Online appendix to

Deep Financial Integration and Volatility

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Appendix A: Detailed Figures

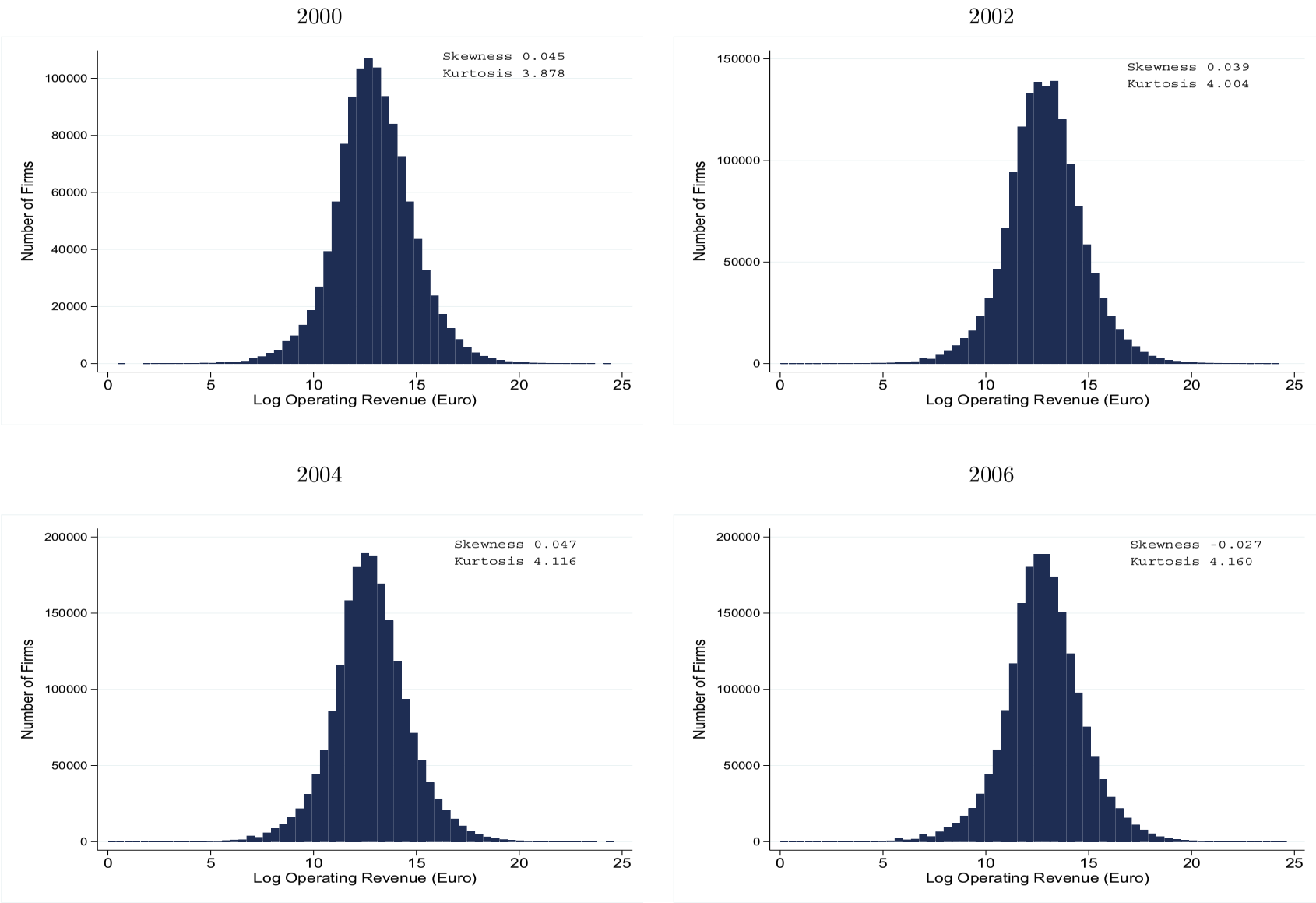


