Expanding Export Variety: The Role of Institutional Reforms in Developing Countries

Online Appendix: Sensitivity Analysis

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Sensitivity Analysis

In this online Appendix, we present the details of all robustness check we have discussed in the paper. First, we check the robustness of the main findings by adopting alternative measures of the extensive margin, excluding processing trade that involves only purely assembly or final goods, and by using ordinary exports as a placebo test. Next, we distinguish three types of firm ownerships—Chinese-owned, joint ventures, and wholly foreign-owned firms; and, we examine whether our main findings are contaminated by other reforms that are concurrent to ownership liberalization in China. Lastly, we use high-income countries as the North in the regression analysis.

To begin with, we use two alternative measures of extensive margin. The first is a simple count of product varieties, where variety is defined as the eight-digit HS product−country pair. This measure differs from the extensive margin index used in previous regressions because the index adjusts for export values. The second measure considers variety as an eight-digit HS product; and it does not distinguish country destinations of exports but still computes the extensive margin index.

We also construct two other measures of the extensive margin by using firm-level Chinese customs data from 2000 to 2006. This sample includes all Chinese firms that participated in international trade during the period and contains the value of firm exports by country and product in the eight-digit HS code. The data set also includes records of customs regimes and locations of each firm. This sample has been used in recent trade studies (see Manova and Zhang (2012) and Yu (2014) for a brief description of the data). We use this firm-level data set for robustness analysis because their time coverage is shorter than that of our main data source; particularly, several years of important information before China's accession to WTO are missing. We construct two measures of export varieties based on the exports of these processing firms: the number of firm−HS8 code pairs and the number of firm−HS8 code−destination country triples. Table C.1 in the Appendix presents the summary statistics of the basic and four alternative measures of the extensive margin. All of these measures are highly correlated with each other.

Table C.2 presents the results of the IV estimation with controls for province−year dummies using the alternative measures of variety. The positive and statistically significant interaction terms

of FDI with encouragement policy, court efficiency, and policy zones are similar to the original estimates reported in Table 2, thus confirming the model's key implications that institutional reforms increase the extensive margins of FDI exports more than those of outsourcing. The negative and statistically significant interaction terms for restriction policy support the results from the opposite direction. These findings show that the benchmark empirical findings are not sensitive to the alternative measures of extensive margin. The two positive coefficients on the linear terms of encouragement policy $(0.057$ and $0.234)$ in Columns (1) and (2) become insignificant negative estimates $(-0.054$ and $-0.022)$ in Columns (3) and (4), possibly because of the shorter data coverage in the last two columns. These results are consistent with the intensified competition from FOEs since China's accession to WTO in 2001. Therefore, the encouragement policy for FDI exports reduces the variety of outsourcing exports. Similar reasons can be used to explain the positive coefficients on the linear terms of restriction policies. Overall, the estimated effects of policy and institutional factors are highly consistent with our benchmark results.

Next, we perform robustness checks that are related to a key feature of the model, that is, relationship-specific investment in contracting. Chinese data categorize exports along two dimensions: (a) final versus intermediate goods based on Broad Economic Categories (Revision 4), and (b) ordinary versus processing exports. Processing exports are further categorized into (a) pure-assembly, which mostly involves simple contracting, and (b) import-and-assembly, which requires more relationship-specific investment.[1] Although the benchmark analysis includes both types of processing exports, we restrict our sample to import and assembly as a robustness check because this form of contracting relates more closely to the model. As a second sensitivity check, we also restrict our sample to exports of intermediate goods, thus conforming well to the model's setting of vertical integration of global production. Moreover, we use ordinary exports as a placebo test for our model. As most ordinary exports do not involve contracting with foreign firms in production,

[1]Under pure-assembly, a foreign firm supplies materials to a factory in China (foreign or domestically owned), and the factory uses the imported materials only for processing and assembly for the foreign client. In return, the foreign firm pays the factory a fee for its processing services. Under import- and-assembly, a factory in China plays a more active role: it chooses where to source materials, how to process them with local productive factors, and where to export (Feenstra and Hanson, 2005).

we do not expect similar estimates by using ordinary exports data.

Columns (1) and (2) of Table C.3 present the estimation results based on the processing exports of intermediate goods and the regime of import and assembly. Benchmark estimates reported earlier using data for all processing exports are not sensitive to alternative data because the signs and magnitudes of the new coefficients remain stable for all key variables. However, for the placebo test based on data of ordinary exports, abnormal results emerge. While the the effects of some policy variables remain stable, column (3) reveals a flipping negative sign for the interaction term $FOE\times\ Encouragement\ policy$, a substantial increase in the coefficient on the FOE indicator, and a statistically positive estimate for the restriction policy for outsourcing export varieties. These results deviate significantly from our basic findings based on data of processing exports, suggesting that our model captures the key underlying mechanisms of processing exports but not those of ordinary exports.

