculty may favor producing doctorates than master's graduates. They may have a greater interest in innovation and production of knowledge by attracting highly skilled students, and engaging them in different research projects. Such universities with high-caliber faculty who spend more time on research are highly efficient in the production of doctorates. As a result, they may tend to give less weight to their master's programs as compared to the focus and efficiency of small universities, with relatively lower spending on research and faculty, in the production of master's graduates. Finally, the results

Table 1.4: VWLS estimation results for the PhD graduation premiums

	Total graduation premiums				Native graduation premiums			
	1	2	3	4	5	6	7	8
IR	0.129**	0.129**	0.141**	0.141**	0.186***	0.191***	0.175***	0.175**
	(0.060)	(0.060)	(0.060)	(0.060)	(0.068)	(0.068)	(0.068)	(0.068)
Res. Exp.	0.037***	0.037***			0.051***	0.051***		
	(0.010)	(0.010)			(0.009)	(0.009)		
Facu. Salary			0.223***	0.234***			0.272***	0.274***
			(0.047)	(0.049)			(0.045)	(0.047)
Facu._Grad		0.032		-0.096		0.156		-0.017
		(0.119)		(0.123)		(0.118)		(0.121)
Public		-20.313***		-12.137***		-29.625***		-15.946***
		(4.840)		(3.534)		(4.712)		(3.498)
Uni FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	148	148	148	148	148	148	148	148
Model $\chi 2$	817	817	808	807	696	695	690	690

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

indicate that public universities have lower premiums than private universities in the production of both master's and PhD graduates.

1.4.2.2 Instrumental variables regression of the premiums

To correct for the possibility of endogeneity that arise from unobserved factors that affect both the premiums and the share of foreign graduates, we estimate our model using instrumental variables regression and DGMM. In our IV regressions, one year lag of the graduation premiums among the total students, and faculty diversity measured by the share of foreign faculty members are considered as instruments. We use these instruments in both the master's and PhD equations, and test their relevance using different test statistics. Table 1.4 and 1.5 shows the IV regression results for master's and PhD graduation premiums, respectively.

Instruments in IV regression are assumed to be correlated with the endogenous variables, but exogenous and uncorrelated with the outcome of the process. The latter implies that the instruments should be orthogonal to the error term in the regression.

However, if this assumption does not hold, the IV regression will not perform better than the OLS at removing biases of the estimated coefficients. In this respect, the relevance of the instruments is tested using the Sargan and Hansen overidentification tests. Under the null hypothesis that the instruments are valid, these tests help to verify whether the instruments are actually uncorrelated with the residuals of the model. The Hansen test is used when the standard errors are robust. The other issue with instruments that are exogenous (pass the overidentification test) is the strength of their relationship with the endogenous variables. The underidentification test using Kleibergen and Paap (2006) *rk* statistic is used to test whether the minimal canonical correlation between the endogenous variables and the instruments is statistically different from zero. In addition, the weak identification test of (Stock and Yogo, 2005) assesses if the instruments are weakly correlated with the endogenous variable. If the non-zero correlation between the instruments and endogenous variables is small (weak) the estimators will be as biased as the OLS estimators.

In the IV regressions, we test the relevance and strength of the two instruments, lagged premium and percentage of foreign faculties. In the master's premiums equation, the Sargan and Hansen tests of overidentification show that the instruments are not orthogonal to the errors. This problem may arise if one instrument is correlated with the error term. When we replace the share of foreign faculties by the share of non-white faculty members as an indicator of faculty diversity, these test statistics rejects the null that the errors are correlated with the instruments. Testing each instrument separately, faculty diversity has limited correlation with the endogenous variable (share of foreign students in total master's graduates) and the underidentification test fails to reject the null that their correlation is zero. However, the lagged premium performs better as an instrument and pass the underidentification test in all setups. When the numbers of endogenous variables and excluded instruments are equal the model is exactly identified and the estimation forces the correlation between the instrument and errors to be zero by construction. In Table 1.5, the Kleibergen-Paap underidentification LM test rejects the null that the lagged premium is uncorrelated with the endogenous variable, the share of foreign master's graduates. Similarly, the Anderson-Rubin Wald test, which is

Table 1.5: IV estimation results for the master's graduation premiums

	Total graduation premiums				Native graduation premiums			
	1	2	3	4	5	6	7	8
IR	4.470*	4.444*	4.177*	4.158*	3.666	3.632	3.396	3.370
	(2.378)	(2.368)	(2.364)	(2.356)	(2.325)	(2.310)	(2.407)	(2.394)
Res. Exp.	-0.102*	-0.101*			-0.072	-0.072		
	(0.054)	(0.054)			(0.046)	(0.046)		
Facu. Salary			-0.395***	-0.394***			-0.288*	-0.286*
			(0.146)	(0.146)			(0.158)	(0.157)
Facu._Grad		-0.016		-0.013		-0.020*		-0.016
		(0.013)		(0.015)		(0.012)		(0.013)
Public		-28.710*		-28.465*		-23.468		-22.944
		(15.278)		(15.081)		(15.082)		(15.411)
Univ. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	436	436	436	436	436	436	436	436
Underid. test	7.578	7.592	7.259	7.274	6.452	6.484	5.507	5.539
A-R Wald $\chi 2$	7.004	6.962	5.829	5.809	4.685	4.620	3.548	3.514

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Underid is the Anderson canonial correlation LM statistic for Underidentification test.

A-R Wald is the Anderson-Rubin weak-instrument-robust test of significance of the endogenous variable

As in the VWLS, we include dummy control for Trinity International University in the years 2000-2003.

robust to the presence of weak instruments, also rejects the null hypothesis that the coefficient of the endogenous regressor is zero in the main equation. The tests and steps we follow are the same for the total and native graduation premiums. Finally, we use one year lag of the total graduation premium as an instrument in both equations.

We use the same instruments in the PhD graduation premium equation and follow similar testing procedures to verify the validity of the instruments. When the model is estimated using both instruments, the overidentification test suggests that the instruments are valid and orthogonal with the residuals. However, the Kleibergen-Paap underidentification test fails to reject the null that the instruments are uncorrelated with the endogenous variable. Since this is a joint significance test, we proceed to determine the relevance of each instrument separately. Individually, the test shows that the model is identified when we use the share of foreign faculty as the only instrument. The Anderson-Rubin Wald weak-instrument-robust test also shows that the endogenous variable is significant when the share of foreign faculty is used as an instrument.

The IV regression results in Tables 5 and 6 suggest that the share of foreign graduates affects masters and PhD graduation premiums positively. One percentage point increase in the share of foreign graduates in master's and PhD programs increases university master's and PhD graduation premiums by about 4 and 2 graduates, respectively. As a result, departments in a university with such increase in foreign degree recipients offer 4 more master's and 2 more PhD degrees than the average number of graduates in similar programs of other universities. These effects are much higher than the increase in premiums by about 0.3 for masters and 0.13 for PhD that we find using the VWLS. The results also suggest that foreign degree recipients produce externality that increases the graduation premiums among native students, particularly in PhD programs. One percentage point increase in the share of foreign doctorate recipients increases PhD graduation premiums among the native students by 2.5 graduates, higher than the effect on total PhD graduation premiums. The estimated coefficient of the share of foreign degree recipients is significant at 10% level in the master's and PhD graduation premiums, as well as the PhD graduation premiums among the native students. Furthermore, the IV results are consistent with the VWLS results and suggests that research expenditure and average faculty salary have significant negative effects on master's, but positive on PhD graduation premiums.

1.4.2.3 DGMM estimations of the premiums

Our third method of estimation is the DGMM technique using internal instruments by taking lags of the instrumented variables. It uses lags of the level endogenous variable - share of foreign graduates - as instruments in the first difference equation. The lag length of the instruments is chosen in a way that the number of instruments does not exceed the number of groups (universities). The DGMM estimation results are shown in Tables 7 and 8. We include lag of the dependent variable - graduation premiums - in

Table 1.6: IV estimation results for the PhD graduation premiums

	Total graduation premiums				Native graduation premiums			
	1	2	3	4	5	6	7	8
IR	1.939*	1.902*	1.701	1.731*	2.667*	2.543*	2.615*	2.586*
	(1.121)	(1.046)	(1.089)	(1.063)	(1.469)	(1.327)	(1.527)	(1.480)
Res. Exp.	0.051***	0.050***			0.055**	0.055**		
	(0.018)	(0.018)			(0.023)	(0.021)		
Facu. Salary			0.313**	0.327**			0.250	0.229
			(0.147)	(0.149)			(0.172)	(0.176)
Facu._Grad		0.082		-0.108		0.351		0.199
		(0.412)		(0.379)		(0.505)		(0.532)
Public		-69.939**		-57.917**		-84.128**		-73.807*
		(31.195)		(28.999)		(36.951)		(38.592)
Uni. FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	141	141	141	141	141	141	141	141
Underid. test	4.364	4.707	3.928	4.107	3.878	4.215	3.942	4.079
A-R Wald $\chi2$	5.365	5.831	5.644	6.086	5.109	5.380	5.926	6.032

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Underid is the Anderson canonial corrlation LM statistic for Underidentification test of Anderson

A-R Wald is the Anderson-Rubin weak-instrument-robust test of significance of the endogenous variable

columns 2, 4, 6 and 8 to introduce dynamics in the model. The internal instruments are two and three years lagged values of the share of foreign graduates and graduation premiums. Lags of the dependent variable are used in the dynamic regressions as an instrument for the dynamic variable - one year lag of the dependent variable. The DGMM estimation results provide similar implications as those from the other techniques. We find that one percentage point increase in the share of degrees granted to foreigners increases master's and PhD graduation premiums by about 1 and 0.5 extra graduates, respectively. These numbers are a little higher than those from VWLS, but much lower than the ones from the IV regressions. With respect to the premiums among natives, we find a significant and positive externality effect on PhD graduation premiums when research expenditure is used as university quality control.

The coefficient of faculty to graduate student ratio is significant and positive in the

Table 1.7: DGMM results for the master's graduation premiums

	Total graduation premiums				Natives graduation premiums			
	1	2	3	4	5	6	7	8
Lag Prem.		0.302*		0.300*		0.219		0.217
		(0.172)		(0.175)		(0.174)		(0.178)
IR	0.831***	1.193*	0.967**	0.820	0.312	-0.088	0.318	0.070
	(0.215)	(0.669)	(0.476)	(0.543)	(0.336)	(0.359)	(0.358)	(0.354)
Res. Exp.	-0.040	-0.034			-0.030	-0.030		
	(0.046)	(0.029)			(0.025)	(0.022)		
Facu. Salary			-0.573***	-0.410**			-0.437***	-0.470***
			(0.142)	(0.162)			(0.093)	(0.113)
Facu._Grad	-1.269	0.112**	0.156***	0.094**	-0.864	-0.005	0.075***	0.038
	(0.945)	(0.044)	(0.021)	(0.040)	(0.706)	(0.063)	(0.013)	(0.049)
Obs.	436	392	394	392	436	392	394	392
Instruments	20	37	20	37	20	37	20	37
Hansen P value	0.466	0.574	0.452	0.319	0.368	0.469	0.228	0.448

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

As in the VWLS, we include dummy control for Trinity International University in the years 2000-2003.

master's premiums implying that the higher faculty-to-students ratio the higher the master's premium will be. Unlike in the other techniques, coefficients of research expenditure and faculty salary turns to be insignificant. Finally, the effect of public ownership is not included in these regressions because the DGMM technique takes the first difference of the variables.

1.4.3 Graduation premiums and foreign students in California universities

Due to data limitation, the estimation of graduation premiums for the universities in California is limited to the master's program. Enrollment data in the archive of CPEC are available for only the two systems, California State University (CSU) and University of California (UC). Since universities in the CSU system are largely confined to grant master's or bachelor's degree, the estimation of PhD graduation premiums lacks diversity in the doctorate-granting institutions. Partial results of the first stage

Table 1.8: DGMM results for the PhD graduation premiums

	Total graduation premiums				Natives graduation premiums			
	1	2	3	4	5	6	7	8
Lag Prem.		0.027		0.016		0.033		-0.006
		(0.166)		(0.160)		(0.173)		(0.163)
IR	0.518*	0.454**	0.647*	0.528	0.517**	0.313	0.455	0.333
	(0.263)	(0.213)	(0.309)	(0.318)	(0.184)	(0.185)	(0.302)	(0.256)
Res. Exp.	0.017	0.019			0.025	0.009		
	(0.040)	(0.041)			(0.026)	(0.030)		
Facu. Salary			0.321	0.259			0.251	0.177
			(0.244)	(0.281)			(0.162)	(0.212)
Facu._Grad	-1.119	-0.663	-1.459**	-0.925	-0.834	0.093	-1.241	-0.014
	(0.942)	(0.857)	(0.696)	(0.736)	(1.349)	(1.446)	(0.984)	(1.238)
Obs.	129	110	129	110	129	110	129	110
Instruments	13	24	13	24	13	24	13	24
Hansen P Value	0.306	0.750	0.260	0.570	0.334	0.750	0.225	0.707

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

regressions and the estimated university master's graduation premiums are reported in appendix Table A3. As in the case of Illinois universities, the results indicate that all the lagged enrollment variables are significant determinants of graduation. In addition, the control for discipline, 2008 - 2012 average salary of new assistant professors by the 2-digit instructional program, has some positive effect on the master's graduation. The results also show that many of the estimated graduation premiums are individually significant. Further, the joint F-statistics indicates that the premiums are jointly significant in most years.

The second stage regressions using DGMM to account for endogeneity are reported in Table 1.9. We observe that an increase in the share of foreign degree recipients is positively related to the master's graduation premiums among the total students in California universities. One percentage point increase in international students' share of master's recipients increases the university graduation premium by more than 0.3 graduates. We also observe that foreign degree recipients generate significant externality on the graduation premiums among the native students. One percentage point increase

Table 1.9: DGMM results for master's graduation premiums in California universities

	Total graduation premiums						Natives graduation premiums					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lag Prem.			0.26***			0.22***			0.31***			0.29***
			(0.06)			(0.07)			(0.07)			(0.07)
IR	0.57***	0.55***	0.38**	0.51***	0.49**	0.37**	0.32**	0.33**	0.21	0.29*	0.32*	0.2
	(0.19)	(0.19)	(0.17)	(0.18)	(0.18)	(0.16)	(0.15)	(0.16)	(0.15)	(0.15)	(0.16)	(0.15)
Res. Exp.	-0.005	0.003	0.003				-0.004	0.001	0.001			
	(0.01)	(0.01)	(0.02)				(0.01)	(0.01)	(0.01)			
Facu. Salary				0.08**	0.13***	0.11**				0.05	0.09**	0.06
				(0.03)	(0.04)	(0.04)				(0.03)	(0.04)	(0.04)
Facu._Grad		0.60***	0.68***		0.84***	0.86***		0.54***	0.66***		0.70***	0.75***
		(0.18)	(0.21)		(0.24)	(0.25)		(0.17)	(0.21)		(0.20)	(0.23)
Obs.	575	575	545	575	575	545	575	575	545	575	575	545
Instruments	46	47	92	46	47	92	46	47	92	46	47	92
Hansen P Value	0.971	0.964	1	0.974	0.987	1	0.973	0.975	1	0.971	0.975	1

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

UC Riverside is dropped in 1999 because the share of foreign graduates almost doubled, 17.1% in 1998 to 33.5% in 1999

in the share foreign degree recipients increases the graduation premiums among the natives by about 0.3 graduates. Comparing the effect of foreign graduates in the California and Illinois universities, we find similar positive and significant effect on the master's graduation premiums among the total student with minor differences in the magnitude. With respect to the effect on graduation premiums among native students, it is significant only in the California universities, although positive in both states.

Unlike the results in Illinois universities, we find that average faculty salary is positively related to graduation premiums among the total and native students. The main differences, which may be responsible for this divergent results, are the pool of universities and length of the study period in the two states. While both public and private universities are included in the Illinois data, only public universities are included in California. The latter is mainly due to lack of enrollment data for universities other than those in the CSU and UC systems. Different payment scales in public and private universities may have caused the different effects of faculty salary on the graduation premiums among universities of the two states. On the other hand, the length of the study period is much longer in California than Illinois. Depending on availability of lagged enrollment data and institutional variables from the IPEDS database, we estimate master's graduation premiums from 1985 to 2009 for California universities and from 2000 to 2010 for Illinois universities. Thus, the length of study period may influence the effect of faculty salary on the graduation premiums. Lastly, faculty to total graduate student ratio has a positive effect on the premiums suggesting that small class size or large faculty size results in higher premiums.

1.5 Conclusion

Enrollment of international students in US graduate programs has increased dramatically in the past decades. The students contribute to their departments, universities, and the country in different aspects. The US has maintained its' lead in science and technology to which the contributions of talented foreign scholars, scientists, and students from around the world is indisputably significant. Some studies have analyzed the impact of skilled immigrants and international students on innovation and the production of knowledge. The studies proved the significant role skilled immigrants play in the advancement of knowledge and technology. However, few studies have looked at the impact of the increased enrollment of foreign students on native graduate school enrollments. Although the results of such studies are mixed depending on fields of study and ethnic/racial groups, recent studies by Shih (2015) and Regets (2007) find some crowding in effect on native students.