Figure A.1: Distribution of Firm-Level Log Operating Revenue (euros), 2000–2006

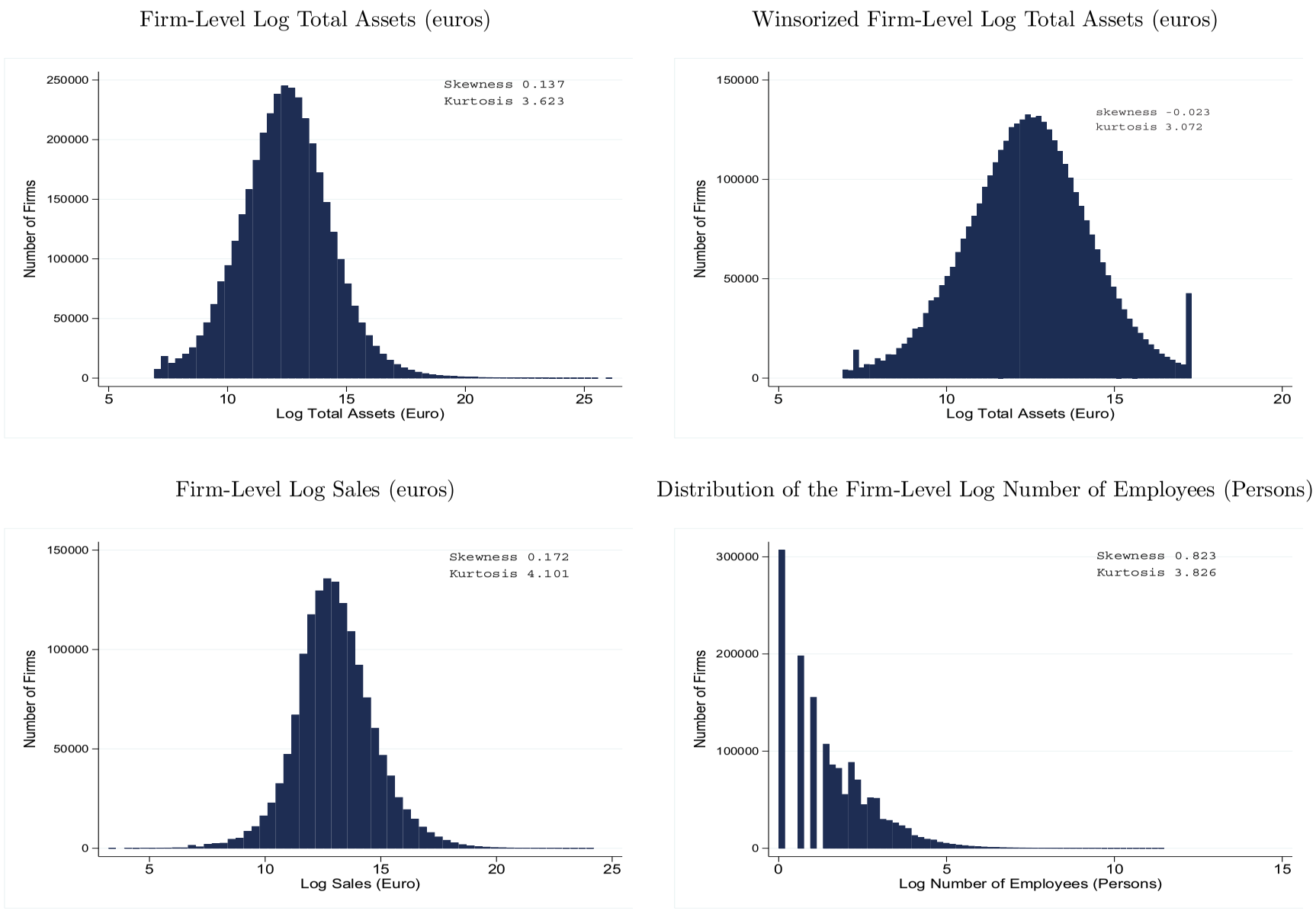


Figure A.2: Distribution of Firm Size (Total Assets) and Other Outcomes, 2006

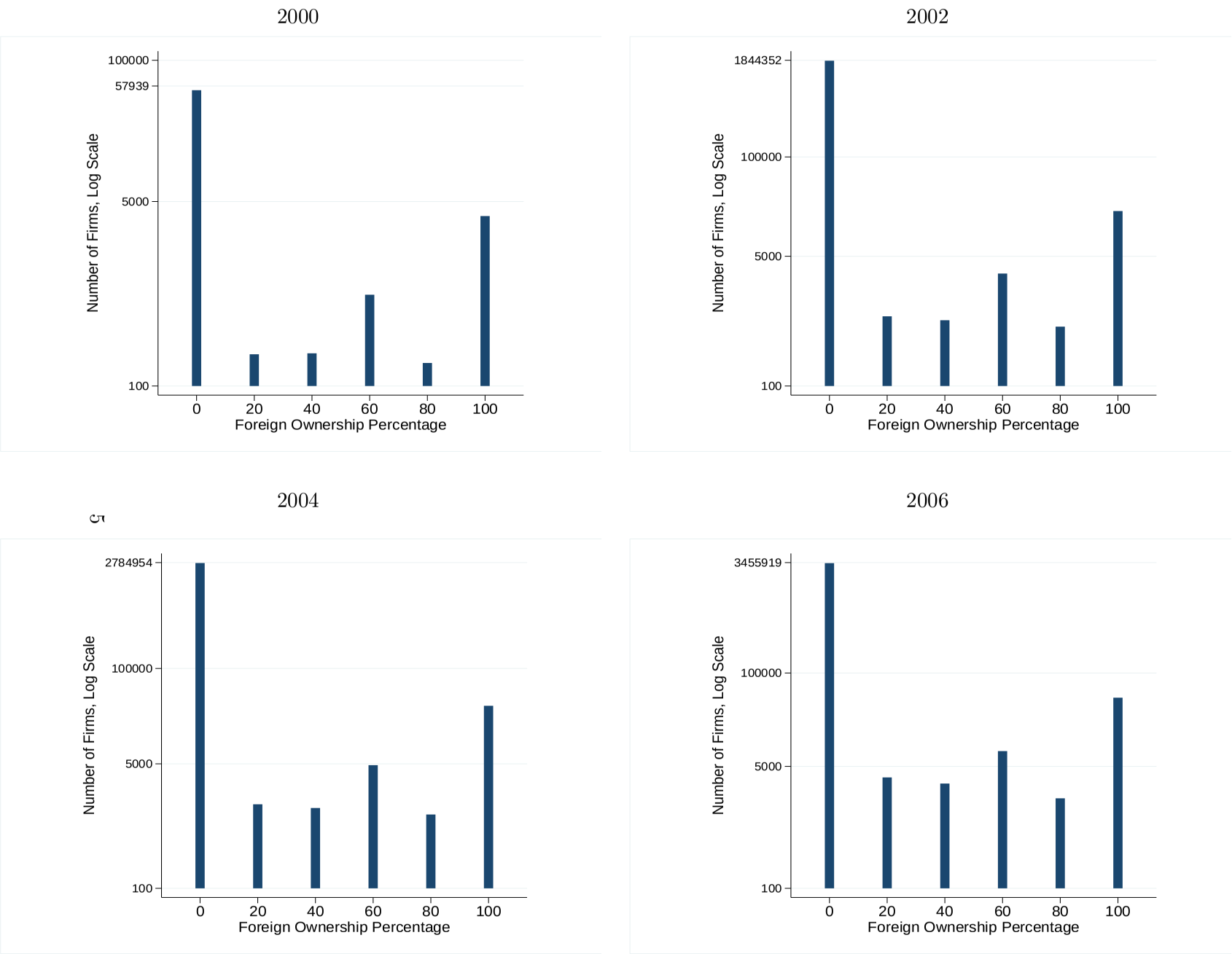