The third sensitivity exercise is related to the classification of firm ownerships. Chinese customs data break ownership into foreign-owned enterprises, joint ventures, and Chinese-owned firms. In the benchmark analysis, we distinguish FOEs from the reference group of joint ventures and Chinese firms because the Chinese government has often applied similar policies to joint ventures and indigenous firms in terms of regulation. To examine whether the main empirical findings are sensitive to this classification, we extend the basic specifications in Table 2 to include three types of firms; the results are presented in Table C.4. Several noticeable findings emerge. First, our benchmark findings on FDI exports are robust to the inclusion of joint ventures as a separate category of firms—the signs and magnitudes of FOE related coefficients are highly stable. Second, as expected, the policy effects on export varieties of joint ventures are different from those of FOEs. Several estimates for the same policy variables show opposite signs, and these results lend support for separating the two types of firms as we do in the benchmark case. Third, both FOEs and joint ventures are responsive to contract environments. In provinces with better institutional quality, both types of firms develop more export varieties relative to indigenous Chinese firms.

There is also a potential concern that other concurrent reforms to FDI liberalization, such as re-

duction in the tariffs of imported inputs and greater market access as a result of WTO membership, may contaminate the main empirical findings. However, one unique feature of Chinese processing trade is that the imported goods for processing trade are duty free for all types of firms and industries. Therefore, the reduction in import tariffs around China's entry to WTO does not affect processing exports. Following Donaldson and Hornbeck (2013), who identified infrastructure as an important determinant of market access, we have compiled a data set on railway and highway density for Chinese provinces to control for the market access. Findings reported in Table C.5 indicate that our key results are robust to the inclusion of the interaction of infrastructure and the FOE indicator. Interestingly we also find that infrastructure helps increase export varieties through FDI more than outsourcing in high headquarter-intensive industries.

Finally, we choose China's trade partners with high incomes as the North instead of using all importers of Chinese goods. This approach is a sensible alternative because developed economies are more likely to offshore production to the South. We define high-income countries according to the World Bank's standard classification.[2] Column (1) of Table C.6 presents the estimation results based on the high-income sample. All estimates are broadly consistent with our benchmark findings. These results are not surprising because China's processing exports to high-income countries account for approximately 89 percent of its total processing exports during the sampled period. To verify the stability of earlier results on headquarter intensity, we further break the sample into high and low headquarter-intensive industries. The regression results reported in Columns (2) and (3) reconfirm the finding that encouragement and restriction policies exert stronger effects on export varieties of FDI firms in industries with high headquarter intensities than those with low headquarter intensities. Moreover, enhanced contract environments and trade zones also help FOEs increase export varieties in technology-advanced industries.

[2]The World Bank does not include Taiwan in the data set, although it qualifies for a high-income region. We add Taiwan to our sample because it is an important trade partner of China.

References

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Table C.1: Summary Statistics and Correlation of Various Measures of Extensive margin

	Chinese Customs Data at Product Level (1997-2007)			Chinese Customs Data at Firm Level (2000-2006)	
	Ln(EM index)	Ln(num.of variety)	Ln(EM index)	Ln(num. of firm-HS8 pair)	Ln(num. of firm-HS8-destination triples)
	Variety= HS8-destination pair	Variety= HS8-destination pair	Variety= HS8		
			A. Summary Statistics		
Obs	29723	29723	29723	18773	18773
Mean	-3.88	2.40	-2.25	1.95	2.67
Std. Dev.	2.22	1.83	1.71	1.76	2.09
Min	-21.22	0.00	-12.79	0.00	0.00
Max	-0.02	8.39	0.00	9.93	10.36
			B. Correlation		
	(a)	(b)	(c)	(d)	(e)
(a)	1.00				
(b)	0.70	1.00			
(c)	0.87	0.58	1.00		
(d)	0.67	0.91	0.59	1.00	
(e)	0.71	0.99	0.59	0.95	1.00

Table C.2: Determinants of Extensive Margin: Alternative Measures of Product Variety