Other than the few studies on publications and research production, there is no study that analyzes the impact of foreign students on the graduation performance of universities and native students. In this study, we provide a different perspective by analyzing the effect of international students on university graduation premiums following the wage premium methodology. We estimate graduation premiums that measure the proportional difference in the number of master's and doctorate recipients across fields of study and universities unexplained by enrollments, but university specific characteristics, most importantly performance. Graduate schools in the US are characterized by low completion rates and longer duration between starting and completing graduate programs. The completion rates differ from university to university and across fields of study. Accordingly, the premiums capture how many more or fewer students graduate with master's or PhD from a certain field of study in a given university relative to the average number of graduates across departments in the sample universities.

We estimate master's and PhD graduation premiums for the total student population and separately for native students using enrollment and graduation data from the Illinois Board of Higher Education and California Postsecondary Education Commission. Following the estimation of graduation premiums, we examine how the share of foreign graduates impacts the premiums. Using three estimation techniques, variance weighted least squares, instrumental variables regression, and difference generalized method of moments, we show that the share of foreign graduates increases university master's and PhD graduation premiums. The estimated coefficients using the difference generalized method of moments lie in-between those from the other two methods, and suggests that one percentage point increase in the share of foreign master's and PhD graduates increases master's and PhD graduation premiums by about 1 and 0.5 additional graduates, respectively, among universities in Illinois. Similarly, a percentage point increase in the share of foreign graduates increases master's graduation premiums by more than 0.3 among universities in California. In addition, the results show that foreign degree recipients generate positive externalities that increase the graduation premiums among the native students. We find a positive and significant effect of foreign degree recipients on the natives' doctoral and master's graduation premiums in Illinois and California, respectively. These suggest that universities with a higher share of foreign graduate students enjoy higher completion rates not only among their international students, but also their native graduate students as well.

CHAPTER 2

EXPORT ENTRY AND EXIT SPILLOVERS FROM EXPORTS AND FDI IN THE ETHIOPIAN MANUFACTURING

2.1 Introduction

In today's developing economies the competition to attract foreign investment and expand trade relations has become an important economic strategy to satisfy the quest of the society for rapid economic growth. The failure of inward-looking economic policies to change the trajectory of long-stagnated economies motivated countries adopt outward-looking trade policies and market economy. As a result, attracting foreign investment and promoting exports emerge to be significant economic and trade strategies. Foreign investment is believed to provide multidimensional benefits to the host economy both directly and indirectly. The main direct benefit is capital inflow that fills the financial gap between required investment and available domestic savings to achieve rapid economic growth. In doing so, foreign investment avails employment opportunities for the mass unemployed young workers, increase per capita income, and generate foreign exchange. In addition, as governments promote foreign direct investment, they deploy transportation, communication, education, and health infrastructures that contribute to the betterment of the general population.

While the direct benefits are important in the short-run, the indirect benefits of diffusion of knowledge and technical know-how towards domestic firms and workers are deemed to be far more significant in the long run. Indirect benefits, generally known as spillover effects, affect the productivity, efficiency, and internationalization of host countries' economic institutions. Thus, spillover effects from foreign direct investment (FDI) have amassed an extensive body of literature in the past two decades. Early studies focused on horizontal spillovers that affect the productivity of firms within the same industry (Caves, 1974; Blomström, 1986; Kokko, 1994; Blomström and Sjöholm, 1999; Haddad and Harrison, 1993; Aitken and Harrison, 1999). According to Gorg and Greenaway's (2004) review of such studies, the evidence for intra-industry productivity spillover is weak or at best mixed. On the other hand, a meta-analysis of later studies on inter-industry (vertical) spillovers such as Javorcik (2004) and Blalock and Gertler (2008) shows strong evidence supporting knowledge transfer from foreign-owned firms towards their domestic suppliers (backward spillover), but small forward and no horizontal spillovers (Havranek and Irsova, 2011).

Aside from the large body of literature on productivity gains from FDI, only a few attempts have been made to explore spillovers on other aspects of domestic firms, such as participation in international markets. Similarly, research on firms' export activity has been concentrated on the relationship between productivity and export status; whether more productive firms self-select to become exporters or there exists learning by exporting to increase productivity. Few studies have examined whether foreign-owned and exporting firms affect the decision of domestic firms to start exporting and the volume of their exports. Among these studies, Aitken et al. (1997) for Mexico and Greenaway et al. (2004) for the UK show that the export activities of multinational enterprises increase domestic firms' probability of being exporters. In addition, using data from Spanish manufacturing Barrios et al. (2003) indicate that export activities of domestic firms increase the likelihood of others to start exporting, but multinational exporters generate no such benefit to local firms. Unlike the others, Kneller and Pisu (2007) explores not only intra-industry but also inter-industry spillovers from multinational enterprises. They find the presence of multinationals in the same or vertically linked industries affects the probability of exporting and export volume of domestic firms.

The literature on export spillovers, i.e. externalities from FDI and exporting activities on local non-exporting firms' decision to enter the export market and how much to export, has mostly been concentrated on horizontal spillovers from multinational enterprises (both exporting and non-exporting). Externalities, particularly vertical spillovers, from domestic exporting firms have been overlooked. Further, available studies focus on the intensive and extensive margins of exports, not the duration of exports.

Policies to increase and strengthen export activities are crucial given the direct and indirect benefits of exports to individual firms and overall economic growth of a country. As a result, promoting exports through incentives such as lower import duties on capital goods or intermediate inputs, reducing export tariffs, increasing access to transportation and communication infrastructures, and providing information are important. However, entry is not enough to materialize the benefits from export markets. As much as the need to enter the market, prolonged duration in the market is needed to materialize the gains fully. Besedes and Prusa (2007) show shorter export duration for products of developing countries and suggest that maintaining a higher survival rate of existing trade flows than introducing new ones is the key to achieve faster export growth. Recent studies such as Harris and Li (2011), Esteve-Perez et al. (2007), and Ilmakunnas and Nurmi (2010) examines firm-level characteristics that affect export survival rates and exit risks.

To our best knowledge, no study examines spillover effects on export survival of domestic firms. Accordingly, we consider whether the presence of domestic exporting and foreign-owned firms in the same and vertically linked sectors reduce the time local manufacturers take to start exporting and their persistence once started exporting. We combine the two strands of literature, spillovers and firms' export entry-exit, to assess effects of the former on the latter using duration and multinomial logit models. With few exceptions, such as Ilmakunnas and Nurmi (2010) and Harris and Li (2011), previous studies examined determinants of switching between exporting and non-exporting, but not the length of exporting spells and only Ilmakunnas and Nurmi (2010) considered the length of non-exporting spells. We follow the method adopted by

Ilmakunnas and Nurmi (2010) to examine spillover effects on how long local firms take to start exporting and for how long they stay exporting.

Unlike other regions, the issues of foreign presence, exporting, and spillovers are underinvestigated in Sub-Saharan Africa (SSA) region. Among the few studies in the region, Waldkirch and Ofosu (2010) and Görg and Strobl (2005) examine the effect of foreign investment on the productivity of Ghanaian manufacturing firms and Amendolagine et al. (2013) studies the backward linkages between foreign and local firms using cross-sectional data for 19 SSA countries. However, there is no study that examines spillover effects on firms' export entry and exit as well as the duration of exporting among firms in SSA. Thus, we use the Ethiopian manufacturing survey data in an attempt to provide empirical evidence on how foreign presence decreases the sunk export entry cost for local firms to easy access international markets and prolong their duration once they enter the market.

2.2 Methodology

2.2.1 Estimation strategies

This chapter analyzes spillover effects from domestic exporting and foreign-owned firms on the time local firms take to start exporting and how long they last exporting once started. To meet this objective, we estimate export entry and exit using discrete-time proportional hazards model. Entry is modeled by taking domestic non-exporting firms to examine the duration until they start exporting. Similarly, an export exit is modeled by taking currently exporting domestic firms to analyze the duration until exit from exporting. Furthermore, using a multinomial logit model, we examine the dynamics of exporting decision conditional on previous year exporting status - continue non-exporting, start, continue, and exit exporting.

To outline the model, let T_i denote the failure event of firm i, i.e., the time the firm starts exporting in the case of export entry and the time it stops exporting in the case of export exit. Hence, T_i is the spell length a firm stays in a given state. Since the manufacturing survey is undertaken annually, we consider T_i as a discrete random variable taking values $t = 1, 2, ..., n$, with a probability density function $f_i(t) = Pr(T_i = t)$. Based on Jenkins (2005), the survival function for the random variable T_i is given by:

$$S_i(t) = Prob(T_i \geq t) = \sum_{k=t}^{\infty} f_i(k). \tag{2.1}$$

It indicates the probability, as a function of time, that firm i continues in a given state beyond time t, i.e., the event of interest, starting to export in the case of entry or stop exporting in the case exit, has not yet happened at time t.

In the discrete time duration model, the hazard rate for export entry, $h_i(t)$, is defined as the conditional probability that firm i starts exporting at time t given it has not been exporting until time $t-1$. The same definition applies to the hazard rate of export exit, which is the conditional probability of leaving the export market at time t conditional on surviving in the market up until time $t-1$. Such hazard functions are given by:

$$h_i(t) = Prob(t-1 < T_i \leq t | T_i > t-1) = \frac{f_i(t)}{S_i(t-1)}. \tag{2.2}$$

Estimation of the hazard rate for export entry and exit based on observed firms' characteristics can be fitted using a linear function by adopting a complementary log-log (*cloglog*) distribution or logistic distribution. The *cloglog* model is the discrete time representation of a continuous time proportional hazards model, whereas the logistic model is applied for survival times, which are intrinsically discrete (Jenkins, 2005). Hence, *cloglog* is widely applied in interval-censored survival data analysis, such as market (including export) entry and exit of firms. Therefore, we use the *cloglog* discrete hazards function of the form:

$$h_i(t) = prob(t - 1 < T_i \leq t | T_i \geq t) = 1 - exp[-exp(\beta' X_{it} + \gamma_t)] \tag{2.3}$$

where X_{it} represents the vector of explanatory variables that affect firms' exporting decisions. The baseline hazard, γ_t, summarizes the pattern of duration dependence, which is estimated using a log of the duration time as a covariate.

In the analysis of export entry, the duration time is given by the number of consecutive years a firm reported zero exports. Similarly, the duration of exporting spells in the analysis of export exit is the number of consecutive survey years a firm reported positive exports. These two duration times may not reflect the correct non-exporting and exporting duration of firms who happened to have zero and positive exports in the first survey round, respectively. There is no information regarding firms' exporting history before appearing in the survey for the first time. For firms who report positive exports the first time they are surveyed, it is not clear when they started exporting and for how long they have been exporting. This may underestimate the possibility of positive duration dependence that explains the persistence in a given state.

The dependent variable is a sequence of zeros showing non-exporting and exporting in the analysis of export entry and exit, respectively. When a firm starts exporting or exit from exporting, the dependent variable takes a value of 1 (showing entry or exit). Afterward, the firm will no longer appear in the analysis. One issue in the analysis of export exit is the presence of multiple spells where some firms exit the market and reenter later after some years. We allow for one year export absence by treating zero exports for a year in a sequence of positive exports as if the firm is still in the export market. However, if a firm fails to export for more than a year it is considered as a complete exit from the export market and the firms reentry at a later time is not included in the analysis.

In addition to the duration models, we estimate multinomial logit model to examine the impacts of spillover effects on the dynamics of firms' exporting activities. We model firms' decision by generating four possible paths depending on previous year exporting status: continue non-exporting, start exporting (given no exports in the previous year), continue exporting, and exit from exporting. The first and the third cases are keeping the status quo of non-exporting and exporting, respectively. The second (entry into export market) and the fourth (exit from the market) are transitions from one state to another. Accordingly, the dependent variable, Y_{it}, which is the export decision of firm i at time t is assigned four different values: $Y_{it} = 1$ if $export_t = 0$ given $export_{t-1} = 0$; $Y_{it} = 2$ if $export_t > 0$ given $export_{t-1} = 0$; $Y_{it} = 3$ if $export_t > 0$ given $export_{t-1} > 0$; and $Y_{it} = 4$ if $export_t = 0$ given $export_{t-1} > 0$. As a result, the probabilities of the four export decisions as a function of a set of explanatory variables takes the form (Greene, 2013):

$$Prob(Y_{it} = j|X_{it}) = \frac{exp(X'_{it}\beta_j)}{\sum_{k=1}^{4} exp(X'_{it}\beta_k)}, k = 1, 2, 3, 4 \tag{2.4}$$

This equation is estimated using maximum log-likelihood method and provides a set of probabilities for the four export choices made by a firm with X_{it} individual and industry level characteristics including the spillover effects. Finally, the multinomial logit model avoids the problem of multiple spells that we face in the duration models. However, it does not explain the duration dependency of exporting and non-exporting spells.

2.2.2 Spillover indexes and control variables

The explanatory variables, X_{it}'s, include firm-level characteristics and industry-level proxies for horizontal and vertical spillovers from domestic exporting and foreign-owned firms. Spillover effects may arise from three groups of firms: foreign-owned firms serving domestic markets, foreign-owned exporting firms, and domestic exporting firms. Each group may generate both horizontal and vertical (backward and forward) spillovers towards the export decision of domestic firms. Horizontal spillovers refer to the externalities generated by these firms towards domestic firms in the same sector. On the other hand, vertical spillovers benefit local suppliers in upstream sectors (backward spillover) and local customers in downstream sectors (forward spillover).

We define horizontal spillovers from the foreign-owned firms serving domestic markets by the share of their domestic sales in total sales of the sector they operate. The index to capture such spillovers is given by:

$$Hor\_F\_NX_{jt} = \frac{S^f_{jt} - E^f_{jt}}{S_{jt}}$$

where S^f_{jt} is the total sales of foreign-owned firms in sector j, E^f_{jt} is the value of their exports, and the denominator, S_{jt}, is the total sales of the sector. Similarly, the horizontal spillovers from domestic and foreign-owned exporting firms are given by the share of their respective export sales in total sales of the sector they operate. The proxies are:

$$Hor\_F\_X_{jt} = \frac{E^f_{jt}}{S_{jt}}$$

and

$$Hor\_D\_X_{jt} = \frac{E^d_{jt}}{S_{jt}},$$

where E^d_{jt} is the total exports of domestic firms in sector j. Thus, $Hor\_F\_X_{jt}$ and $Hor\_D\_X_{jt}$ capture the horizontal spillovers emanating from foreign-owned and domestic exporting firms, respectively.

We use the national input-out table to determine supplier-buyer linkages and drive the backward and forward spillovers generated by the three groups of firms. Following the measures proposed by Javorcik (2004), we compute the index for backward spillovers generated by the the foreign-owned firms serving local markets as:

$$Back\_F\_NX_{kt} = \sum_{j \neq k} \alpha_{kj} Hor\_F\_NX_{jt}$$

where α_{kj} is the proportion of sector k's output supplied to sector j, excluding the output used for final consumption. This is taken from the 2005/06 Ethiopian Social Account Matrix (SAM), which we utilize to create the input-output table by matching the activity and commodity accounts in the matrix. Thus, $Back\_F\_NX_{kt}$ is the weighted share of the domestic sales of foreign-owned firms in downstream (customer) industries of sector k, where the weight is the proportion of sector k's output sold to each downstream sector. It is a proxy for backward spillovers towards firms in sector k from the foreign-owned firms in all customer sectors serving domestic markets. The index increases with an increase in the proportion of sector k's output supplied to sectors with large number of foreign-owned firms or an increase in the domestic sales of the foreign-owned firms.

Likewise, the proxy for forward spillovers from the foreign-owned firms serving domestic markets is computed as:

$$Fward\_F\_NX_{kt} = \sum_{j \neq k} \beta_{jk} Hor\_F\_NX_{jt},$$

where β_{jk} is the share of sector k's inputs purchased from sector j. This index captures spillovers generated by foreign-owned firms (serving local markets) in the intermediate input supplying sectors to sector k. Inputs from foreign-owned firms are presumed to transfer information and technology towards the local buyers. Following the same procedures, the indexes for backward and forward spillovers generated by domestic and foreign-owned exporting firms are given as:

$$Back\_F\_X_{kt} = \sum_{j \neq k} \alpha_{kj} Hor\_F\_X_{jt}$$

$$Fward\_F\_X_{kt} = \sum_{j \neq k} \beta_{jk} Hor\_F\_X_{jt}$$

$$Back\_D\_X_{kt} = \sum_{j \neq k} \alpha_{kj} Hor\_D\_X_{jt}$$

$$Fward\_D\_X_{kt} = \sum_{j \neq k} \beta_{jk} Hor\_D\_X_{jt},$$

where the first two are the backward and forward spillover indexes from foreign-owned exporting establishments and the last two are those from domestic exporting firms.

Other than the spillover indexes, labor productivity, the total value of production per worker, is considered as an explanatory variable that may affect firms' export decision.

Irrespective of whether exporting improves productivity or more productive firms self-select to export, theoretical and empirical evidence suggests that more productive firms are more likely to engage in export activities than the less productive ones. It is also possible that productive firms may have a higher chance to stay longer in export markets. As noted in Ilmakunnas and Nurmi (2010), the productivity effect reflects self-selection in the analysis of export entry. However, in the analysis of exit and multinomial logit model, it may not distinguish the possibility of a bi-directional relationship between exporting and productivity.