Figure A.3: Distribution of Firm-Level Foreign Ownership

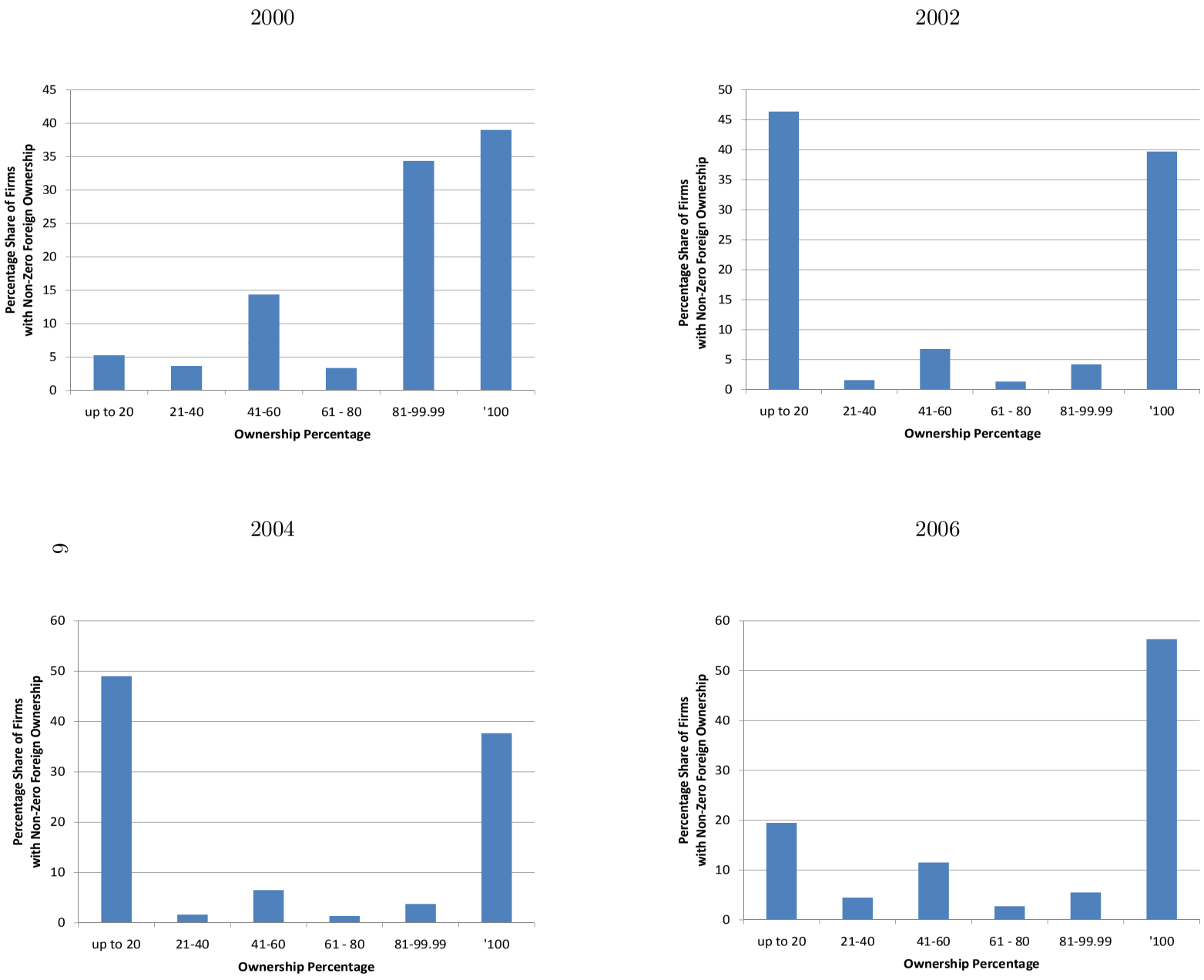


Figure A.4: Distribution of Firm-Level Foreign Ownership for Firms with Non-Zero Foreign Ownership