	Chinese customs product-level data (1997-2007)		Chinese customs firm-level data (2000-2006)	
	Ln(num of HS8-destination pair)	Ln(EM index based on HS8)	Ln(num of firm-HS8 pair)	Ln(num of firm-HS8-destination triples)
Independent variables	(1)	(2)	(3)	(4)
FOE indicator	-0.766***	-0.607***	-0.833***	-0.866***
	(0.058)	(0.052)	(0.067)	(0.073)
Enc. policy	0.057	0.234***	-0.054	-0.022
	(0.039)	(0.046)	(0.047)	(0.061)
Res. policy	0.079*	-0.046	0.077*	0.053
	(0.041)	(0.040)	(0.043)	(0.060)
FOE $\times$ Enc. policy	0.185***	0.104***	0.202***	0.179***
	(0.031)	(0.027)	(0.030)	(0.042)
FOE $\times$ Res. policy	-0.266***	-0.248***	-0.227***	-0.201***
	(0.035)	(0.036)	(0.031)	(0.039)
FOE $\times$ Court eff.	2.554***	1.663***	1.099**	2.381***
	(0.540)	(0.458)	(0.540)	(0.615)
FOE $\times$ Natl. zones	0.034***	0.022***	0.043***	0.041***
	(0.006)	(0.004)	(0.006)	(0.006)
First stage F-stat	145.27	145.27	103.01	103.01
Industry dummy	+	+	+	+
Prov-year dummy	+	+	+	+
Observations	28,582	28,582	18,080	18,080
Partial R^2	0.051	0.042	0.050	0.044

Note: The interaction terms of factor intensity and factor abundance are also included but not reported. Two-step GMM method is adopted for IV estimates in all regressions. The R-squared are the residual R-squared according to the Frisch-Waugh-Lovell (FWL) theorem as we partial out the province-year and industry fixed effects. Province-year pair cluster robust standard errors in parentheses. *, **, and *** indicate significance at the 10,5, and 1 percent levels.

Table C.3: Determinants of Extensive Margin by Intermediate Goods and Customs Regimes

	Intermediate goods	import-and-assembly	Ordinary exports
Independent variables	(1)	(2)	(3)
FOE indicator	-0.737***	-0.946***	-2.353***
	(0.080)	(0.078)	(0.073)
Enc. policy	0.156**	0.231***	0.168***
	(0.072)	(0.066)	(0.043)
Res. policy	0.055	-0.042	0.118***
	(0.055)	(0.058)	(0.032)
FOE $\times$ Enc. policy	0.181***	0.196***	-0.122***
	(0.051)	(0.041)	(0.031)
FOE $\times$ Res. policy	-0.364***	-0.242***	-0.429***
	(0.050)	(0.050)	(0.033)
FOE $\times$ Court eff.	2.569***	2.110***	2.004***
	(0.756)	(0.667)	(0.617)
FOE $\times$ Natl. zones	0.041***	0.043***	0.065***
	(0.007)	(0.006)	(0.007)
First stage F-stat	130.18	134.84	146.14
Industry dummy	+	+	+
Prov-year dummy	+	+	+
Observations	20,466	26,174	27,860
Partial R^2	0.025	0.034	0.465

Note: The dependent variable is the log extensive margin index based on HS8-country pair. The interaction terms of factor intensity and factor abundance are also included but not reported. Two-step GMM method is adopted for IV estimates in all regressions. The R-squared are the residual R-squared according to the Frisch-Waugh-Lovell (FWL) theorem as we partial out the province-year and industry fixed effects. Province-year pair cluster robust standard errors in parentheses. *, **, and *** indicate significance at the 10,5, and 1 percent levels.

Table C.4: Determinants of Extensive Margin by Three Types of Firm Ownership

	OLS	IV	IV
Independent variables	(1)	(2)	(3)
JV indicator	0.214***	0.263***	0.290***
	(0.056)	(0.060)	(0.062)
FOE indicator	-0.284***	-0.296***	-0.268***
	(0.089)	(0.092)	(0.094)
Enc. policy	0.231***	0.273***	0.283***
	(0.061)	(0.060)	(0.059)
JV $\times$ Enc. Policy	0.035	0.024	0.011
	(0.044)	(0.043)	(0.043)
FOE $\times$ Enc. policy	0.285***	0.223***	0.228***
	(0.052)	(0.051)	(0.050)
Res. policy	-0.167***	-0.156***	-0.157***
	(0.055)	(0.056)	(0.056)
JV $\times$ Res. policy	0.165***	0.155***	0.174***
	(0.049)	(0.048)	(0.048)
FOE $\times$ Res. policy	-0.163***	-0.119**	-0.134**
	(0.058)	(0.056)	(0.056)
Court eff.	-1.184***	-2.185***	
	(0.346)	(0.697)	
JV $\times$ Court eff.	2.160***	2.957***	3.214***
	(0.319)	(0.489)	(0.487)
FOE $\times$ Court eff.	2.655***	3.513***	3.805***
	(0.501)	(0.747)	(0.741)
Natl. zones	0.067***	0.066***	
	(0.011)	(0.011)	
JV $\times$ Natl. zones	-0.003	-0.008	-0.009
	(0.005)	(0.005)	(0.006)
FOE $\times$ Natl. zones	0.037***	0.036***	0.034***
	(0.008)	(0.008)	(0.008)
First stage F-stat		> 76.46	> 101.66
Industry dummy	+	+	+
Yearly dummy	+	+	
Prov-year dummy			+
Observations	38,324	38,324	38,324
R^2	0.443	0.441	0.020