Firm size, proxied by the log of the number of workers, is an important leverage that improves profitability and the ability of firms to cover the sunk export entry cost. Large firms have the financial, technical, and managerial advantages to easily enter into and survive in the export markets. Moreover, ownership, private or public, influences firms' decision-making process. Public firms can be less efficient in production activities and handling of customers, which would reduce their chance to start exporting and survive in the market. Despite this disadvantage, public enterprises may have government support in the form of subsidy, lower export duties, access to credit, and other protections which could improve their access to international markets. Thus, we include an indicator for public ownership to examine the export status and performance of public versus private firms. In addition, we include capital intensity, the ratio of imported intermediate inputs, and industry and year fixed effects.

2.3 Data and descriptive statistics

We use the annual manufacturing survey data from the Ethiopian Central Statistical Agency (CSA) for the period 1996 - 2010. The agency annually collects data on all manufacturing plants that employ ten or more workers and use power-driven machines. The unbalanced panel dataset consists of more than 15,900 firm/year observations. However, export activity is confined to few sectors. The major exporting sectors are food and beverages, textiles, wearing apparel, and tanning leather and footwear.[1] Consequently, we limit our analysis of export entry and exit to these sectors where the unbalanced panel data has more than 6000 firm/year observations.

The dataset provides information on the values of production, sales, exports, employment, initial and current paid up capital by gender and citizenship status, total and imported intermediate inputs, investment, and several other variables. We deflate the values of some of these variables using appropriate price deflators from the Ethiopian ministry of finance and economic development (MoFED). Output, sales, and materials are deflated using implicit price deflator for large and medium manufacturing industries, and energy using implicit GDP deflator for water and electricity. To reduce inconsistencies in the reported year-end value of fixed capital, we construct a separate capital variable using the perpetual inventory method. We use 5% depreciation rate for buildings and 10% for machinery and equipment. Investment is deflated using implicit fixed capital formation deflator from the World Bank's world development indicators (WDI). Additionally, the census provides data on the number of permanent and temporary employees. Unfortunately, temporary employment data is unavailable for the year 2010, which forces us to measure labor by the number permanent employees.

The Ethiopian manufacturing sector has only a few exporters of limited product categories. The number of exporting firms has increased from only 24 in 1996, of which 9 were in the leather sector, to 88 in 2010 with 67 of them from the four main exporting sectors. This fourfold increase in the number of exporting establishments is accompanied by 200% increase (from 617 to 1895) in the number of manufacturing plants over the same period. Although the industry has shown increasing export activities and product diversification in recent years, it is still at its early stage by any standard. Furthermore, the sector is characterized by high rates of export entry and exit. Table 2.1 summarizes the export market entry and exit rates in the four sectors, allowing for one-year absence of firms from the export market.

[1] In subsequent discussions, we refer to wearing apparel and tanning leather and footwear sectors as apparel and leather, respectively.

Table 2.1: Export entry and exit rates of the four industrial groups

Year	All four sectors			Food & Beverages		Textiles		wearing apparel		Leather & footwear	
	Exporters	exit	entry	exit	entry	exit	entry	exit	entry	exit	entry
1997	24	20.00	35.00	20.00	40.00	40.00	0.00	0.00	200.00	11.11	33.33
1999	35	15.38	57.69	33.33	33.33	0.00	200.00	0.00	100.00	8.33	25.00
2001	37	21.62	16.22	27.27	18.18	0.00	16.67	25.00	0.00	25.00	18.75
2003	39	8.11	27.03	15.38	7.69	0.00	14.29	0.00	0.00	6.25	12.50
2005	50	20.00	20.00	7.69	7.69	40.00	10.00	50.00	75.00	16.67	33.33
2007	51	19.61	15.69	17.65	5.88	30.00	0.00	50.00	125.00	10.00	20.00
2009	64	14.81	27.78	12.50	31.25	10.00	40.00	83.33	33.33	18.18	18.18
Avg.	43	19.78	26.47	18.24	26.87	20.75	30.43	32.89	80.68	16.04	22.48

Source: own compilation using the manufacturing survey data

The entry rate is a ratio of the number of new exporting firms to the total number of exporting firms in the previous year. Similarly, the exit rate is a ratio of the number of firms exiting the export market (or production altogether) to the total number of exporting firms in the previous year. The pattern indicates that on average about 20% of firms exited the export market each year from 1997 - 2010. On the other hand, about 26% of firms started exporting each year out-pacing the exit rates, which contributes to the positive net growth in the number of exporting firms. The export turnover rate, average of the two rates, is about 23%. The average turnover rate is higher in the apparel sector (57%) followed by textiles (26%), food and beverages (23%), and lowest in the leather sector (19%). Contrary to these rates, the average number of exporting firms for the period 1996 - 2010 is the highest in the leather sector (17 firms) followed by food and beverages (14 firms), textiles (8 firms), and apparel (5 firms). This implies that sectors with higher export activities are characterized by higher export persistence and lower turnovers.

The other issue of interest is export survival, how long firms stay exporting once they enter the market. From 81 new exporting firms (in the four sectors) since 1997, 28 (35%) quit exporting after being in the market just for a year. Additionally, of those who managed to export for two consecutive years, 17% did not graduate to the third

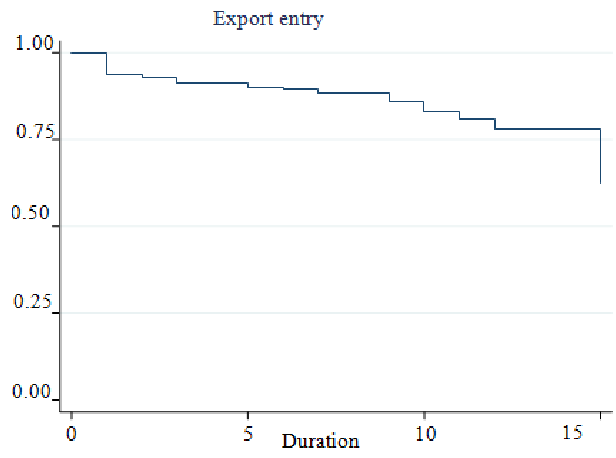

Figure 2.1: Kaplan-Meier survival estimates for export entry

year. As a result, less than 50% of the firms who started exporting continue to export for three or more consecutive years. In these computations, firms with positive export sales in 1996, the first survey round, are not included because of the lack of information regarding their previous export activities. Irrespective of that, among the 19 exporting firms in 1996, only 3 (15%) quit exporting in the following 3 years. Thus, 85% of these firms continued to export for 3 more years and about 63% of them continue to export for 9 more years. This shows high export persistence among the incumbents.

Figure 2.1 shows the Kaplan–Meier survival estimates of export market entry for newly established plants since 1996. Survival, in this case, is defined as the continuity of non-exporting. Firms may start to appear in the dataset for the first time after being in business for some years. We have no information whether they have been exporting or not. There are two main reasons to exclude newly established plants from the survey; either they employ less than the threshold 10 workers or use non-power-driven production methods. Therefore, the duration of non-exporting refers to the number of years a new firm has been observed without any export values until it starts exporting for the first time. For this reason, firms that have been in business long before the manufacturing survey are not included in these Kaplan-Meier estimates. The figure shows that export market entry is rare and sluggish. The highest entry rate, 6.2%, is among the newly established firms observed in the survey for the first time. Among firms that did not start exporting outright, after starting a business or being observed in the survey for the first time, only 1.3% started exporting in the second year. Subsequently, entry becomes harder as firms stay longer outside the export market.

Similarly, Figure 2.2 shows the Kaplan–Meier export survival estimates, where survival refers to the continuity of firms' export activities. Irrespective of the year of establishment, there are 100 firms at risk of export exit a year after reporting positive export values. Many of these firms, about 30%, left the export market a year after having positive exports for the first time in their business or after appearing in the dataset. In 5 years about 50% of the exporting firms exited the market. However, the survival function shows that the probability of exit decreases as firms stay longer in the export market.

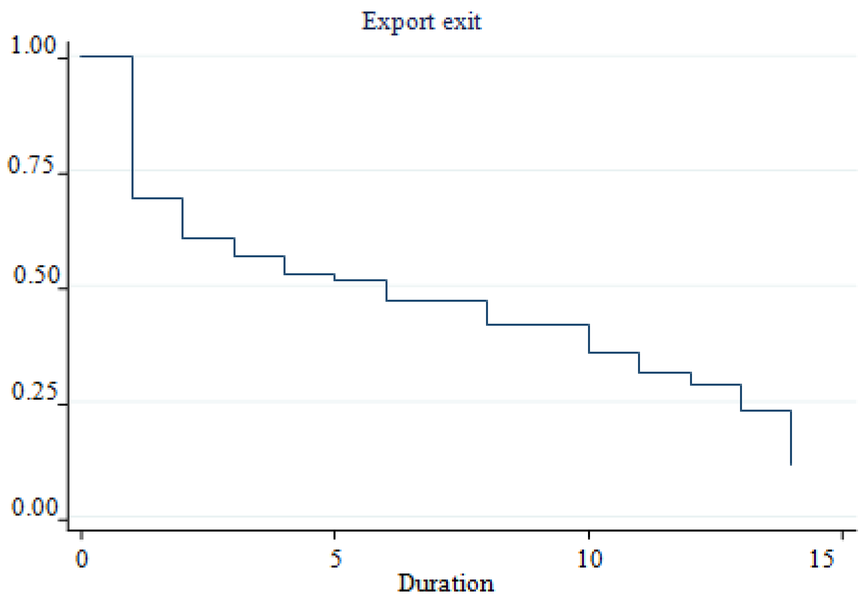

Figure 2.2: Kaplan-Meier survival estimates for export exit

2.4 Results and Discussion

2.4.1 Export entry and exit duration models

Initially, we estimate spillover effects of foreign investment and export activities without considering the export orientation of foreign-owned firms. We use the total sales of foreign-owned firms, irrespective of where they sell their products, to construct an aggregate horizontal, backward and forward spillover indexes. Similarly, we use total sectoral exports to create spillover indexes from export activities without identifying whether the exports are from foreign-owned or domestic firms. However, to avoid multiple counts, we estimate the spillover effects from exporting and foreign-owned firms separately. Table 2.2 presents the initial estimates of the discrete proportional hazards model for export entry and exit.

The results show that foreign-owned firms generate positive horizontal spillovers that increase the export market entry of domestic firms. This is similar to the results reported in previous studies examining horizontal spillovers (Aitken and Harrison, 1999; Greenaway et al., 2004). However, when both horizontal and vertical spillovers are considered (column 3), only the vertical effects continued to be significant. The presence of foreign firms in downstream (input buying) and upstream (input supplying) sectors decreases the non-exporting spells of domestic firms. The hazards rate ($e^{\beta} - 1$) indicates that one percentage point increase in the backward spillover index, the presence of foreign-owned firms in downstream sectors, increases the probability of export entry of domestic firms in upstream sectors by 75%. Besides, one percentage point increase in the forward spillover index, the presence of foreign-owned firms in upstream sectors, increases the probability of export entry of domestic firms in downstream sectors by 20%. On the other hand, the presence of exporting firms (columns 4 - 6) in the same and downstream sectors increases the export entry of local non-exporting firms.

The analysis of export exit, columns 7 - 12, shows that the presence of foreign firms in the same sector increases domestic firms' export survival, i.e., a higher presence of foreign firms in a given sector decreases the export exit hazards of domestic firms in the same sector. In addition, exporting enterprises in sectors buying intermediate inputs decreases the probability of export exit of domestic firms in the supplying sectors. The results in column 9 also suggest some negative forward spillovers that increase the export exit of domestic firms as a result of the presence of foreign-owned firms in upstream (input supplying) sectors.

Table 2.2: Results of the proportional hazards model with aggregate spillover indexes

	Entry						Exit					
	Spillovers from FDI			Spillovers from export			Spillovers from FDI			Spillovers from export		
Horizontal	0.032*		-0.022	0.025		0.031*	-0.044*		-0.078**	-0.027		-0.025
	(0.017)		(0.031)	(0.017)		(0.019)	(0.025)		(0.034)	(0.017)		(0.018)
Backward		0.491***	0.562***		0.675***	0.708***		-0.24	0.000		-0.496*	-0.459
		(0.147)	(0.174)		(0.207)	(0.221)		(0.193)	(0.221)		(0.291)	(0.296)
Forward		0.126**	0.183*		-0.008	0.025		0.006	0.198*		-0.122	-0.178
		(0.06)	(0.099)		(0.119)	(0.117)		(0.078)	(0.11)2		(0.181)	(0.178)
Productivity	0.502***	0.511***	0.516***	0.501***	0.551***	0.510***	-0.474***	-0.462***	-0.421***	-0.424***	-0.501***	-0.458***
	(0.118)	(0.123)	(0.122)	(0.115)	(0.12)	(0.121)	(0.117)	(0.117)	(0.12)	(0.118)	(0.121)	(0.123)
Size	0.495***	0.506***	0.509***	0.493***	0.538***	0.517***	-0.399**	-0.470***	-0.407**	-0.422**	-0.513***	-0.456***
	(0.126)	(0.135)	(0.134)	(0.123)	(0.126)	(0.131)	(0.173)	(0.166)	(0.167)	(0.168)	(0.157)	(0.158)
Log(K/L)	0.014	0.012	0.011	0.015	0.001	0.012	0.155	0.104	0.114	0.129	0.099	0.108
	(0.076)	(0.075)	(0.074)	(0.076)	(0.07)	(0.074)	(0.126)	(0.119)	(0.12)	(0.122)	(0.111)	(0.115)
Import ratio	-0.357	-0.259	-0.252	-0.368	-0.161	-0.206	-0.343	0.032	-0.217	-0.404	0.241	-0.005
	(0.391)	(0.39)	(0.385)	(0.381)	(0.374)	(0.387)	(0.635)	(0.695)	(0.686)	(0.631)	(0.752)	(0.776)
Public	0.758*	0.758	0.762*	0.785*	0.709	0.756*	0.255	0.192	0.109	0.289	0.129	0.11
	(0.456)	(0.464)	(0.461)	(0.46)	(0.435)	(0.452)	(0.456)	(0.481)	(0.48)	(0.447)	(0.508)	(0.51)
Log duration	0.055	0.075	0.072	0.047	0.061	0.062	-0.428*	-0.364	-0.447*	-0.416*	-0.405	-0.483*
	(0.282)	(0.268)	(0.267)	(0.28)	(0.254)	(0.262)	(0.238)	(0.24)	(0.25)	(0.24)	(0.253)	(0.255)
Obs.	3692	3692	3692	3692	3692	3692	422	422	422	422	422	422
Log likelihood	-234.822	-230.049	-229.821	-235.39	-229.601	-227.846	-110.694	-111.251	-108.329	-111.051	-109.465	-108.165

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

With respect to firm-level characteristics, labor productivity (log of output per worker) and size (log of the number of workers) are important determinants of entry into and survival in export markets. For instance, one percent increase in labor productivity increases the probability of export entry by 66% ($e^{0.510} - 1$)(column 6) and decreases the probability of export exit by 52% (column 9). Besides, firm size increases the probability of export entry, but decreases the probability of exit. These results are similar to those reported in Ilmakunnas and Nurmi (2010). We also find that public-owned firms are more likely to start exporting than private firms. Finally, coefficients of the log duration suggest negative duration dependence that decreases the probability of export exit as firms stay longer in the export market.

After these initial results, in the next set of regressions we identify the export activities of foreign-owned and domestic firms. Tables 2.3 and 2.4 present estimation results of the proportional hazards model for export entry and exit, respectively. We run three sets of regressions using different combinations of the spillover indexes. These include, spillovers from foreign-owned firms (columns 1, 2, & 3), domestic exporting firms (columns 4, 5, & 6), and both domestic exporting and foreign-owned firms (columns 7, 8, & 9). We find significant spillovers that increase the probability of export entry of domestic firms, backward ($Back\_D\_X$) from domestic exporting, forward ($Fward\_F\_X$) and backward ($Back\_F\_X$) from foreign-owned exporting, and horizontal from the foreign-owned firms serving local markets.

When considering only horizontal spillovers, the results suggest that domestic sales of foreign-owned firms increase the probability of export entry of domestic firms in the same sector. Domestic firms may get access to the products and production processes of foreign firms that may satisfy international standards. Such access might help local firms to imitate the products and technologies of foreign firms and produce standardized products for international markets. The horizontal spillover may also work through competition. When foreign-owned firms compete in local markets, domestic firms, more likely the large and productive ones, will try to improve their productivity to overcome the new competition and further look to expand their market through exporting. However, when both horizontal and vertical spillovers are considered, significant spillovers arise from the foreign-owned exporting firms.

Domestic and foreign-owned exporting firms generate backward spillovers that increase the exporting probability of domestic non-exporting firms in upstream sectors supplying intermediate inputs. As noted in Alvarez and López (2008), domestic exporters may transfer knowledge and technically assist firms in upstream sectors, so that they can satisfy higher quality requirements in foreign markets. In the same way, domestic suppliers may benefit from their foreign-owned exporting customers. The possibility of increasing productivity through such interactions may increase the chances of domestic non-exporting firms to start exporting and become a better competitor in international markets. Further, domestic suppliers may easily identify international demand for their products through their interactions with exporting firms.

In addition, the results suggest that foreign-owned exporting firms generate forward spillovers that increase the export entry of domestic firms in downstream sectors. They may signal information regarding the quality of intermediate inputs that local firms in downstream sectors should use to to produce international standard products. The purchase of inputs from foreign-owned exporting firms may help local firms understand the inputs used by international competitors and the standards required to satisfy foreign customers.