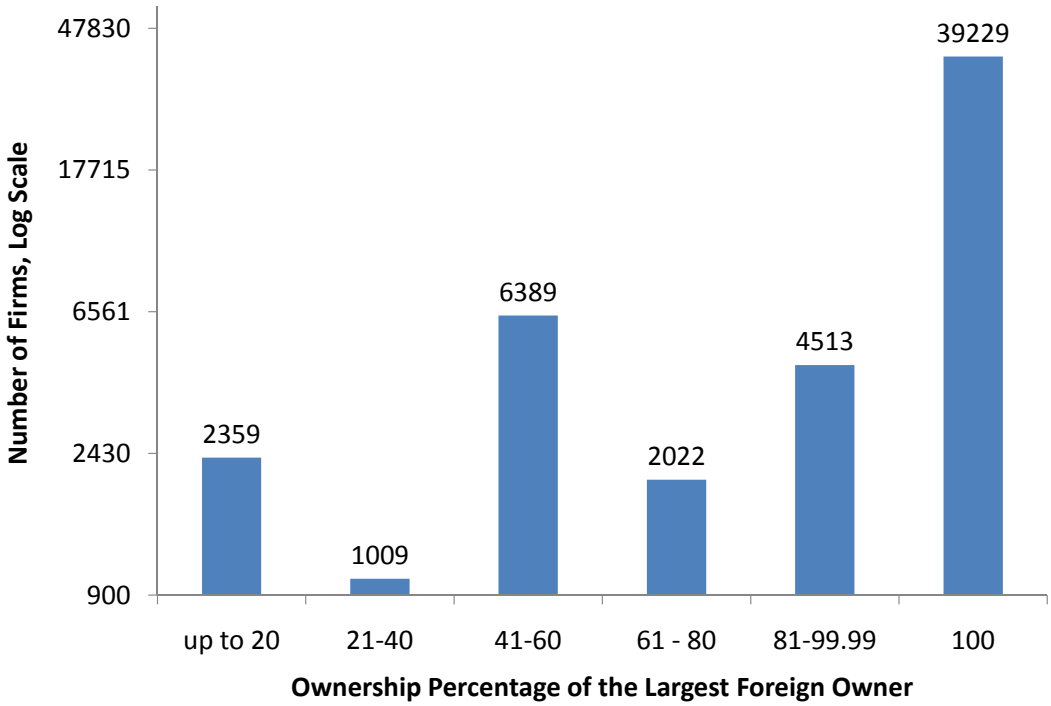


Figure A.5: Distribution of Firm-Level Foreign Ownership for Firms with Largest Owner Foreign, 2006

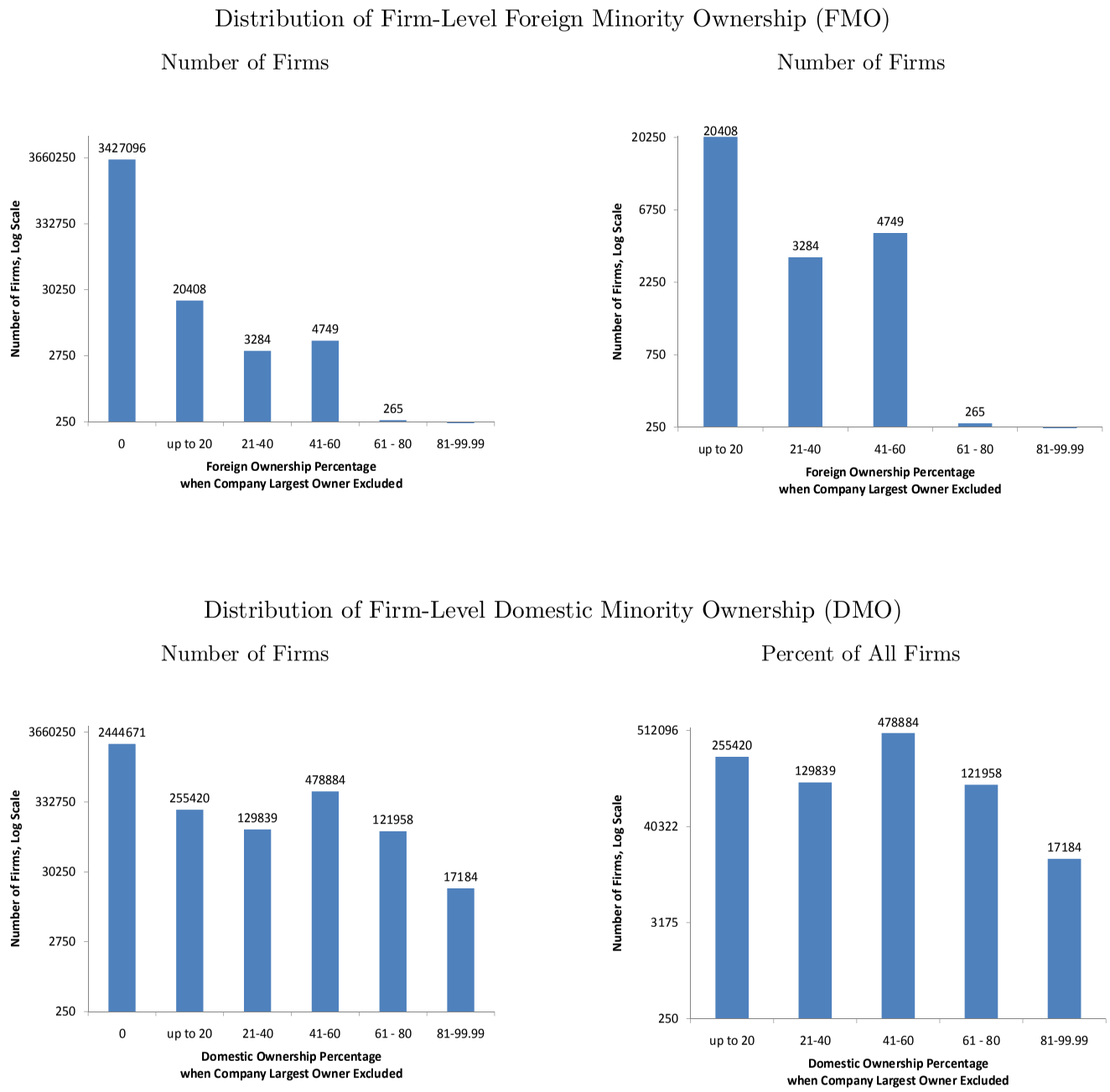
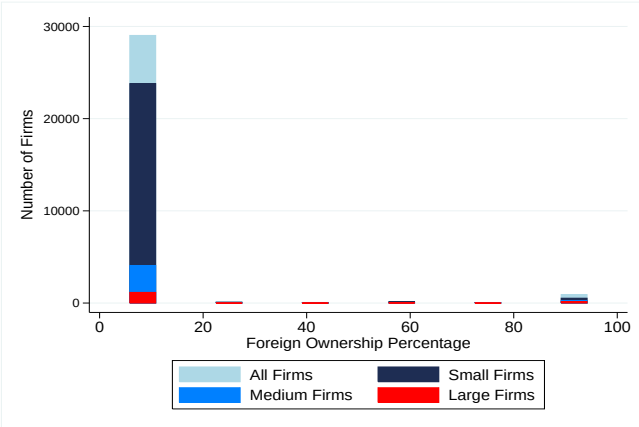