Note: The dependent variable is log(extensive margin index), based on the definition of variety as HS8-country pair. The interaction terms of factor intensity and factor abundance are also included but not reported. Additional control variables including distance, border, coastal, real GDP, and population density are also included in regressions (1) and (2). The R-squared in Column (3) is the residual R-squared according to the Frisch-Waugh-Lovell (FWL) theorem as we partial out the province-year and industry fixed effects. Province-year pair cluster robust standard errors in parentheses. *, **, and *** indicate significance at the 10,5, and 1 percent levels.

Table C.5: Infrastructure and Export Varieties

	All	High HQ industries	Low HQ industries
Independent variables	(1)	(2)	(3)
FOE indicator	-0.798***	-0.903***	-0.980***
	(0.107)	(0.150)	(0.113)
Enc. policy	0.279***	0.770***	-0.209***
	(0.064)	(0.110)	(0.071)
Res. policy	-0.046	-0.107	-0.036
	(0.055)	(0.067)	(0.095)
FOE $\times$ Enc. policy	0.145***	0.570***	0.119**
	(0.042)	(0.088)	(0.051)
FOE $\times$ Res. policy	-0.235***	-0.384***	0.058
	(0.046)	(0.065)	(0.068)
FOE $\times$ Court eff.	1.462**	2.450**	0.435
	(0.706)	(1.052)	(0.691)
FOE $\times$ Natl. zones	0.035***	0.018**	0.052***
	(0.006)	(0.008)	(0.006)
FOE $\times$ Infrastructure	0.096	0.252***	0.012
	(0.060)	(0.086)	(0.071)
First stage F-stat	91.16	77.5	95.23
Industry dummy	+	+	+
Prov-year dummy	+	+	+
Observations	28,245	12,631	15,614
Partial R^2	0.037	0.051	0.028

Note: The dependent variable is the log extensive margin index with definition of variety as HS8-country pair. The interaction terms of factor intensity and factor abundance are also included but not reported. For Columns (2) and (3), we use skill intensity to measure the headquarter service intensity at the industrial level, and high headquarter intensity refers to skill intensity above the mean level. Two-step GMM method is adopted for instrument estimates in all regressions. The R-squared in column are the residual R-squared according to the Frisch-Waugh-Lovell (FWL) theorem as we partial out the province-year and industry fixed effects. Province-year pair cluster robust standard errors in parentheses. *, **, and *** indicate significance at the 10,5, and 1 percent levels.

Table C.6: Determinants of Extensive Margin with High-income Trade Partners

	All	High HQ industries	Low HQ industries
Independent variables	(1)	(2)	(3)
FOE indicator	-0.776***	-1.009***	-0.883***
	(0.073)	(0.120)	(0.074)
Enc. policy	0.171***	0.571***	-0.207***
	(0.060)	(0.107)	(0.069)
Res. policy	0.006	-0.009	-0.054
	(0.055)	(0.066)	(0.089)
FOE $\times$ Enc. policy	0.212***	0.687***	0.104**
	(0.043)	(0.087)	(0.050)
FOE $\times$ Res. policy	-0.297***	-0.455***	-0.032
	(0.046)	(0.065)	(0.061)
FOE $\times$ Court eff.	1.776***	3.717***	0.191
	(0.620)	(0.896)	(0.559)
FOE $\times$ Natl. zones	0.031***	0.013*	0.049***
	(0.006)	(0.007)	(0.005)
First stage F-stat	141.69	144.07	130.78
Industry dummy	+	+	+
Prov-year dummy	+	+	+
Observations	27,048	11,995	15,053
Partial R^2	0.031	0.039	0.025

Note: The dependent variable is the log extensive margin index with definition of variety as HS8-country pair. The interaction terms of factor intensity and factor abundance are also included but not reported. For Columns (2) and (3), we use skill intensity to measure the headquarter service intensity at the industrial level, and high headquarter intensity refers to skill intensity above the mean level. Two-step GMM method is adopted for instrument estimates in all regressions. The R-squared in column are the residual R-squared according to the Frisch-Waugh-Lovell (FWL) theorem as we partial out the province-year and industry fixed effects. Province-year pair cluster robust standard errors in parentheses. *, **, and *** indicate significance at the 10,5, and 1 percent levels.