As noted earlier, productivity and size are significant firm-level characteristics that affect the exporting probability of domestic firms. Productivity and size increase the hazard rates of export entry, i.e., the two factors significantly decrease firms' non-exporting spells. The same is true for public ownership of firms. At 10% significance level, public-owned firms are 118% ($e^{0.782} - 1$) (column 3) more likely to exit the non-exporting state than other firms. On the other hand, we find no evidence to support positive or negative duration dependence. The lack of information regarding firms' past export history may have undermined the non-exporting duration dependence.

Table 2.3: Results of the proportional hazards model for export entry

	Spillovers from								
	Foreign firms			Domestic exporting firms			Domestic exporting & Foreign Firms		
Hor_F_NX	0.063**		-0.084				0.062**		-0.096
	(0.027)		(0.068)				(0.027)		(0.065)
Hor_F_X	0.088		0.128				0.075		0.097
	(0.063)		(0.087)				(0.07)		(0.106)
Back_F_NX		1.299	1.026					2.645	2.357
		(0.906)	(0.977)					(1.937)	(2.033)
Back_F_X		1.809***	3.500**					0.333	2.329
		(0.602)	(1.505)					(0.713)	(1.58)
Fward_F_NX		0.064	0.036					0.076	0.052
		(0.045)	(0.057)					(0.05)	(0.062)
Fward_F_X		0.455**	0.610***					0.451*	0.595**
		(0.214)	(0.234)					(0.23)	(0.246)
Hor_D_X				0.026		0.028	0.007		0.012
				(0.019)		(0.021)	(0.021)		(0.032)
Back_D_X					0.881***	0.910***		0.926**	0.926**
					(0.28)	(0.3)		(0.368)	(0.373)
Fward_D_X					-0.198	-0.162		-0.075	-0.114
					(0.129)	(0.128)		(0.129)	(0.138)
Productivity	0.509***	0.514***	0.502***	0.504***	0.543***	0.512***	0.506***	0.510***	0.494***
	(0.118)	(0.121)	(0.121)	(0.115)	(0.118)	(0.119)	(0.119)	(0.121)	(0.121)
Size	0.503***	0.503***	0.500***	0.494***	0.533***	0.518***	0.501***	0.514***	0.511***
	(0.13)	(0.134)	(0.136)	(0.122)	(0.125)	(0.128)	(0.131)	(0.131)	(0.133)
Log(K/L)	0.011	0.009	0.015	0.014	-0.001	0.009	0.012	0.006	0.013
	(0.074)	(0.073)	(0.075)	(0.076)	(0.071)	(0.074)	(0.075)	(0.073)	(0.075)
Import ratio	-0.304	-0.236	-0.268	-0.359	-0.175	-0.201	-0.308	-0.174	-0.21
	(0.397)	(0.383)	(0.387)	(0.377)	(0.378)	(0.387)	(0.397)	(0.384)	(0.39)
Public	0.74	0.764	0.834*	0.782*	0.713*	0.751*	0.744	0.748*	0.823*
	(0.461)	(0.466)	(0.482)	(0.459)	(0.423)	(0.433)	(0.463)	(0.436)	(0.448)
Log duration	0.07	0.072	0.055	0.048	0.036	0.036	0.071	0.04	0.02
	(0.27)	(0.266)	(0.267)	(0.278)	(0.259)	(0.264)	(0.27)	(0.266)	(0.269)
Obs.	3692	3692	3692	3692	3692	3692	3692	3692	3692
Log likelihood	-232.537	-228.612	-226.844	-235.594	-228.455	-227.423	-232.499	-224.656	-222.701

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Results of the export exit hazards model (Table 2.4) suggests significant spillovers from the export activities of foreign-owned and domestic firms. Foreign exporting firms increase the export survival of domestic firms operating in the same industry. The two groups, domestic and foreign-owned exporting firms, may compete each other to enlarge their exports and attract more international customers. It is generally agreed that exporting firms are productive than non-exporting firms. Therefore, competition may intensify the export activities of the domestic firms as opposed to forcing them to exit. Furthermore, foreign-owned exporters, mostly affiliates of multinational corporations, may possess valuable information regarding the tastes and preferences of international customers and changes in the global business operations. They may also engage in product development and marketing researches, while sharing information within their networks. However, these information and assets may spillover to the domestic exporting firms that could help them sustain and strengthen their export activities. Domestic exporters may also get easy access, with lesser sunk entry cost, to new destinations that are opened by the foreign-owned exporters of similar products.

On the other hand, domestic exporting firms generate spillovers that increase the export duration of other domestic firms in upstream and downstream sectors. Exporters, whether domestic or foreign, requires international standard intermediate inputs. To meet the required standards, local suppliers may have to adopt new technologies, advance technical know-how of workers, and receive assistance from their exporting customers. While constantly maintaining and improving their products to satisfy local needs of domestic exporting customers in downstream sectors, domestic exporting firms in upstream sectors would be able to survive in the export market. Besides, domestic exporting firms generate forward spillovers contributing to lower the export exit hazards rate of other domestic exporting firms in downstream sectors. Thus, not only does the quality requirements set by the exporting firms improve export survival of the local producers, but also the quality inputs produced by the local firms helps the local buyers to sustain and strengthen their exporting activities.

The backward and forward spillovers that improve export survival of domestic firms

Table 2.4: Results of the proportional hazards model of export exit

	Spillovers from								
	Foreign firms			Domestic exporting firms			Domestic exporting & Foreign Firms		
Hor_F_NX	-0.033		0.016				-0.037		-0.033
	(0.032)		(0.072)				(0.033)		(0.08)
Hor_F_X	-0.179**		-0.229**				-0.219**		-0.401***
	(0.074)		(0.089)				(0.092)		(0.134)
Back_F_NX		-1.125	-0.86					-1.373	-2.165*
		(1.213)	(1.175)					(1.115)	(1.215)
Back_F_X		-0.838	-0.894					1.097	2.427
		(0.969)	(1.84)					(1.556)	(2.334)
Fward_F_NX		-0.04	0.037					-0.055	0.057
		(0.059)	(0.069)					(0.061)	(0.077)
Fward_F_X		0.256	0.192					0.041	-0.097
		(0.269)	(0.342)					(0.297)	(0.355)
Hor_D_X				-0.025		-0.026	0.014		0.041
				(0.019)		(0.023)	(0.023)		(0.027)
Back_D_X					-0.693*	-0.627		-1.024	-1.065*
					(0.378)	(0.391)		(0.67)	(0.62)
Fward_D_X					-0.338*	-0.417*		-0.375*	-0.528**
					(0.198)	(0.224)		(0.205)	(0.228)
Productivity	-0.447***	-0.452***	-0.393***	-0.426***	-0.509***	-0.461***	-0.467***	-0.518***	-0.483***
	(0.117)	(0.122)	(0.121)	(0.12)	(0.121)	(0.126)	(0.123)	(0.13)	(0.136)
Size	-0.381**	-0.485***	-0.423**	-0.433**	-0.544***	-0.495***	-0.384**	-0.580***	-0.530***
	(0.163)	(0.175)	(0.168)	(0.169)	(0.157)	(0.159)	(0.164)	(0.167)	(0.167)
Log(K/L)	0.146	0.074	0.088	0.125	0.072	0.072	0.152	0.048	0.068
	(0.122)	(0.125)	(0.121)	(0.121)	(0.107)	(0.11)	(0.122)	(0.114)	(0.113)
Import ratio	-0.371	0.037	-0.257	-0.365	0.288	0.074	-0.34	0.278	-0.017
	(0.669)	(0.68)	(0.684)	(0.631)	(0.719)	(0.743)	(0.683)	(0.708)	(0.731)
Public	0.218	0.151	0.152	0.289	0.097	0.075	0.226	0.109	0.15
	(0.482)	(0.499)	(0.492)	(0.444)	(0.51)	(0.506)	(0.476)	(0.532)	(0.516)
Log duration	-0.482**	-0.353	-0.456*	-0.397*	-0.38	-0.447*	-0.469*	-0.382	-0.468*
	(0.243)	(0.242)	(0.244)	(0.24)	(0.259)	(0.266)	(0.246)	(0.25)	(0.257)
Obs.	422	422	422	422	422	422	422	422	422
Log likelihood	-108.565	-110.067	-106.75	-111.539	-108.236	-107.194	-108.381	-106.832	-102.189

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

arises mainly from the domestic exporters, not the foreign-owned exporters. This indicates a relatively strong backward and forward linkage among domestic exporters, but weak linkages between domestic and foreign-owned exporting firms. Although we observe that the presence of foreign-owned exporting firms improve export entry of their domestic customers and suppliers, such spillover does not contribute to the survival of local firms in international markets.

Other than the spillover effects, exporting is characterized by negative duration dependence. The longer domestic firms stay exporting, the lower their probability of exit from export markets. Finally, from firm-specific characteristics, only labor productivity and size are significant determinants of domestic firms' export survival.

2.4.2 Multinomial logit model of export dynamics

In addition to the export entry and exit analysis using duration models, we adopt a multinomial logit model to examine the impacts of spillovers and firm-level characteristics on firms' exporting decisions. The decision at a particular year conditional on previous year exporting status follows four possible transitions: continue non-exporting, start exporting, continue exporting, and exit from exporting. The multinomial logit analysis estimates probabilities of the different exporting outcomes relative to a reference outcome, continue non-exporting.

Initially, we use the aggregate spillover indexes to capture the presence of foreign-owned firms without splitting their domestic and export sales; and spillover indexes from export activities without identifying foreign and domestic exporting firms. The results in Table 2.5 show that the presence of foreign-owned firms in downstream and upstream sectors increases the probability that domestic firms start exporting. Similarly, presence of foreign-owned firms in the same sector decreases the probability of domestic firms exit from exporting. Further, the positive coefficients of the backward and forward spillovers in the exit equation (column 3) suggest an increase in the domestic firms' probability of exit from exporting compared to the base outcome, continue non-exporting. However, interpretation of these coefficients needs to reconcile with the coefficients of the survival (continue exporting) equation. For instance, the backward spillovers index from foreign-owned firms has almost the same coefficient in the survival and exit equations. This suggests that the backward spillovers has no effect on the probability of domestic firms survival in export markets compared to exiting the market. On the hand, coefficient of the forward spillover index is only significant in the exit equation, which is greater than the coefficient in the survival equation. Thus, forward spillovers increases probability of export exit of domestic firms. Some of these results that are consistent with the duration models in Table 2.2 includes the backward and forward spillovers that increase export entry and horizontal spillovers that decrease the export exit of domestic firms.

Table 2.5: Results of the multinomial logit model with aggregate spillover indexes

	Spillovers from FDI			Spillovers from export		
Reference: Non-exporting	Entry	Survival	Exit	Entry	Survival	Exit
Horizontal	-0.003	0.019	-0.044*	0.031*	-0.01	-0.013
	(0.026)	(0.02)	(0.024)	(0.016)	(0.012)	(0.012)
Backward	0.320**	0.381**	0.362**	0.219	0.292**	0.067
	(0.161)	(0.155)	(0.15)	(0.141)	(0.116)	(0.147)
Forward	0.147*	-0.013	0.201**	-0.149	-0.09	-0.033
	(0.086)	(0.079)	(0.084)	(0.096)	(0.114)	(0.139)
Productivity	0.616***	1.068***	0.173*	0.598***	1.076***	0.161*
	(0.095)	(0.095)	(0.093)	(0.095)	(0.096)	(0.092)
Size	0.781***	1.324***	0.793***	0.779***	1.325***	0.793***
	(0.092)	(0.072)	(0.114)	(0.092)	(0.071)	(0.112)
Log K/L	0.051	0.237***	0.388***	0.051	0.231***	0.396***
	(0.065)	(0.057)	(0.077)	(0.065)	(0.057)	(0.077)
Import ratio	-0.881***	-2.371***	-1.437***	-0.878***	-2.348***	-1.398***
	(0.326)	(0.256)	(0.365)	(0.328)	(0.257)	(0.368)
Public	0.304	0.459**	0.893***	0.322	0.462**	0.885***
	(0.303)	(0.187)	(0.334)	(0.3)	(0.186)	(0.328)
Log likelihood	-1293.05			-1296.32		
Obs.	4289			4289		

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

On the spillovers from exporting (columns 4 - 6), the presence of exporting firms in the same and downstream sectors increases the rates of domestic non-exporting firms' entry into and survival in export markets, respectively. These results are as well consistent with the duration models in Table 2.2, except the positive backward spillovers in the export entry duration model. With respect to firm-level characteristics, we find that productivity and size increases the probability of domestic firms entry into exporting, relative to continue non-exporting. Additionally, large and productive firms are more likely to continue exporting than exit from exporting. Unlike the duration models, the results in Table 2.5 indicates that capital intensity and ratio of imported raw materials increases probability of domestic firms exit from exporting relative to continue exporting (i.e., the gap between the coefficients of the survival and exit equations).

Estimation results of the multinomial logit model with spillover indexes that identify export activities of domestic and foreign-owned firms are presented in Table 2.6. Each column represents separate estimations with different combinations of the spillover indexes. Our results show that foreign-owned exporting firms generate backward and forward spillovers that increase domestic firms' probability of export entry. There are also horizontal spillovers from foreign-owned firms serving local markets and backward spillovers from foreign-owned exporting firms that increase the export survival of domestic firms relative to staying non-exporting. But, these spillovers are significant only when the horizontal and vertical spillovers are estimated separately.

Furthermore, foreign-owned exporting firms generate horizontal spillovers that decrease the exit probability of domestic exporting firms. On the other side, the presence of domestic exporting firms decreases export entry of domestic non-exporting firms in downstream sectors and increases the export survival of domestic firms in upstream sectors. Finally, with respect to firm-level characteristics, productivity and size increase the probability of export entry and survival of domestic firms. Compared to continuing exporting (survival), the share of imported raw materials increases the probability of domestic firms exit from exporting.

Consistent with the duration models, the multinomial logit model predicts that the presence of foreign-owned exporting firms in upstream and downstream sectors increase

Table 2.6: Results of the multinomial logit with disaggregate spillover indexes

	Spillovers from								
	Foreign firms			Domestic exporting firms			Exporting & Foreign Firms		
	1	2	3	4	5	6	7	8	9
Reference: continue Non-exporting									
Entry									
Hor_F_NX	0.031		-0.058				0.028		-0.078
Hor_F_X	0.089*		0.092				0.05		0.036
Back_F_NX		1.123*	0.973					1.072	0.935
Back_F_X		1.090*	2.251*					0.843	2.412
Fward_F_NX		0.088*	0.069					0.075	0.062
Fward_F_X		0.331*	0.443**					0.199	0.314
Hor_D_X				0.035**		0.03	0.025		0.024
Back_D_X					0.23	0.241		0.128	0.135
Fward_D_X					-0.304***	-0.276***		-0.217**	-0.216**
Productivity	0.607***	0.613***	0.605***	0.588***	0.614***	0.602***	0.598***	0.619***	0.600***
Size	0.782***	0.779***	0.778***	0.778***	0.784***	0.779***	0.779***	0.781***	0.777***
Log(K/L)	0.052	0.05	0.053	0.054	0.045	0.047	0.053	0.046	0.051
Import ratio	-0.883***	-0.870***	-0.882***	-0.894***	-0.814**	-0.856***	-0.904***	-0.860***	-0.881***
Public	0.309	0.307	0.33	0.302	0.317	0.325	0.307	0.318	0.345
Survival									
Hor_F_NX	0.056**		0.025				0.059***		0.027
Hor_F_X	0.021		0.013				0.023		0.008
Back_F_NX		0.174	0.28					0.146	0.279
Back_F_X		1.934***	1.298					1.720**	1.182
Fward_F_NX		0.038	0.024					0.035	0.005
Fward_F_X		-0.057	-0.065					-0.1	-0.083
Hor_D_X				-0.007		-0.012	-0.012		-0.018
Back_D_X					0.263**	0.278**		0.103	0.119
Fward_D_X					-0.063	-0.07		-0.081	-0.078
Productivity	1.075***	1.073***	1.074***	1.068***	1.067***	1.076***	1.084***	1.075***	1.085***
Size	1.327***	1.327***	1.327***	1.321***	1.322***	1.323***	1.329***	1.327***	1.329***
Log(K/L))	0.231***	0.236***	0.235***	0.232***	0.231***	0.230***	0.230***	0.235***	0.233***
Import ratio	-2.376***	-2.372***	-2.366***	-2.380***	-2.358***	-2.351***	-2.373***	-2.364***	-2.350***
Public	0.434**	0.455**	0.444**	0.456**	0.462**	0.464**	0.436**	0.460**	0.458**
Exit									
Hor_F_NX	0.032		-0.004				0.031		-0.018
Hor_F_X	-0.088		-0.127**				-0.081		-0.160*
Back_F_NX		0.017	0.05					-0.149	-0.298
Back_F_X		0.869	1.068					1.616	2.153
Fward_F_NX		0.043	0.082*					0.038	0.085*
Fward_F_X		0.288	0.28					0.219	0.193
Hor_D_X				-0.012		-0.015	-0.002		0.008
Back_D_X					0.016	0.019		-0.34	-0.344
Fward_D_X					-0.169	-0.188		-0.113	-0.166
Productivity	0.158*	0.167*	0.180*	0.158*	0.154*	0.164*	0.159*	0.169*	0.183*
Size	0.795***	0.794***	0.790***	0.793***	0.796***	0.792***	0.795***	0.793***	0.789***
Log(K/L)	0.402***	0.387***	0.383***	0.398***	0.393***	0.391***	0.401***	0.382***	0.378***
Import ratio	-1.389***	-1.467***	-1.431***	-1.395***	-1.427***	-1.403***	-1.392***	-1.479***	-1.453***
Public	0.885***	0.901***	0.870***	0.873***	0.905***	0.886***	0.881***	0.899***	0.871**
Obs.	4289	4289	4289	4289	4289	4289	4289	4289	4289
Log Likelihood	-1297.27	-1293.15	-1288.9	-1301.37	-1297.69	-1295.06	-1295.92	-1290.25	-1284.35

Standard errors are robust. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the probability of domestic firms entry into export markets. In addition, their presence decreases the export exit probability of domestic firms in the same sector. Both estimations predict that domestic exporting firms generate positive backward spillovers that increase the export survival of domestic firms in upstream sectors supplying intermediate inputs.