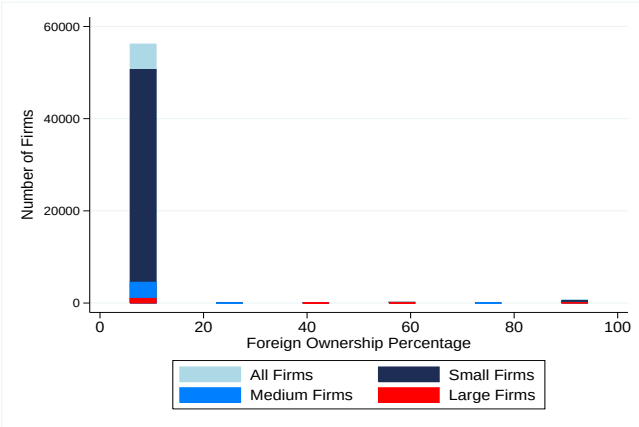
Figure A.6: Distribution of Firm-Level Minority Ownership, 2006

Foreign Ownership

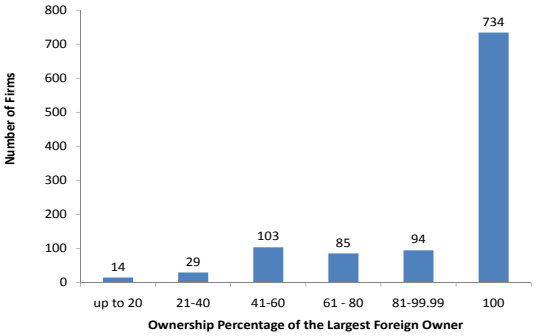
Bavaria 2006



Scotland 2006

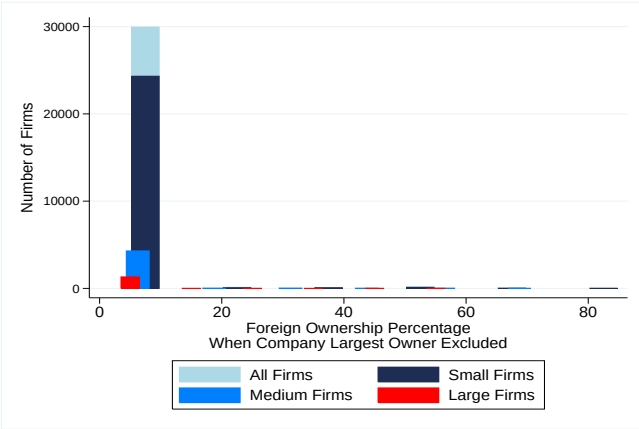


Majority Ownership, Firms with Largest Owner Foreign, Bavaria 2006



Minority Ownership, Bavaria 2006

Foreign Minority Ownership



Domestic Minority Ownership

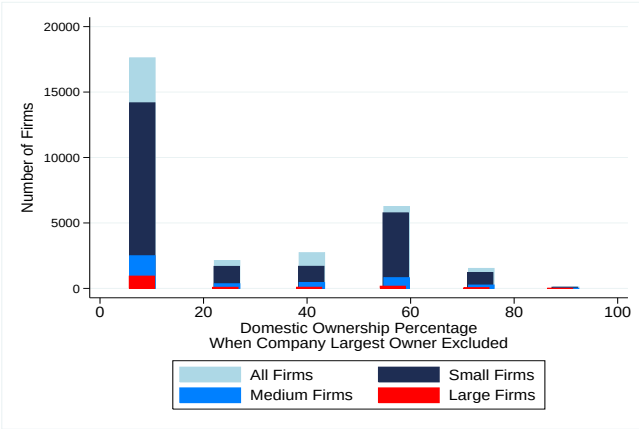


Figure A.7: Distribution of Ownership in 2006 for Two Regions

Figure A.7 displays distributions of ownership for small, medium, and large firms for two regions, Scotland and Bavaria (Bayern), in 2006. The upper panel displays the distribution of direct foreign ownership FO_i. In Bavaria about 30,000 firms have foreign ownership shares less than 20%—of these more than 20,000 are small, about 5,000 are medium size, and the rest are large. The majority of companies within each size group have no foreign owners. The mid-panel shows that the share owned by the largest owner most commonly is 100%. The lower panel shows, for Bavaria, the distribution of foreign and domestic minority ownership; i.e., when the ownership share of the largest owner is excluded and it appears that foreign minority owners typically hold very small stakes while the stakes of domestic minority owners are quite evenly distributed.

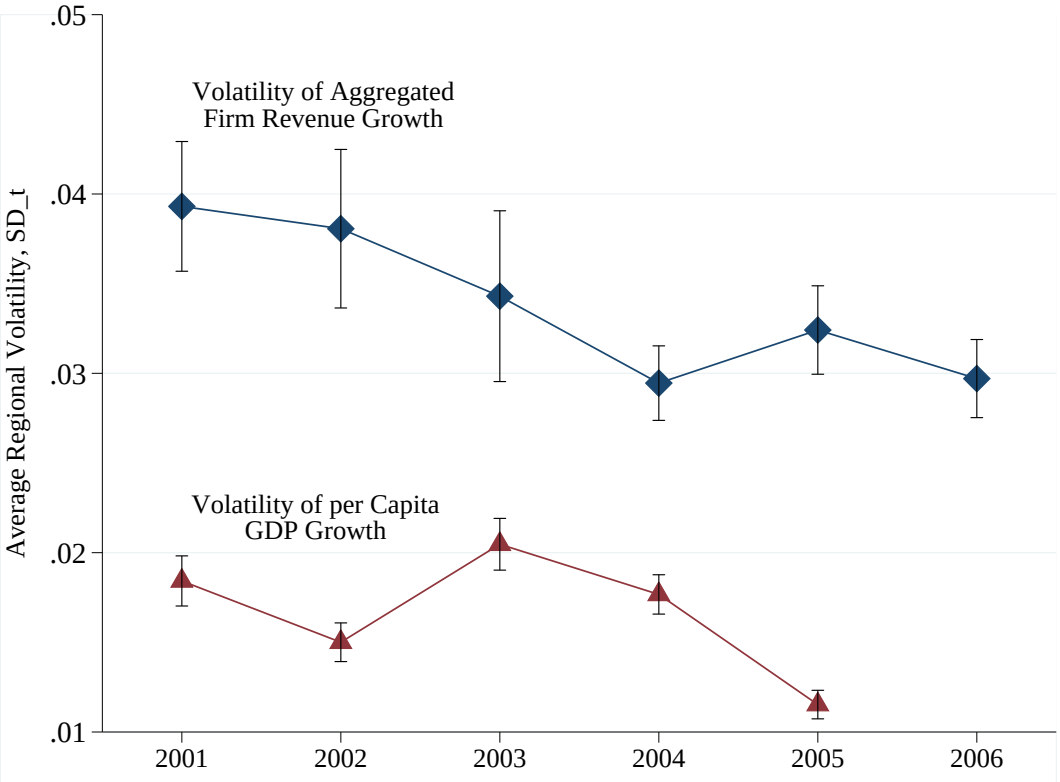
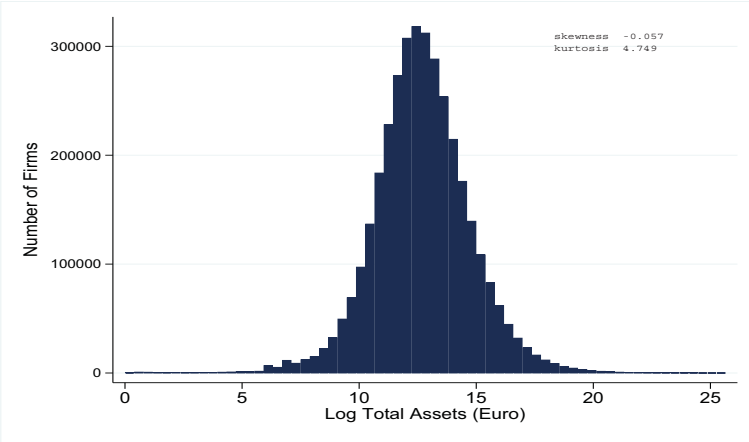


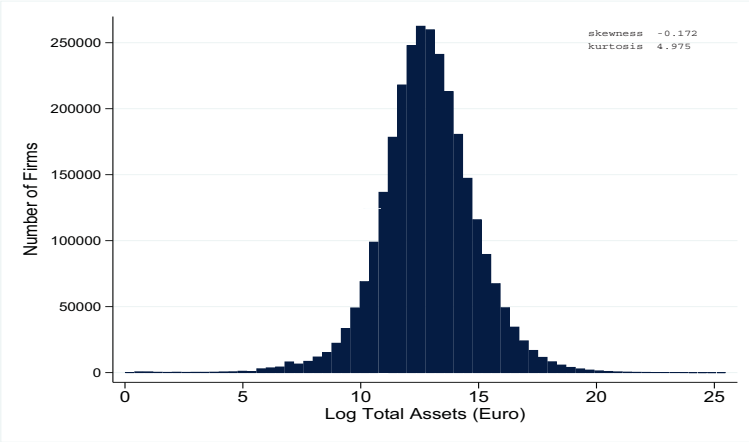
Figure A.8: Dynamics of Aggregate Volatility

Notes: Cross-sectional average of the time-varying volatility measure calculated for aggregated operating revenue from AMADEUS (upper line) or regional per capita GDP from Eurostat. The vertical lines show +/− one standard deviation.

Panel A: All Firms



Panel B: Reporting Firms



Panel C: Non-Reporting Firms

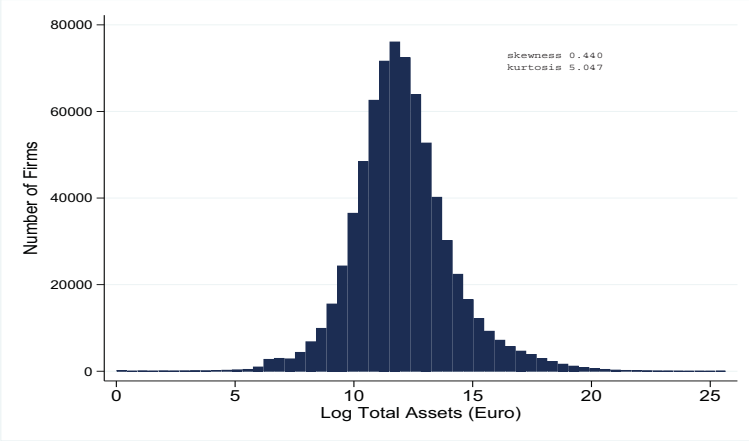
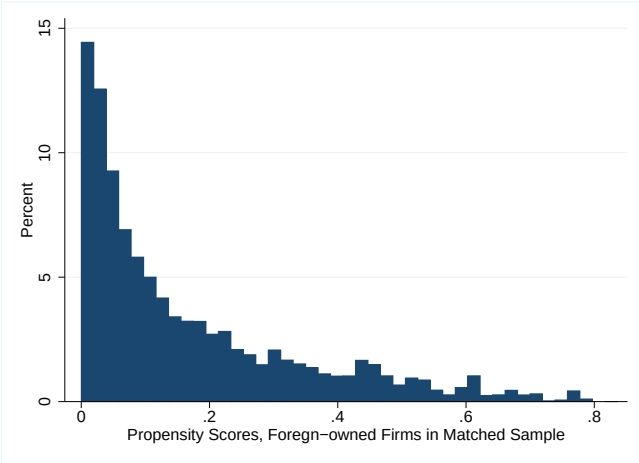