2.5 Conclusion

This chapter examines spillovers from foreign presence on the export entry and exit of local firms in the Ethiopian manufacturing sector. We use discrete time proportional hazards and multinomial logit models to analyze the impacts of spillovers from domestic exporting and foreign-owned firms on the non-exporting and exporting durations of local enterprises. Spillover indexes are computed following the method adopted by Javorcik (2004) using sectoral linkages retrieved from the national input-output table.

Estimation results using the discrete hazards model indicate that exporting firms, both domestic and foreign, produce spillovers that increase the probability of export entry of domestic non-exporting firms and export survival of domestic exporting firms. Presence of foreign-owned exporting firms in downstream and upstream sectors increases the exporting probability of their domestic input suppliers and output buyers, respectively. Similarly, domestic exporting firms generate extenalities that increase the export entry rates of local input suppliers. On the export survival of domestic firms, positive horizontal spillovers arise from foreign-owned exporting firms, and backward and forward spillovers from domestic exporting firms.

The multinomial logit model confirms the backward and forward spillovers from foreign-owned exporting firms towards the export entry of domestic firms. Similarly, it confirms the horizontal and backward spillovers from the foreign-owned and domestic exporters, respectively, that increase exporting survival of domestic firms. Thus, using the two models, we observe that exporting activities of domestic and foreign-owned firms generate significant spillovers that increase exports of the manufacturing sector through the intensive margin, entry of new exporting firms, as well as extensive margin, survival of exiting exporting firms.

With the exception of the horizontal spillovers from foreign-owned exporting firms on the export survival of domestic firms, all the results support vertical spillovers. The policy implications of these results for the small manufacturing sector of Ethiopia with limited export activities, is to promote exporting among selected sectors with strong backward and forward linkages. In addition, as externalities are mainly arising from exporting firms, it is important to attract foreign firms with export potentials that will use local intermediate inputs and supply intermediate inputs to local firms. Such foreign-owned exporting firms transfer valuable information and technology that may reduce the sunk export entry cost, thereby helping local firms to start exporting. Thus, to enlarge the manufacturing exports, policy makers should provide export incentives and attract foreign firms to sectors with strong sectoral linkages.

CHAPTER 3

DOES FOREIGN PRESENCE IMPROVE ETHIOPIAN DOMESTIC FIRMS' EFFICIENCY?

3.1 Introduction

As we discuss in the second chapter, inward foreign investment is believed to boost the economic growth of host countries directly through employment creation and capital formation, and indirectly through knowledge, technology, and information spillovers. Multinationals have superior technologies, technical know-how, and managerial and marketing experiences than domestic firms. Similarly, exporting firms, domestic or foreign, have advantages over non-exporting firms regarding access to advanced technologies that are more productive and efficient. However, multinationals and exporters may not fully internalize the benefits of these assets. The benefits may spillover to domestic and non-exporting firms through market interactions, competition, and public nature of the assets.

The two primary channels of spillovers are information and competition (Kokko, 1996; Blomstrom and Kokko, 1998; Kneller and Pisu, 2007). Domestic firms may increase their productivity or efficiency utilizing the information about new products, technologies, and managerial practices that are accessible as a result of the presence of foreign firms. This information channel works through the demonstration effect where domestic firms imitate the products and technologies of foreign-owned plants or affiliates of multinational corporations. Furthermore, foreign affiliates may vigorously compete with local firms over the control of domestic markets and customers, which may produce both positive and negative effects. Competition can force local producers to shrink their production or exit the market if they fail to overcome the pressure. On the other hand, local producers may become efficient and competitive by adopting advanced technologies and use their resources optimally. Generally, horizontal spillovers include both information and competition effects, whereas vertical (backward and forward) spillovers mainly work through the information channel as foreign firms have less incentive to compete with their suppliers or customers in other sectors. As mentioned previously, the empirical evidence suggests significant inter-industry productivity spillovers from foreign firms, but weak or no horizontal spillovers.

Unlike the spillovers from foreign investment, there are a handful of studies regarding spillovers from exporting firms, particularly local exporting enterprises. The access to advanced technologies and well informed foreign clients compel exporters to improve their efficiency, marketing strategy, and product quality. Their knowledge of new technologies and products, as well as information on international markets and clients, may spillover to improve the productivity of local non-exporting enterprises. Exporters are also likely to create a more competitive environment in local markets that will create pressure on the non-exporting firms to improve their performance so as to stay in business and maintain their market share. A study by Alvarez and López (2008) shows positive productivity spillovers from domestic and foreign-owned exporting firms to their local suppliers in upstream sectors (backward spillover). Similarly, Girma et al. (2008) suggests that horizontal spillovers arise from the export-oriented foreign firms, while the domestic-market oriented firms produce backward spillovers. Besides, Wei and Liu (2006) finds a positive inter-industry but negative intra-industry spillovers from export activities in China's manufacturing industry.

According to the micro (firm-level) literature on productivity, there are three sources of total factor productivity (TFP) growth: technical progress, technical efficiency change, and scale effect. However, most studies on productivity spillovers use TFP from the Cobb-Douglas production function without due considerations to its components. Girma and Gorg (2007) argued that the empirical literature neglected the issue of decomposing productivity effects of multinationals. As a result, to examine the causal relationship between foreign ownership and productivity growth Girma and Gorg (2007) decomposed productivity growth of the UK manufacturing firms into technological and scale effects. Decomposing productivity growth helps explain how spillovers benefit domestic firms; either through knowledge transfers to improve technical know-how and utilize existing technologies more efficiently or through information and demonstration of new technologies and production methods that cause technological progress. Besides, spillovers may affect the efficiency of domestic firms in utilizing their scale of production. Suyanto et al. (2009, 2012) uses stochastic production frontier (SPF) and Malmquist productivity index to decompose productivity growth and examine spillover effects of FDI in the Indonesian manufacturing sector. They study externalities generated by foreign-owned firms without identifying their market (domestic versus export) orientations. Moreover, externalities produced by domestic exporting firms has not been examined in these and other studies using similar methods. Thus, in this study, we consider spillovers from domestic exporting and foreign-owned firms that influence the efficiency of local enterprises. In doing so, we identify the domestic and export sales of the foreign-owned firms.

We follow two-step estimations to analyze the spillover effects on the efficiency of domestic firms. Although several studies, including Suyanto et al. (2009, 2012) use the stochastic frontier model of Battese and Coelli (1995), it does not distinguish inefficiency from individual time-invariant heterogeneities. To account for firms' unobserved time-invariant characteristics, we employ the 'true' fixed-effects model proposed by Greene (2005a,b). However, due to the incidental parameters problem, the Maximum Likelihood Dummy Variables (MLDV) technique suggested by Greene (2005a,b) produces inconsistent variance estimates. To overcome this issue, we employ the first difference data transformation proposed by Belotti and Ilardi (2014). Combining the estimates of technical efficiencies across sectors, we use system GMM in the second stage to examine how spillovers and individual characteristics affect the performance of domestic firms.

Our source of data is the annual Ethiopian manufacturing survey for the period 1996 - 2010. Ethiopia has a small manufacturing sector and limited inflow of foreign investment. The manufacturing sector accounts for about 4% of the country's GDP and produces mainly light manufacturing goods such as food, beverage, leather, textile, apparel, and others. In recent years, the economy has become one of the fast growing economies in Sub-Saharan Africa and start to attract considerable foreign investment. Accordingly, this study identifies the impact of foreign investment and export activities on the small, labor-intensive local firms with a limited competitive advantage relative to the technological endowed foreign and exporting firms. As in the second chapter, we focus on the four sectors where most of the exporting and foreign-owned firms operate: manufactures of food and beverages, textiles, wearing apparel, and tanning leather and footwear.

3.2 Methodology

First proposed by two team of researches, Meeusen and Van den Broeck (1977) and Aigner et al. (1977), the stochastic frontier literature has grown rapidly over the last three decades. Its development benefited from advances in econometric techniques, availability of longitudinal data, and computation capabilities. The major developments following the original cross-sectional data models include three phases: (i) panel data models with time invariant inefficiency term (Schmidt and Sickles, 1984; Pitt and Lee, 1981), (ii) panel data models with time varying inefficiency term (Cornwell et al., 1990; Kumbhakar, 1990; Lee and Schmidt, 1993; Battese and Coelli, 1992, 1995), and (iii) models disentangling individual heterogeneity from inefficiency (Greene, 2005a,b; Belotti and Ilardi, 2014).

A general specification of the stochastic frontier panel data models can be written as:

$$y_{it} = \beta_0 + f(x_{it}, t; \beta) + \nu_{it} - u_{it} \tag{3.1}$$

where y_{it} represents output of firm i at time t, $f(x_{it}, t; \beta)$ implies the deterministic production function with x_{it} inputs and time t capturing technical progress, ν_{it} is the idiosyncratic error term, and u_{it} is the one-sided error term capturing technical inefficiency.

In the first set of panel data models, the inefficiency term, u_{it}, has no time subscript and it it is specified as u_i. There are fixed and random effects version of this model. Schmidt and Sickles (1984) proposed a fixed effects model specifying u_i as a fixed parameter, which reduces the model to:

$$y_{it} = \alpha_i + f(x_{it}, t; \beta) + \nu_{it},$$

where $\alpha_i = \beta_0 - u_i$, is a firm-specific intercept term. Then, the inefficiency term is estimated as $\hat{u}_i = max(\hat{\alpha}_i) - \hat{\alpha}_i$. On the other hand, the random effects version of this model, Pitt and Lee (1981), considers u_i as a random error term. The random effects model can be written as:

$$y_{it} = \beta_0^* + f(x_{it}, t; \beta) + \nu_{it} - u_i^*,$$

where $\beta_i^* = \beta_0 + E(u_i)$, $u_i^* = u_i - E(u_i)$, and $E(u_i)$ is the mean inefficiency across firms. The inefficiency estimates are then retrieved as $\hat{u}_i = max(\hat{u}_i^*) - \hat{u}_i^*$. This model requires distributional assumption (half-normal or exponential) regarding the one sided error term, u_i.

The second group of literature considers time-varying inefficiency, i.e., the inefficiency term has time subscript, u_{it}. Different functional forms of the inefficiency term (as a function of time, t) are proposed (see Kumbhakar and Lovel (2000) for details):

- Fixed-effects models:
  - Cornwell et al. (1990): $u_{it} = \theta_{it} + \theta_{it}t + \theta_{it}t^2$
  - Lee and Schmidt (1993): $u_{it} = \beta(t)u_i$, where $\beta(t)$ is represented by a set of time dummy variables.
- Random-effects models:

– Kumbhakar (1990): $u_{it} = [1 + exp(\gamma t + \delta t^2)]^{-1} * u_i$

– Battese and Coelli (1992): $u_{it} = exp(-\gamma(t - T_i) * u_i$

The main criticism of the above two groups of literature is that they do not distinguish inefficiency from individual time-invariant characteristics that affect production. For instance, the time-varying inefficiency in the second group, u_{it}, captures both inefficiency and individual heterogeneities. However, lower level of production due to unobserved hererogeneities, such as age of technology or lack of transport infrastructure, should not be considered as inefficiency. This critique is addressed in the 'true' fixed-effects (TFE) and 'true' random-effects (TRE) models proposed by Greene (2005a,b). These models are specified as:

$$y_{it} = \alpha_i + f(x_{it}, t; \beta) + \nu_{it} - u_{it}.$$

In the TFE model, α_i is defined as firm-specific constant term, which is estimated using Maximum Likelihood Dummy Variable (MLDV) approach. Likewise, in the TRE model, estimated using maximum likelihood method, α_i is considered as a random variable that capture firms' time-invariant individual heterogeneity.

Following the TFE and TRE models, two new updates are proposed. One of the updates (not considered in this study) focuses on the time-invariant individual heterogeneity component, α_i, and argue that such effects may also capture persistent inefficiency. Filippini and Greene (2015) propose a 'Generalized True Random Effects' model with four random components, including the idiosyncratic error term (ν_{it}), time-varying inefficiency (u_{it}), time-invariant inefficiency, and individual random effects. Similarly, Kumbhakar et al. (2014) developed a multi-step model to separate firm effects from the persistent and time-varying technical inefficiencies.

The other update is regarding the incidental parameters problem of the TFE model. It is argued that, although computationally feasible, the MLDV estimation of the TFE model may lead to inconsistent variance estimates, particularly in short panel data with large units of observation (Belotti and Ilardi, 2014; Belotti et al., 2012). To address this issue, Chen et al. (2014) propose within maximum likelihood estimator that maximizes the likelihood based on the joint density of the deviations from the individual means of ν_{it} and u_{it}. Similarily, Belotti and Ilardi (2014) propose first-difference data transformation to avoid the incidental parameters problem and achieve consistency under both fixed-n and fixed-T asymptotics. They suggest two alternative estimation methods: maximum simulated likelihood estimator (MMSLE) for homoskedastic normal-half normal and normal-exponential models, and pairwise difference estimator (PDE) for heteroskedastic normal-exponential specifications. Consequently, in this study, we adopt the TFE model using first different data transformation and the *sftfe* Stata command written by Belotti and Ilardi (2014).

The next step, following the stochastic frontier analysis, is to examine how spillovers and individual characteristics affect the performance of firms as measured by their estimated technical efficiencies. Although it is possible to estimate the stochastic production function and the determinants of technical inefficiencies simultaneously in one stage, we need to pool the efficiency estimates across sectors to address our question. The sectoral spillover indexes (defined in chapter two) lack variability when used in each sectors' stochastic frontier analysis separately. Thus, the analysis of spillover effects is best addressed through a regression equation of the efficiency of firms pooled across sectors.

As in Kraay (2006) and Bigsten et al. (2000), we estimate firms' performance, the efficiencies retrieved from the stochastic frontier analysis, in a dynamic form where we include previous year efficiency as a control. Performance in a given period may heavily depend on past performance, which leads to serial dependence in the efficiency variable. Accordingly, the regression function for the dynamic model is:

$$E_{ikt} = \alpha + \lambda E_{ik,t-1} + x'_{ikt}\beta + s'_{kt}\gamma + e_{ikt} \tag{3.2}$$

where E_{ikt} represents is the technical efficiency of firm i in sector k at time t, x_{ikt} represents a vector of firm-level characteristics such as size, factor intensity, exporting status (dummy indicator if exporting), and public ownership; and s_{kt} is a vector of the spillover indexes to sector k. In addition, we include a proxy for absorptive capacity to examine the argument that highly productive firms benefit more from spillovers. We measure absorptive capacity by the ratio of labor productivity of a firm relative to the average productivity of the top 10 percent most productive firms in the same sector.

Although information and technology spillovers may arise from foreign investment and exporting activities, the impact may depend on the capability of domestic firms to absorb, process, and utilize such spillovers. At national, regional, sectoral, or individual enterprise level, the existing infrastructure, technology, and technical know-how is crucial to strategically utilize the transfer of knowledge and information. Among early studies, Kokko (1996) finds significant positive spillovers towards Uruguayan domestic firms with moderate technological gap vis-a-vis foreign firms, but not domestic firms with large technological gaps. Similarly, the theoretical model of Glass and Saggi (1998) indicates that the significant technological gap between the host and home countries of multinationals prohibits the transfer of technology from the latter to the former through FDI. They argued that unless the host country is sufficiently advanced, transfer of technology is costly for the foreign firms. Girma and Gorg (2003) and Girma (2005), using firm-level data for the UK, find a u-shape relationship between productivity growth and spillovers from FDI interacted with absorptive capacity. In these papers, absorptive capacity is measured by the ratio of previous year total factor productivity (TFP) of a firm to the maximum TFP in the sector where the firm is operating.

Finally, we estimate the regression equation using Arellano and Bover (1995) and Blundell and Bond (1998) system GMM to account for endogeneity and the dynamic bias created by the lag of the dependent variable. Roodman (2006) argued that using lagged dependent variable as a control, in our case $E_{ik,t-1}$, creates a 'dynamic panel bias.' Besides, the variables exporting and absorptive capacity are suspected of endogeneity as unobserved firm-characteristics may affect them and the dependent variable, efficiency, simultaneously.

3.3 Data

We use the firm-level panel data collected by the Ethiopian Statistics Agency (CSA) for the period 1996-2010. In the stochastic frontier production function, we define output by the total value of production, deflated using the manufacturing sector GDP deflator. The inputs, on the other hand, include capital (K), labor (L), and material (M). The survey provides information regarding the value of fixed assets at the beginning and end of each survey year. To minimize inconsistencies in the reported values of fixed assets, we construct a new capital stock series using the perpetual inventory method. The series is generated based on the initial book value of fixed assets that firms report when surveyed for the first time, thereby sequentially adding investment and subtracting depreciation and sold out capital in each year. Investment is deflated using fixed capital formation deflator (base year 1996) from the World Bank's WDI. The rates of depreciation are assumed to be 5% for buildings and 10% for machinery and equipments.

The data measures employment using number of workers, rather than hours worked. Besides, it provides temporary and permanent employment for all survey years except 2010. This constrained us to measure labor with only permanent employment. When not considering seasonal employment, the number of workers may fall short of the threshold 10 workers. With respect to materials, we use the total expenditure on raw materials (imported and domestic intermediate inputs) and energy (fuel, electricity, and wood and charcoal). The values of raw material and energy are deflated using the implicit price deflators for the manufacturing sector and energy and water, respectively.

The stochastic frontier analysis is sensitive to outlier observations. To identify such observations, we estimate a translog production function for each sector and predict the residuals. Observations with residual four standard deviations away from the mean are scrutinized to identify if they have outliers or large jumps overtime in their output or input values. Some firm/year combinations with inconsistent or outlier values are removed from the stochastic frontier analysis. Besides, we consider plants observed in at least two survey rounds with capital stock greater than 100 ETB (Ethiopian Birr).

Table 3.1: Descriptive statistics of the variables in the production function

Industrial Group		Output	Labor	Capital	Material	Obs.
	Mean	12200	104	6948	4886	
Food & Beverages	Min	8.95	1	0.17	2.82	3667
	Max	512000	9103	326000	225000	
	Mean	18500	661	22800	11500	
Textile	Min	24.81	2	1.14	3.90	450
	Max	155000	5059	481000	95800	
	Mean	2949	160	2649	1695	
Appareal	Min	11.41	2	0.45	11.65	385
	Max	76100	3469	84600	45900	
	Mean	11000	122	5477	7516	
Leather	Min	4.82	1	0.17	3.20	816
	Max	385000	996	49000	126000	

Output, capital, and material are in thousands ETB.

Source: Compiled from the manufacturing survey data

Table 3.1. presents summary statistics of the variables included in the stochastic frontier analysis. The variables except labor are deflated using appropriate price deflators.

3.4 Analysis and Discussion

Table 3.2 presents estimation results of the first stage stochastic frontier analysis based on three models: 'true' fixed-effects using the MLDV estimators (TFE1), 'true' random-effects (TRE), and 'true' fixed-effects using Belotti and Ilardi's (2014) first difference data transformation technique (TFE2). Further, output elasticities and summary of the estimated production efficiencies from each model are incorporated. The output elasticities at mean values of the inputs are all significant, except with respect to labor in the leather industry. Output elasticity with respect to materials is the highest in all sectors. One percent increase in materials increases output by more than 0.85%, 0.80%, 0.72%, and 0.69% in food & beverages, textile, apparel, and leather industries, respectively. Besides, output is more responsive to changes in capital than labor in food & beverages, apparel, and leather sectors, but not in the textile sector. Further, the returns to scale (RTS), the sum of the elasticities, shows that food & beverages and leather industries have decreasing returns to scale while textile and apparel sectors have increasing and constant returns to scale, respectively. However, the results from the TRE model suggests constant RTS in food & beverages and textile sectors. Besides, it is important to note that the elasticities and RTS may change over time.

There is a wide performance variation among the manufacturing firms as measured by their estimated technical efficiencies. The efficiency score in the food & beverages industry ranges from 24% (TFE models) and 30% (TRE) to about 96% (in both models) with a mean efficiency of 80%. In the textile industry, the range is 17% to 96% with a mean of 68% using the first difference TFE estimates, but varies from 47% to 94% and 39% to 93% in the TFE MLDV estimators and TRE, respectively. The difference between the two TFE estimates may arise as a result of the incidental parameters problem of the MLDV estimators. On the other hand, efficiency scores using first difference TFE estimators range from 20% to 94% with an average of 69% in the apparel sector and 16% to 95% with an average of 73% in the leather industry. Although the minimum scores vary across the three models, the maximum and the mean are relatively similar.

With the efficiency ranking of sectors, neither clear winner nor consistent ranking appears while considering the different models. For instance, when using the first difference TFE estimates, the food & beverages industry is relatively more efficient followed by the leather sector while apparel and textile sectors share the third place together. On the other hand, textile and food & beverages are ranked first in the TFE MLDV estimators and the TRE model, respectively. In these cases, apparel and leather to some extent share the third ranking together. Overall, apparel and leather industries have close average efficiency scores. Besides, food & beverages and textile industries have very close efficiency scores, except in the first difference TFE estimators. Of course, when looking at these scores in a broader sense and considering variations that

Table 3.2: Estimation results of the translog stochastic frontier production function

	Food & Beverages			Textile			Apareal			Leather		
	TFE1	TRE	TFE2	TFE1	TRE	TFE2	TFE1	TRE	TFE2	TFE2	TRE	TFE2
lnY												
lnL	0.259**	-0.0002	0.258**	-0.011	0.117	-0.265	-0.497*	-0.579**	-0.535*	0.601***	0.713***	0.597**
	(0.109)	(0.1)	(0.12)	(0.308)	(0.23)	(0.316)	(0.269)	(0.258)	(0.289)	(0.224)	(0.201)	(0.243)
lnK	-0.01	-0.121**	-0.02	0.079	0.117	0.042	0.463	-0.067	0.428	-0.629**	-0.074	-0.635**
	(0.074)	(0.055)	(0.081)	(0.317)	(0.135)	(0.327)	(0.433)	(0.17)	(0.477)	(0.256)	(0.092)	(0.279)
lnM	0.582***	0.667***	0.582***	0.412*	0.446**	0.517**	1.350***	1.655***	1.423***	0.554***	0.371**	0.562***
	(0.07)	(0.068)	(0.077)	(0.241)	(0.185)	(0.247)	(0.254)	(0.249)	(0.273)	(0.162)	(0.145)	(0.176)
T	0.050***	0.063***	0.051***	0.032	0.061	0.077	0.402***	0.393***	0.418***	0.116**	0.071**	0.116**
	(0.018)	(0.018)	(0.019)	(0.057)	(0.048)	(0.057)	(0.07)	(0.065)	(0.074)	(0.046)	(0.034)	(0.05)
$\frac{1}{2}(lnL)^2$	0.028*	0.02	0.026	0.092***	0.038	0.111***	-0.033	-0.065	-0.031	0.034*	0.050***	0.033*
	(0.015)	(0.014)	(0.016)	(0.035)	(0.031)	(0.038)	(0.044)	(0.041)	(0.047)	(0.017)	(0.015)	(0.019)
$\frac{1}{2}(lnK)^2$	0.001	0.005	0.001	0.032	0.002	0.026	-0.001	0.028**	0.000	0.076***	0.023***	0.076***
	(0.006)	(0.005)	(0.006)	(0.024)	(0.013)	(0.025)	(0.028)	(0.013)	(0.031)	(0.021)	(0.008)	(0.023)
$\frac{1}{2}(lnM)^2$	0.029***	0.023***	0.027***	0.074***	0.055***	0.064***	-0.008	-0.038	-0.015	0.047***	0.062***	0.045**
	(0.007)	(0.007)	(0.008)	(0.019)	(0.016)	(0.021)	(0.025)	(0.025)	(0.027)	(0.018)	(0.017)	(0.019)
$\frac{1}{2}(T)^2$	0.000	-0.001***	-0.001	-0.004***	-0.003*	-0.007***	-0.002	-0.002	-0.002	0.001	0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
(lnL)(lnK)	0.018**	0.037***	0.018**	0.016	0.030*	0.028	-0.024	-0.029*	-0.025	-0.019	-0.011	-0.02
	(0.008)	(0.007)	(0.009)	(0.018)	(0.015)	(0.018)	(0.017)	(0.017)	(0.018)	(0.013)	(0.012)	(0.014)
(lnL)(lnM)	-0.037***	-0.029***	-0.036***	-0.033*	-0.041***	-0.032*	0.060***	0.079***	0.063***	-0.035*	-0.059***	-0.034
	(0.008)	(0.008)	(0.009)	(0.017)	(0.015)	(0.018)	(0.019)	() 0.018)	(0.02)	(0.02)	(0.019)	(0.022)
(lnK)(lnM)	0.001	0.000	0.002	-0.035***	-0.016*	-0.032**	-0.025**	-0.02	-0.024*	-0.018	-0.011	-0.018
	(0.005)	(0.004)	(0.005)	(0.012)	(0.01)	(0.013)	(0.012)	(0.013)	(0.013)	(0.012)	(0.011)	(0.01()3
(T)(lnL)	-0.008***	-0.010***	-0.008***	-0.007	-0.003	-0.005	0.034***	0.045***	0.036***	0.009**	0.009**	0.009*
	(0.002)	(0.002)	(0.003)	(0.004)	(0.004)	(0.005)	(0.006)	(0.006)	(0.007)	(0.005)	(0.004)	(0.005)
(T)(lnK)	-0.001	0.001	-0.001	0.005	0.000	0.003	0.015***	0.013***	0.015***	0.003	0.004*	0.003
	(0.001)	(0.001)	(0.001)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
(T)(lnM)	0.000	-0.001	0.000	0.000	0.000	0.001	-0.053***	-0.054***	-0.055***	-0.015***	-0.013***	-0.015***
	(0.001)	(0.001)	(0.002)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.004)
Cons.		3.643***			4.089***			-2.579			4.743***	
		(0.496)			(1.34)			(1.629)			(0.994)	
σ_u	0.289	0.264	0.293	0.225	0.275	0.473	0.489	0.394	0.487	0.415	0.417	0.433
σ_v	0.302	0.369	0.341	0.342	0.376	0.272	0.231	0.341	0.277	0.264	0.321	0.295
Log L.	-1334.18	-2190.63	4425.06	-188.818	-261.484	-550.06	-157.597	-233.715	-472.073	-322.776	-441.937	-1000.36
N	3667	3673	3667	450	450	450	380	380	380	817	817	817
Elasticity at Mean												
L	0.028*	0.082***	0.026*	0.154***	0.127***	0.206***	0.123***	0.174***	0.123***	0.037	0.001	0.395
K	0.075***	0.081***	0.073***	0.161***	0.057***	0.121**	0.156***	0.044**	0.154**	0.175***	0.095***	0.175***
M	0.857***	0.864***	0.859***	0.814***	0.798***	0.823***	0.719***	0.778***	0.727***	0.689***	0.745***	0.692***
RTS	0.96	1.027	0.958	1.129	0.982	1.15	0.998	0.996	1.004	0.864	0.84	0.867
Efficiency												
Mean	0.8	0.812	0.798	0.837	0.805	0.683	0.702	0.739	0.687	0.736	0.73	0.731
Min	0.239	0.3	0.245	0.469	0.386	0.167	0.167	0.31	0.202	0.13	0.186	0.159
Max	0.964	0.951	0.956	0.939	0.927	0.958	0.947	0.926	0.936	0.956	0.941	0.953

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

arise from different models, it is fair to say that the four sectors would rank close to each other in a list including several other sectors.

In the second stage, we pool the estimates of firms' technical efficiencies across the sectors to assess the impacts of foreign presence, domestic exporting and foreign-owned firms, on the performance of local enterprises. Table 3.3 presents the system GMM estimation of a dynamic efficiency model for the domestic non-exporting firms. We define efficiency as a function of its own lag value (L.Eff), absorptive capacity (ABC), spillover indexes, firm-level characteristics, industry fixed effects, and interaction terms between the spillover indexes and absorptive capacity. In these estimations, we examine whether domestic exporting firms generate spillovers that affect the performance of domestic non-exporting firms. The results show no spillovers from domestic exporting to domestic non-exporting firms when interaction terms are not included. Including the interaction terms, we find significant positive horizontal spillovers that increase with absorptive capacity. The presence of domestic exporting firms in the same sector enhances the efficiency of local non-exporting firms with the resources and capabilities needed to absorb and process information and technology spillovers. On the other hand, such horizontal spillovers may reflect the effects of competition between the two groups, exporting and non-exporting firms, to capture higher market shares in the local economy. Relatively technologically endowed local non-exporting firms would be able to become more productive and efficient while amassing their effort to overcome the competition pressure.

Unlike the positive horizontal spillovers, there is a negative forward spillover from domestic exporting firms in upstream sectors to the local non-exporting enterprises in downstream sectors. In the last column of Table 3.3, while the coefficient of the forward spillover index ($Fward\_D\_X$) is negative, the interaction term between the absorptive capacity and forward spillovers index ($ABC\#Fward\_D\_X$) is significant positive. This suggests that the negative forward spillovers decreases with firms' absorptive capacity. The input supplied by the exporting firms may become costly for the non-exporting enterprises which would affect their efficiency. Further, exporting may reduce the

Table 3.3: Estimation results of the spillover effects from domestic exporting firms

	1	2	3	4	5	6
L.Eff	0.117***	0.1198***	0.11755***	0.11141**	0.11800***	0.11297**
	(0.04321)	(0.04342)	(0.04327)	(0.04374)	(0.04306)	(0.0439)
ABC	0.0001***	0.00045	0.00098***	0.00084***	0.00094***	0.00022
	(0.00023)	(0.00028)	(0.00024)	(0.00027)	(0.00022)	(0.0003)
Hor_D_X	0.0007	-0.0001			0.0007	-0.00009
	(0.00051)	(0.00059)			(0.00051)	(0.00058)
ABC#Hor_D_X		0.00004**				0.00004**
		(0.00002)				(0.00002)
Back_D_X			-0.00193	0.0055	-0.00159	0.01035
			(0.00698)	(0.01137)	(0.0069()8	(0.01157)
ABC#Back_D_X				-0.00042		-0.00065
				(0.00048)		(0.00051)
Fward_D_X			-0.00331	-0.00981**	-0.00331	-0.01035**
			(0.00286)	(0.00436)	(0.00288)	(0.00427)
ABC#Fward_D_X				0.00016		0.00018*
				(0.00011)		(0.00011)
ln(K/L)	-0.00711	-0.00646	-0.00727	-0.00561	-0.00704	-0.00431
	(0.00482)	(0.00479)	(0.00475)	(0.00492)	(0.00475)	(0.00491)
lnL	0.00025	0.00028	0.00023	-0.00022	0.00024	-0.00055
	(0.00169)	(0.00168)	(0.00168)	(0.00196)	(0.00167)	(0.00194)
Public	-0.00105	0.00312	-0.00145	0.00216	-0.001	0.00808
	(0.00594)	(0.00562)	(0.00586)	(0.00637)	(0.0058)	(0.00618)
Sector FE (Ref: food & bev.)						
Textile	-0.102***	-0.104***	-0.095***	-0.101***	-0.10***	-0.111***
	(0.011)	(0.0108)	(0.0167)	(0.0175)	(0.0168)	(0.01737)
Apareal	-0.122***	-0.117***	-0.08***	-0.067**	-0.089***	-0.062**
	(0.013)	(0.01312)	(0.03066)	(0.03021)	(0.03075)	(0.03022)
Leather	-0.089***	-0.09***	-0.056***	-0.067***	-0.089***	-0.095***
	(0.025)	(0.025)	(0.00612)	(0.00609)	(0.02543)	(0.02489)
Constant	0.752***	0.753***	0.757***	0.75***	0.752***	0.744***
	(0.062)	(0.0622)	(0.061)	(0.062)	(0.061)	(0.062)
N	3517	3517	3517	3517	3517	3517
Instruments	211	211	212	212	213	213
Hansen	205.57	205.46	197.1	204.06	198.38	212.17
Hansen P-Value	0.397	0.381	0.564	0.388	0.539	0.233

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

availability of intermediate inputs in local markets.

Regarding the control variables, the coefficient of the lagged efficiency variable suggests that the current performance of a firm significantly depends on its previous year performance. The positive effect of the absorptive capacity also suggests that firms with higher labor productivity ratio (relative to the maximum in their respective sector) and technology level are more efficient than the others. However, the additional controls such as a log of capital intensity, size (the log of the number of workers), and public ownership do not affect the efficiency of the local non-exporting firms. Finally, the industry fixed effects are all significant negative, suggesting that textile, apparel, and leather industries are on average less efficient than the food & beverages industry.

Table 3.4 presents estimations results of the efficiency regression equation for domestic firms, both exporting and non-exporting, and include the spillover indexes capturing externalities that arise from foreign-owned firms. We use dummy indicator for export status instead of absorptive capacity and interact this term with the spillover indexes. As suggested in the literature, the results indicate that exporting firms are more efficient than the non-exporting firms. Since the endogeneity issue between exporting and efficiency is addressed with the GMM estimation technique, the positive coefficient of exporting indicates a causal effect of exporting on efficiency.