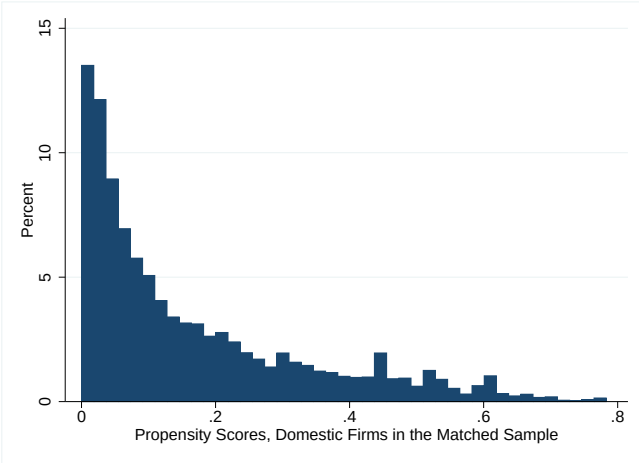
Figure A.9: Distribution of Firm Assets in AMADEUS by Availability of Ownership Data, 2006

A: Firms in the Matched Sample

Firms with Non-Zero Foreign Ownership



Firms with Zero Foreign Ownership



B: Unmatched Firms

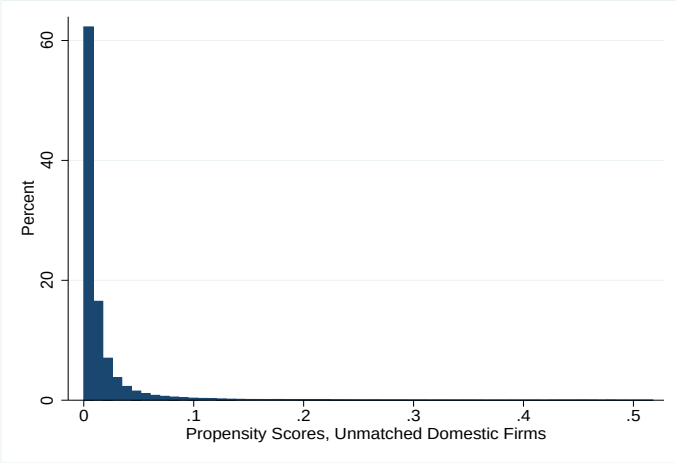


Figure A.10: Distribution of the Propensity Scores for Matched and Unmatched Firms

Notes: In Panel A the distribution of the propensity scores is for 24,879 firms with non-zero foreign ownership (left graph) and 24,879 firms with zero foreign ownership (right graph) making up the matched sample. In Panel B, the distribution of the propensity scores is for 1,007,958 unmatched domestic firms. Matching is performed on firm age, total assets, country- and industry-dummies at the 2-digit NACE level. The propensity scores are the estimated (logistic) probabilities of being foreign-owned conditional on these variables. See Section 3.1.2 for detailed explanations.