Foreign-owned firms serving domestic markets generate backward and forward spillovers that improve the efficiency of domestic exporting firms, while negatively affecting the efficiency of the non-exporting enterprises. The negative coefficient on the backward index ($Back\_F\_NX$) indicates that one percentage point increase in the weighted average domestic sales share of foreign-owned firms in downstream sectors decreases the efficiency of local non-exporting firms in upstream sectors by 2.6 percentage points. However, the spillovers effect is no longer negative when considering domestic exporting firms. As indicated in column 4 of Table 3.4, one percentage point increase in the backward spillovers index increases the efficiency of domestic exporting firms by 3.6 percentage points. On the presence of foreign-owned exporting firms (columns 5 - 8), we find negative backward spillovers that decrease the efficiency of non-exporting local

Table 3.4: Estimation results of the spillover effects from foreign-owned firms

	1	2	3	4	5	6	7	8	9
L.Eff	0.151***	0.146***	0.160***	0.163***	0.149***	0.148***	0.185***	0.187***	0.194***
	(0.042)	(0.042)	(0.04()2	(0.042)	(0.041)	(0.041)	(0.052)	(0.05()2	(0.049)
Exporting	0.0392*	0.052**	0.005	-0.008	0.053**	0.049**	0.043*	0.041*	0.016
	(0.023)	(0.021)	(0.024)	(0.024)	(0.021)	(0.022)	(0.022)	(0.021)	(0.025)
Hor_F_NX	-0.0001			-0.0003					0.0003
	(0.0005)			(0.0005)					(0.0003)
Exporting#Hor_F_NX	0.0032			0.004					0.000
	(0.003)			(0.003)					(0.002)
Back_F_NX		-0.011	-0.026*	-0.026*					-0.003
		0.012	0.015	0.014					0.014
Exporting#Back_F_NX			0.077**	0.062*					0.004
			(0.038)	(0.035)					(0.039)
Fward_F_NX		-0.004**	-0.007**	-0.007***					-0.007**
		(0.002)	(0.003)	(0.003)					(0.003)
Exporting#Fward_F_NX			0.013*	0.013*					0.016*
			(0.008)	(0.007)					(0.01)
Hor_F_X					-0.0001			-0.0007	-0.0001
					(0.002)			(0.002)	(0.002)
Exporting#Hor_F_X					0.002			0.003	0.000
					(0.004)			(0.004)	(0.004)
Back_F_X						-0.035	-0.298**	-0.300**	-0.273**
						(0.042)	(0.13)	(0.13)	(0.123)
Exporting#Back_F_X							0.685**	0.689**	0.629**
							(0.297)	(0.297)	(0.276)
Fward_F_X						-0.004	-0.005	-0.005	0.005
						(0.005)	(0.009)	(0.009)	0.011
Exporting#Fward_F_X							0.004	0.003	-0.027
							(0.033)	(0.033)	(0.041)
ln(K/L)	-0.004	-0.005	-0.004	-0.004	-0.005	-0.005	-0.003	-0.003	0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.005)
lnL	-0.004	-0.003	-0.002	-0.002	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Public	0.003	0.001	0.003	0.001	0.004	0.003	0.001	0.001	0.001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Sector FE (Ref: food & bev.)									
Textile	-0.100***	-0.089***	-0.089***	-0.085***	-0.102***	-0.097***	-0.087***	-0.086***	-0.080***
	(0.009)	(0.014)	(0.014)	(0.013)	(0.009)	(0.01)	(0.012)	(0.012)	(0.015)
Apareal	-0.098***	-0.092***	-0.087***	-0.086***	-0.101***	-0.098***	-0.091***	-0.090***	-0.078***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.011)
Leather	-0.061***	-0.054***	-0.047***	-0.046***	-0.064***	-0.060***	-0.056***	-0.056***	-0.047***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.009)
Cons	0.724***	0.739***	0.723***	0.721***	0.734***	0.738***	0.689***	0.683***	0.648***
	(0.07)	(0.072)	(0.071)	(0.07)	(0.073)	(0.073)	(0.088)	(0.088)	(0.072)
N	3952	3952	3952	3952	3952	3952	3952	3952	3952
Instruments	211	212	212	213	211	212	212	213	216
Hansen	202.963	201.272	196.014	192.634	204.449	206.124	193.25	192.857	187.276
Hansen P-value	0.448	0.481	0.547	0.594	0.419	0.387	0.602	0.59	0.642

Robust standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

firms in upstream sectors. In contrast, domestic exporting firms in upstream sectors gain efficiency as a result of their interactions with the foreign-owned exporting firms in customer sectors.

The negative backward spillovers (to the local non-exporting firms) from the foreign-owned firms may arise due to their preferences for quality intermediate inputs. Technical requirements or lack of high-quality local supplies promote imports of intermediate inputs, particularly by the foreign-owned firms. Such practice hurts the businesses of local small, technologically disadvantaged, and non-exporting firms. The local exporting firms are relatively better placed to satisfy the quality requirements of the foreign-owned customers. Accordingly, increased presence of foreign-owned firms in downstream sectors would improve the businesses of the local exporting firms whose knowledge and technological advantage make them produce high standard products for international customers domestically or abroad. Besides, as firms' efficiency reflects their relative standing to the production frontier, improving the efficiency of local exporting firms leaves the non-exporting enterprises far behind the frontier. Further, local exporting firms have higher absorptive capacity in terms of technology, knowledge and information than their non-exporting counterparts. The transfer of knowledge and information, as well as the competition pressure, would most likely benefit the exporting firms at the expense of the non-exporting enterprises.

On the other hand, the results indicate that foreign-owned firms serving the local markets generate forward spillovers that decrease the efficiency of local non-exporting firms (column 3 of Table 3.4), but improve the efficiency of local exporting firms. The forward spillovers arise from the inputs supplied by foreign-owned firms to the local companies in downstream sectors. These inputs are more likely to be high quality than domestic supplies and may accompany additional information regarding the technologies and knowledge levels of companies in international markets. Such information would help local firms to improve their efficiencies through imitation of new products, production processes, and advances in management and marketing practices. However, the negative influence on the efficiency of local non-exporting firms may arise due to three factors. First, the inputs produced by the foreign-owned companies could be costlier than local inputs. Second, the design and technical complexity may not fit the technology of the local non-exporting firms. Lastly, as the local exporting firms with the financial and technological capability to afford and utilize such inputs improve their efficiency, the non-exporting firms would lag behind.

3.5 Conclusion

Using the Ethiopian manufacturing survey data for the period 1996 - 2010, this chapter examines efficiency gains as a result of the presence of domestic exporting and foreign-owned firms. Following the efficiency estimates from the 'true' fixed-effects stochastic production function, we adopt system GMM to assess the effects of intra- and inter-industry spillovers that affect the performance of local enterprises. Our results indicate that domestic exporting firms generate backward spillovers that improve the efficiency of local non-exporting firms with a higher absorptive capacity. However, they also produce negative forward spillovers that decrease with the absorptive capacity of the non-exporting firms. On the spillovers from foreign-owned firms, we find separate effects for the domestic exporting and non-exporting firms. Local exporting firms gain efficiency as a result of their backward and forward trade relations with foreign-owned firms, whereas the efficiency of the non-exporting firms deteriorates as a result of such relations.

Overall, the results suggest that spillovers from inward foreign investment and exporting activities improve the efficiency of local exporting and productive firms. Vertical spillovers from foreign-owned firms improve the efficiency of local exporters, while the horizontal spillovers from domestic exporters improve performance of local non-exporting firms with greater absorptive capacity. It is also important to note that, the presence of foreign-owned firms in upstream and downstream sectors deteriorates the efficiency of local non-exporting firms. Concerning policy, although we see efficiency gains from foreign presence, the capability of domestic enterprises to absorb and utilize the information, knowledge, and technology spillovers is crucial. To optimize the gains from an inward foreign investment, it is important to promote exporting and build the capacity of local firms. Given the wide range of the efficiency scores, increasing the absorptive capacity of local enterprises through trainings aiming to improve the skills and technical know-how of manufacturing workers is necessary to optimize the gains from spillovers. Besides, providing easy access to credit, infrastructural development, and reducing bureaucratic bottlenecks may help promote exports and improve the absorptive capacity of local enterprises.

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APPENDICES

Table A1: Institutions included in estimating master's graduation premiums

Argosy Univ. Chicago Campus	Lewis University	Rush University
Aurora University	Lincoln Christian University	School of the Art Inst. Chicago (SAIC)
Benedictine University	Loyola University of Chicago	Southern Illinois Univ. Carbbondale (SIUC)
Bradley	Midwestern University (MWU)	Southern Illinois Univ. Edwarsville (SIUE)
Chicago State University (CSU)	National-Louis University (NLU)	St. Xavier University
Columbia College Chicago (CCC)	North Central College	The John Marshall Law School (John M.)
Concordia University	North Park University	Trinity International University
DePaul University	Northeastern Illinois University (NEIU)	Univ. of Illinois at Chicago (UIC)
Dominican University	Northern Illinois University (NIU)	Univ. of Illinois at Springfield (UIS)
Eastern Illinois Univ. (EIU)	Northwestern University (NWU)	Univ. of Illinois at Urbana/Champaign (UIU)
Elmhurst College	Olivet Nazarene University	University of Chicago (UC)
Governors State University (GSU)	Quincy University	University of St. Francis
Illinois Institute of Technology (IIT)	Rockford College	Western Illinois University (WIU)
Illinois State University (ISU)	Roosevelt University	Wheaton College
Lake Forest College	Rosalind Franklin Univ. of Medicine	

Table A2: Institutions included in estimating PhD graduation premiums

Benedictine University	Northwestern University (NWU)	Chicago School of Prof. Psychology (CSPP)
DePaul University	Roosevelt University	The John Marshall Law School (John M.)
Illinois Institute of Technology (IIT)	Rosalind Franklin Univ. of Medicine	University of Illinois at Chicago (UIC)
Illinois State University (ISU)	Rush University	Univ. of Illinois at Urbana/Champaign (UIU)
Loyola University of Chicago	Southern Illinois Univ. Carbondale (SIUC)	University of Chicago (UC)
Midwestern University (MWU)	Southern Illinois Univ. Edwardsville (SIUE)	Wheaton College
Northern Illinois University (NIU)		

Table A3: Partial results of the master's graduation equation in California universities

Dependent Var:	Total						Native					
Degree Granted	2009	2005	2000	1995	1990	1985	2009	2005	2000	1995	1990	1985
New Enrollment												
L1.	0.17**	0.15	0.29***	0.37***	0.36***	0.43***	0.15**	0.35***	0.29***	0.33***	0.36***	0.46***
L2.	0.51***	0.41***	0.26***	0.27***	0.10***	0.18**	0.55***	0.13**	0.24***	0.26***	0.10***	0.17*
L3.	0.32***	0.41***	0.37***	0.34***	0.48***	0.33***	0.32***	0.51***	0.38***	0.41***	0.46***	0.29***
Ass. Prof. Salary	-0.23	0.07	0.30***	0.32*	0	0.16	-0.23*	-0.11	0.25***	0.29**	-0.06	0.17
Premiums												
Cal Poly San Luis Obispo		-8.05*	-0.58	-8.19*	3.04	-3.82		-6.51	-0.62	-8.07**	3.63	-3.31
Cal State Poly Pomona		-3.34	-4.07	-5	-2.8	1.05		0.74	-1.72	-4.3	-2.7	8.55
CSU Bakersfield		4.75	2.06	-5.97*	-15.47**	-5.98***		5.02	1.52	-5.67	-10.81**	-4.55***
CSU Chico		1.7	-1.62	-10.66***	5.49	-2.25		-0.03	-1.08	-8.82***	4.69	-2.46
CSU Dominguez Hills		7.29**	4.16	11.25	6.12	-1.73		6.37	5.02	10.71	0.09	-3.13
CSU East Bay		0.78	2.06	3.02	6.05	5.2		1.58	-0.89	2.57	5.21	6.67
CSU Fresno		11.39**	-1.87	3.33	2.83	3.42		15.80**	-1.62	3.58	3.40*	3.19
CSU Fullerton		-4.32	2.79	0.18	-9.46***	-1.07		-8.39***	2.7	0.01	-9.09***	0.25
CSU Long Beach		14.61*	1.41	15.01**	-11.20**	-2.82		7.32	1.72	13.89**	-10.61**	-2.24
CSU Los Angeles		-9.45*	0.02	-13.03***	-5.57	-3.73		-21.00***	0.13	-11.31***	-4.85	-3.12
CSU Monterey Bay		4.49						2.35				
CSU Northridge		-1.81	3.37	4.27	-3.11	-1.41		3.34	2.35	3.2	-2.29	-1.46
CSU Sacramento		1.63	-3.16	6.11	-3.84	-1.01		2.28	-2.43	6.2	-2.45	0.22
CSU San Bernardino		-2.75	-5.21	-11.91***	8.58	-7.61*		-1.6	-4.31	-10.15***	4.34	-7.38*
CSU San Marcos		-7.61	-30.03***					-4.75	-30.71***			
CSU Stanislaus		3.79	0.35	-3.81	-4.47	-4.89		8.34	0.8	-3.42	-3.49	-2.95
Humboldt State Uni.		0.08	-2.74	-8.69*	3.56	-3.43		4.09	-2.62	-6.26	3.34	-1.33
San Diego State Uni.		-7.62	1.09	5.55	8.05*	0.92		-1.45	0.98	4.38	5.93	0.19
San Francisco State Uni.		1.15	-3.27*	0.42	-1.29	4.33		-0.24	-2.33	1.11	0.08	4.37
San Jose State Uni.		-4.87	-1.45	-1.28	-0.54	-2.6		-12.49**	-0.72	-3.97	-0.93	8.28**
Sonoma State Uni.		-1.11	0.7	-4.11	2.54	-4.18		0.76	1.16	-3.72	2.35	-3.33
UC Berkeley	-3.24	1.57	4.50**	-12.10***	3.81	1.99	-2.14	10.14***	3.33	-11.21***	5.03	2.68
UC Davis	-4.7	3.39	-4	-2.36	4.45**	-5.50**	-1.91	5.90**	-5.7	-2.5	3.73*	-4.75**
UC Irvine	8.64**	7.39*	-1.53	-5.05	3.75	-3.97	6.18*	9.69**	-3.77*	-5.34	3.01	-3.05
UC Los Angeles	-1.6	-4.34	6.91	-11.56**	7.82*	-1.63	-1.78	2.22	7.76	-9.03*	8.94**	-2.32
UC Riverside	6.41*	3.88	-4.78***	-0.68	7.11**	-2.05	5.56	4.61	-4.30**	-1.16	6.73***	-2.92
UC San Diego	5.31*	0.81	-3.11	-1.48	2.28	0.92	4.36*	4.83	-4.24**	-1.89	2.79	0.86
UC Santa Barbara	-0.34	5.42**	-3.78*	-2.52	5.61*	2.67	-1.59	6.12**	-5.50**	-2.89	4.68*	0.72
UC Santa Cruz	-2.58	1.2	-3.57*	-2.02	3.4	0.58	-1	2.76	-3.87**	-1.67	4.80*	-0.05
Constant	14.31	-3.55	-12.93**	-14.98	0.19	-6.58	12.97*	4.33	-9.86*	-13.68*	3.07	-6.96
Obs	92	370	358	349	315	288	92	370	358	349	315	288
Joint F for Prem.	2.44***	2.02***	5.63***	2.78***	2.02***	1.32	2.00*	2.60***	10.45***	2.47***	2.14***	1.52*

Standard errors are robust. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A4: Estimated PhD graduation premiums among the total doctoral students

	2010		2009		2008		2007		2006		2005		2004		2003	
	prem	se	prem	se	prem	se	prem	se	prem	se	prem	se	prem	se	prem	se
Bened	-5.363	7.11	6.49	4.21	0.792	4.4	4.051	4.02	-17.960**	7.23	16.644***	4.845				
DePaul	3.167	5.17	6.105**	2.99	-7.607	8.65	2.626	2.68	22.067	20.2	-15.345	11.33	-8.926*	5.11	-3.281	9.06
IIT	-6.622	5.67	-1.67	2.06	5.743***	1.99	7.919**	3.84	0.089	2.54	5.547	5.395	5.983	4.34	-7.009	4.7
ISU	10.205*	5.55	-1.369	1.94	5.255**	2.06	2.743	2.17	-0.183	4.66	1.573	3.534	-4.49	4.06	-3.947*	2.19
Loyola	0.587	3.11	6.048**	3.04	0.865	5.29	7.962***	2.3	1.735	3.48	7.275*	4.196	-0.223	3.86	-3.986*	2.27
MWU	0.654	12.4	-29.506***	8.02	-59.552***	10.4	-47.567***	6.38	-6.222	49.8	-11.849	30.14	27.327**	13.6	75.998***	5.1
NIU	-1.423	2.47	1.115	3.21	5.086*	2.96	0.434	3.06	-0.621	5.26	-0.732	4.641	0.408	1.83	2.094	2.6
NWU	-3.501	3.38	-2.2	1.42	2.93	2.16	0.794	1.72	-2.988	4.32	0.585	4.064	-1.809	2.22	-4.264	3.11
Roosevelt	-8.457	6.43	-2.728	2.91	6.697**	2.77	8.152***	1.14	6.668**	3.05	11.386***	2.516	-2.386	5.04	3.201	4.38
Rosalind	-0.892	6.64	10.002***	3.25	11.351***	4.19	4.064	6.91	-1.549	2.72	2.261	3.776	-13.05	9.84	4.712	8.14
Rush	-10.914	7.42	12.486	8.26	20.836***	6.09	6.342***	2.33	11.784*	6.66	4.676	6.349	1.371	6.47	-4.981	4.01
SIUC	4.013	2.69	-0.917	1.53	6.038***	1.95	5.998***	1.97	2.471	3.52	0.508	3.576	-6.070**	2.73	-7.504***	2.37
SIUE	-7.501	8.03	27.685***	5.56	-15.351**	6.68	7.495***	1.24	4.448	3.88	-2.797	3.557	-4.643***	1.56	-3.647***	1.34
CSPP	11.546*	6.91	12.938***	3.68	8.190*	4.4	-3.764	8.51	-12.505	15.8	3.08	16.15	-28.242***	9.48	-0.779	2.42
John M.	-16.754	20.4	-4.57	8.22	-34.039***	9.03	-20.448	14.4	69.322**	29.5	29.768	26.63	90.541***	11.5	7.905	5.96
UIC	2.853	3.37	-2.168	1.52	4.709*	2.45	5.644*	3.12	-0.802	3.05	2.441	3.208	-3.886	3.28	-4.585***	1.72
UIU	2.792	3.67	2.9	2.19	5.223***	1.87	2.078	2.61	-13.111	8.3	-8.316	5.227	-12.881***	4.82	-5.970**	2.65
UC	2.571	2.24	-0.887	2.17	6.304***	2.12	1.29	2.05	-7.428	6.13	-1.078	4.532	-6.380***	2.41	-2.909	3.86
Wheaton	4.718***	1.69	-5.706***	0.99	6.461***	1.69	3.288**	1.26	3.206*	1.81	-3.151	2.282				
N	126		123		123		121		124		122		116		122	
Joint F stat	3.72		604.79		8.33		9.10E+05		339.76		67.51		24.75		80.47	

Standard errors are robust. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A5: Estimated graduation premiums among the total master's students

	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Argosy	56.113***	-19.777**	3.556	-18.765***	-2.252	15.217***	5.954	6.348	-5.9	-46.347***	
Aurora	-10.86	-29.195	-13.739	-22.388	-13.933	-16.125	10.078	-18.131	-10.985	6.006	8.34
Bene.	14.269*	-5.744	-20.526	4.298	10.3	21.772*	5.296	15.987*	7.993	20.202*	2.412
Bradley	-0.323	2.533	-5.506**	0.441	12.586	5.751*	5.89	3.425	0.086	9.489***	0.773
CSU	0.699	5.238	4.492	-7.493*	2.991	4.308	3.347	5.222	8.143	4.285	-2.942
CCC	8.989	5.755*	1.02	-4.622	-2.17	0.172	-0.548	-4.304	2.378	14.634***	9.999
Conco	-1.206	6.115	18.966	-20.202	-10.049	-17.108	13.585*	10.875	2.019	6.807**	-8.925
DePaul	2.568	8.238	2.092	-9.447**	-2.663	3.58	5.058	1.478	-2.788	16.469*	5.42
Domin.	-6.592	-5.016	25.849***	23.785**	11.319**	-16.153	-8.622	0.215	-6.061	-13.38	-15.096***
EIU	3.458	1.414	-3.024	-5.164*	-3.987*	5.671*	7.624	2.498	2.735	9.024***	2.055
Elmhurst	3.776	0.362	1.732	-5.686**	-0.803	4.594*	4.16	0.539			
GSU	-16.26	-3.525	8.117	17.651	6.289	1.845	5.665	10.125	-9.677	10.999***	4.859
IIT	0.85	20.566**	-2.879	-12.009*	-0.983	17.103***	14.969**	2.761	-9.809	0.346	3.118
IST	-2.099	1.513	-1.867	-3.844	1.76	6.147**	5.659	7.623	3.183	7.288*	0.374
Lake F.	3.124**	-2.794	-4.586**	-4.725*	6.869***	3.414	3.676	4.778	3.685	13.217***	1.699
Lewis	-6.64	-3.342	1.291	4.774	-18.589**	1.378	7.332*	10.083	0.445	5.532**	4.726
Lincoln C.U.	15.122***	1.545	-10.516***	-19.614***	-18.585***	-20.067***	-11.855***	-9.524**	11.179**	3.466	14.118***
Loyola	-10.577*	-6.111	6.462	-1.571	1.502	7.37	7.353	6.894	8.178	10.140***	5.57
MWU	0.959	5.613	-3.502	-18.429*	11.833	6.081**	-10.978***	8.469**	27.653***	24.089***	-38.378***
NLU	19.346*	29.635	-5.505	46.656	2.203	-53.850*	-140.508***	-145.565**	-88.402	-94.637***	-21.903
North C.	1.627	4.405	1.445	1.23	-2.823	7.608	11.703	8.883	-32.255**	-20.974**	-0.11
North P.	-10.332	-2.062	-9.001	3.868	-0.441	-0.456	-4.383	7.515	-4.275	-1.872	-0.637
NEIU	2.857	1.713	-0.723	0.763	0.689	3.950*	0.222	4.37	0.674	5.806**	2.2
NIU	8.686	1.952	1.603	-1.065	6.554	4.206	1.309	1.562	7.021	6.345**	2.222
NWU	3.361	-2.132	-5.698	-5.631	2.548	-1.508	16.679	9.024	18.099***	12.007***	-3.312
Olivet	-1.946	-16.978	-2.546	-10.357	32.681	27.119**	-2.765	1.856	25.925	-34.448	9.106
Quincy	-1.635	8.689*	13.985**	-7.395	-6.174	-0.281	-9.089	-25.997***	-37.163***	15.430***	49.777***
Rockford	-97.554***	-58.010***	-12.105**	41.752***	9.102	1.52	40.786***	102.853***	10.552***	45.306***	56.763***
Roosevelt	4.98	1.062	-2.766	2.306	-3.790*	8.921**	-0.423	0.357	3.971	13.857**	9.560**
Rosalind	4.425	3.527	22.455**	4.33	-9.875	4.076	6.226	10.305	12.356**	6.458***	8.892
Rush	-4.877	-13.265	0.028	-10.452	-6.374	-17.679	5.813	4.711	5.45	5.696**	-5.307
SAIC	-6.849	-3.77	-6.641**	0.782	7.746**	3.009	12.327	-0.698	8.681	5.579	5.751
SIUC	0.996	4.417	-2.198	-0.689	2.816	3.651	4.056	4.128	-5.594	-2.485	-3.066
SIUE	-2.213	-1.177	4.112*	1.741	1.967	2.212	3.137	8.433*	0.53	4.827	0.8
St. Xavier	-18.07	-10.899*	-3.864	27.083	-5.099	-14.805	10.358	11.36	20.883**	4.716	-5.591
John M.	-21.075***	-13.745	12.662	1.465	32.354***	2.003	-8.207	-19.798***	4.055	8.989**	3.493
Trinity	9.327***	-16.408**	0.593	-20.290*	-21.976	1.468	22.541	36.161*	9.366	-6.494***	11.708**
UIC	-0.539	2.127	-2.381	0.133	1.167	2.118	5.266	8.962*	1.705	10.641***	8.023
UIS	-6.629	2.386	21.781	-9.480**	3.771	9.373**	4.34	0.163	3.196	10.528**	1.656
UIU	5.741	-2.96	-3.819	-5.215	-9.175**	0.912	16.812***	27.258***	13.074*	3.292	2.61
UC	-4.442	-5.848	-1.87	-8.074	-3.314	6.564	9.956	18.782***	21.396**	-4.068	-6.443
St. Francis	2.394	-12.154	1.202	12.635**	32.241	19.844	51.747	2.46	-17.865	-24.921***	-31.911
WIU	6.036**	1.86	-2.194	-4.875	-9.499	0.855	4.348	9.802	1.226	9.006*	4.218
Wheaton	-2.19	-7.039**	-2.607	2.942	-2.554	12.154***	10.688	6.912	10.752	10.144***	-11.752*
N	405	409	387	378	371	363	361	359	355	358	362
Joint F Stat	95.03	20.24	53.03	728.5	1670.94	578.12	8.94	356.04	617.44	7844.16	1167.36

Standard errors are robust. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A6: Estimated PhD graduation premiums among the native students

	2010		2009		2008		2007		2006		2005		2004		2003	
	prem	se	prem	se	prem	se	prem	se	prem	se	prem	se	prem	se	prem	se
Bened	-3.416	6.554	7.892*	4.272	3.678	3.75	9.643**	4.084	-16.437***	4.916	13.044***	4.153				
DePaul	0.92	4.576	5.211**	2.279	-3.561	4.639	3.484	2.532	17.871	15.843	-15.834	12.248	-9.784*	5.247	-3.437	8.186
IIT	-5.927	6.312	0.162	2.119	5.282**	2.093	8.463**	3.489	1.453	2.212	6.134	5.063	3.843	3.645	-8.652*	4.969
ISU	9.032*	5.328	0.137	2.069	2.458	2.735	3.202	2.368	1.758	3.683	4.124	3.286	-4.835	4.929	-8.152**	3.794
Loyola	-1.814	2.545	5.618*	2.854	0.766	4.896	8.858***	2.748	2.613	3.003	8.167**	3.663	-1.507	3.332	-5.646*	2.887
MWU	13.675	12.245	-36.087***	13.483	-37.438***	11.994	-48.860***	11.366	-29.951	30.489	-23.815	20.419	17.741	15.074	72.869***	5.091
NIU	-0.331	2.579	1.348	3.218	5.415**	2.464	2.896	2.28	-1.151	4.331	-0.293	4.771	-2.601	2.269	-0.089	2.483
NWU	-1.406	3.38	-1.595	1.303	2.809	1.888	0.513	2.122	-1.4	2.903	-0.032	3.635	-2.501	2.535	-5.866***	2.171
Roosevelt	-8.294	7.86	-1.44	3.007	4.447	2.72	7.996***	1.719	6.893***	2.41	10.818***	2.342	1.649	3.209	6.478***	2.248
Rosalind	-2.881	5.89	14.470***	4.458	12.092**	5.003	2.745	7.966	-4.147	4.585	-2.446	4.978	-12.691	8.888	6.768	11.498
Rush	-7.921	6.985	12.85	8.728	16.715***	6.14	5.826	5.198	9.769*	5.384	5.621	4.434	4.158	3.65	-6.245*	3.497
SIUC	3.691	2.83	-0.181	1.45	6.314***	1.849	7.892***	1.988	2.401	2.902	-0.331	2.805	-5.713**	2.267	-6.592***	1.862
SIUE	-3.157	8.776	28.441***	5.833	-26.406***	5.634	7.344***	1.483	4.498	3.011	-2.732	2.588	-5.932***	1.21	-4.560***	1.124
CSPP	8.899	8.528	14.393***	3.6	-0.665	5.838	-12.062	8.03	-6.978	7.921	6.477	11.094	-24.482**	10.974	-0.285	1.629
John M.	-26.672	23.078	-6.913	7.398	-33.010***	8.824	-13.783	14.078	42.871***	16.273	23.387	19.508	73.794***	10.422	6.297	5.72
UIC	1.882	3.87	-0.881	1.866	4.374**	1.961	6.566***	1.94	0.125	3.19	2.418	2.6	-2.17	2.424	-5.007***	1.747
UIU	3.338	2.959	3.217	2.051	4.777***	1.781	2.577	2.598	-6.028	4.354	-2.171	3.434	-8.271***	2.936	-5.385**	2.181
UC	2.324	2.486	-1.194	2.017	7.636***	2.104	1.462	2.025	-5.505	4.088	-2.145	3.853	-11.307***	3.161	-6.576**	3.212
Wheaton	5.104**	2.103	-4.852***	0.925	5.170***	1.509	2.088	1.31	1.85	1.639	-0.846	2.208				
N	126		123		123		121		124		122		116		122	
Joint F	6.51		2134.3		9.56		15.3		121.53		52.11		56.83		33.5	

Standard errors are robust. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A7: Estimated master's graduation premiums among the native students

	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Argosy	50.753***	-15.294**	9.082**	-16.619***	-2.122	17.010***	8.795**	7.416	-7.749	-47.380***	
Aurora	-11.572	-27.958	-16.976	-26.674	-13.595	-14.115	20.461	-16.533	-7.695	6.036	10.456
Bene.	14.610*	-6.949	-26.667**	1.854	13.234*	21.960**	2.918	15.892*	7.444	21.299*	3.919
Bradley	2.281	2.942	-0.076	-1.886	2.506	6.456**	3.279	4.192	-0.229	11.100***	3.483
CSU	0.132	6.635	6.752	-6.251	2.792	5.546*	0.236	5.207	6.517	6.358	-4.21
CCC	8.436	6.619**	5.392	-0.39	-1.973	-3.851	-2.544	-4.686	-0.847	17.169***	10.348
Conco	1.072	5.434	14.756	-17.075	-6.01	-17.346	10.032	10.65	-0.508	7.495*	-9.294
DePaul	1.132	8.221	6.215	-7.609*	-1.276	6.126	2.028	-1.84	-2.802	24.286*	5.945
Domin.	-0.141	-2.231	12.008	23.373**	7.467	-8.79	-0.884	0.94	-7.048*	-13.282	-13.009**
EIU	3.24	1.859	-1.152	-4.382	-3.216	6.438**	4.981	1.96	0.508	12.262***	3.691
Elmhurst	3.508*	1.725	3.111	-4.378*	-1.478	5.319**	0.65	0.038			
GSU	-15.186	-9.246	10.239	19.059*	4.229	1.144	3.226	12.406	-10.409	14.180***	7.178
IIT	-0.264	7.998***	2.353	-11.626**	-2.68	10.954***	4.221	0.678	-3.704	8.072*	0.123
IST	-2.798	2.95	0.241	-2.043	0.642	6.567**	1.991	7.877	1.796	10.278**	1.347
Lake F.	2.204	-1.133	-0.145	-1.672	7.272***	4.644*	-0.148	3.287	0.405	17.254***	2.175
Lewis	-6.14	-3.121	-2.039	2.191	-17.675**	0.74	6.553	12.512**	-0.632	9.585**	5.645
Lincoln C.U.	10.124***	4.462*	-3.799*	-18.261***	-23.690***	-19.767***	-15.470***	-8.185**	12.267***	7.628*	9.666***
Loyola	-9.730*	-4.417	5.827	-0.686	0.357	7.679	7.712	8.028	6.606	11.209***	5.236
MWU	1.285	7.1	-1.12	-16.2	12.581	7.839***	-7.261*	8.582**	27.808***	22.996***	-37.919***
NLU	19.720*	28.328	-14.557	29.343	1.828	-52.191*	-93.854**	-110.050*	-54.8	-122.828***	-21.965
North C.	1.359	5.61	2.403	1.517	-2.583	7.143	7.287	10.345	-31.729***	-17.982*	2.769
North P.	-9.022	-0.627	-5.833	5.203	0.258	-0.557	-7.946	7.312	-3.613	2.497	4.322
NEIU	3.86	2.767	-0.481	0.287	1.9	5.786**	-2.365	4.231	-0.683	8.206**	2.966
NIU	9.992*	-0.088	1.743	-2.323	4.869	4.336	1.165	2.842	8.814	8.671***	1.739
NWU	2.157	-1.186	-0.306	2.985	3.767	-2.606	1.986	2.367	13.026**	14.007***	-4.332
Olivet	-2.015	-14.892	-1.374	-9.977	31.354	28.334**	2.91	4.195	27.267	-30.873	10.394
Quincy	-0.331	11.711**	12.159***	-8.910*	-5.212	-0.404	-7.435	-17.245**	-26.891***	5.193	54.828***
Rockford	-100.239***	-60.171***	-18.653***	43.865***	1.596	-0.544	29.129***	103.429***	11.055***	50.012***	59.705***
Roosevelt	4.745	2.265	-3.153	2.665	-2.341	8.094	0.343	4.64	0.388	12.161***	8.885*
Rosalind	4.959	5.341	19.398*	2.299	-7.832	3.32	4.863	10.453	12.830*	6.789***	9.457
Rush	-3.543	-8.422	2.052	-9.139	-6.827	-15.193	2.484	5.385	4.99	8.575**	-5.373
SAIC	-4.840**	-1.532	-5.758	0.097	8.713**	3.167	9.1	-2.96	7.456	7.065*	7.013
SIUC	1.745	5.110*	-0.89	0.5	0.553	4.07	2.424	3.564	-5.506	-1.424	-1.67
SIUE	-2.925	0.515	6.346***	1.308	1.259	3.846	-1.445	4.967	1.429	9.374***	2.756
St. Xavier	-17.179	-12.808	-13.023	14.366	-6.265	-15.919	20.932	14.66	23.165*	6.477	-2.971
John M.	-22.833***	24.971***	9.635	-2.265	21.352***	-0.891	0.23	0.013	-9.495*	12.842***	11.899***
Trinity	10.103***	-12.388*	4.091	-22.053*	-23.639*	-8.257**	15.799*	23.311**	23.413**	13.039	5.133*
UIC	-2.249	1.089	0.003	-0.966	1.544	6.019*	0.516	5.845	0.525	10.575***	4.876
UIS	-4.177	4.816*	10.026**	-4.742	3.454	9.897***	1.945	1.443	2.329	14.452***	3.615
UIU	3.922	0.55	-1.72	-4.676	-7.292*	-1.644	9.484**	17.136**	7.412	3.755	-1.704
UC	-4.873	-3.969	1.454	-8.891	-3.106	12.665**	9.514*	15.626**	10.398*	0.589	-1.466
St. Francis	3.568	-12.934	-2.422	8.909*	33.087	20.558	69.679	15.716	-14.692	-23.746***	-30.785
WIU	5.094	3.292	1.503	-3.756	-9.107	2.427	0.403	10.688	0.052	11.186**	4.645
Wheaton	-3.475	-5.986**	0.282	6.791	-2.87	11.497***	6.866	4.652	6.937	9.903***	-10.193
N	405	409	387	378	371	363	361	359	355	358	362
Joint F-Stat	130.2	59.67	49.7	4013.5	1966.24	7.07	4.4	198.34	244.7	556.08	3427.91

Standard errors are robust. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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