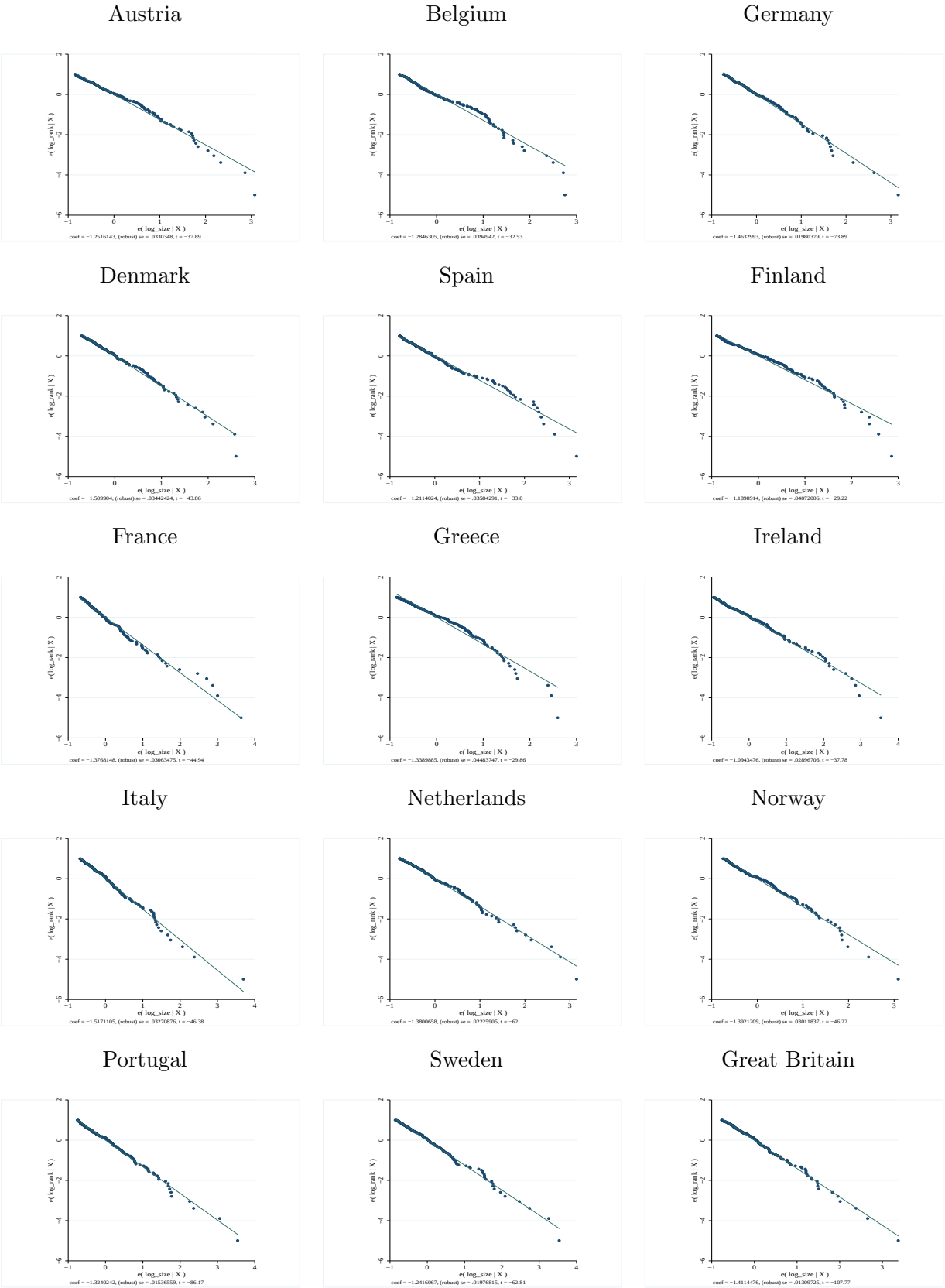


Figure A.11: Granularity of Firms

Notes: The figure presents partial correlation plots from regressions estimating power law coefficients (Gabaix 2009) for the top 200 companies by size in a country. We include countries with at least 500 companies with non-missing outcomes. The measure of firm size is firm operatingrRevenue in constant 2005 Euros. The power law coefficient is the estimate of the slope in the regression the following form: $\ln(i-s) = \text{constant} + \widehat{\varsigma}^{\text{OLS}} \ln\ S_{(i)} + error$, where i is the firm's rank in terms of the measure of firm size S and the largest firm has the rank 1. The constant s, which takes the value 0.5, is a shifter which has been shown to reduce small-sample bias.

Table A.1: Firm-Level Volatility and Foreign Ownership: Region Fixed Effects
Sample: All firms

	(1)	(2)	(3)	(4)
	Dependent variable: Log Volatility of firm outcome			
Volatility Measure	Std. dev. of firm outcome growth, SD			
Firm Outcome	Value Added	Sales	Operating Revenue	Employment
	Panel A: Effects of Foreign Ownership			
Log Foreign Ownership	.062***	.041***	.032***	.001
	(.003)	(.002)	(.002)	(.002)
Log Total Assets	–.019***	–.068***	–.070***	–.181***
	(.001)	(.001)	(.001)	(.001)
Log Firm Age	–.271***	–.357***	–.342***	–.295***
	(.003)	(.003)	(.002)	(.002)
	Panel B: Effects of Majority/Minority Foreign Ownership			
Largest Owner is Foreign	.259***	.172***	.134***	.001
	(.011)	(.010)	(.008)	(.008)
Log Foreign Minority Ownership	.041***	.035***	.035***	–.008
	(.010)	(.008)	(.007)	(.008)
Log Domestic Minority Ownership	–.014***	–.010***	–.021***	–.013***
	(.001)	(.001)	(.001)	(.001)
Log Total Assets	–.019***	–.068***	–.069***	–.180***
	(.001)	(.001)	(.001)	(.001)
Log Firm Age	–.270***	–.356***	–.341***	–.294***
	(.003)	(.003)	(.002)	(.002)
Region Fixed Eff.	yes	yes	yes	yes
Industry Fixed Eff.	yes	yes	yes	yes
Firms	574245	748040	1044381	617796

Notes: This table explores if the results are robust to controlling for region fixed effects rather than country fixed effects as in Table 4. Standard errors are clustered at the firm level and reported in parentheses. *** , **, * and † denote significance at 1%, 5%, 10%, and 15% levels, resp. SD is the standard deviation of growth of firm outcome over 2002–2008. The explanatory variables are for 2002. Log Foreign Ownership denotes the logarithm of 1 + percent ownership share that belongs to foreigners. Largest Owner is Foreign is a dummy variable that takes a value of one if the largest owner of a given firm is a foreigner. Log Foreign Minority Ownership denotes the logarithm of 1 + the remaining percent ownership share belonging to foreigners after the share of the largest owner is excluded; Log Domestic Minority Ownership is calculated similarly. Log Firm Age is the logarithm of the difference between the end year in our sample and the date of incorporation. Sales, Operating Revenue, Value Added, and Assets are all in 2005 constant euros. Sales are not available for Denmark, Ireland, Great Britain, and Norway. Employment is the number of full-time employees. Industry-fixed effects are at the 2-digit NACE level. See Appendix C for detailed explanations.

Table A.2: Firm-Level Volatility and Foreign Ownership: 25 EU Countries

Sample: All firms, 2002–2008

	(1)	(2)	(3)	(4)
	Dependent Variable: Log Volatility of firm outcome			
Volatility Measure	Std. dev. of firm outcome growth, SD			
Firm Outcome	Sales	Operating Revenue	Employment	Value Added
Largest Owner is Foreign	.198***	.163***	.028***	.288***
	(.009)	(.007)	(.007)	(.011)
Log Foreign Minority Ownership	.038***	.040***	–.003	.045***
	(.007)	(.007)	(.007)	(.009)
Log Domestic Minority Ownership	–.009***	–.021***	–.013***	–.014***
	(.001)	(.001)	(.001)	(.001)
Log Total Assets	–.069***	–.070***	–.179***	–.019***
	(.001)	(.001)	(.001)	(.001)
Log Firm Age	–.351***	–.338***	–.297***	–.268***
	(.003)	(.002)	(.002)	(.003)
Country Fixed Eff.	yes	yes	yes	yes
Industry Fixed Eff.	yes	yes	yes	yes
Firms	787,186	1,085,282	646,702	594,510

Notes: Standard errors are clustered at the firm level and reported in parentheses. *** , **, * and † denote significance at 1%, 5%, 10%, and 15% levels, resp. Firms in Slovenia are excluded due to missing age data while employment data are missing for Cyprus. SD is the standard deviation of growth of firm outcome 2002–2008. The explanatory variables are for 2002. Largest Owner is Foreign is a dummy variable that takes a value of one if the largest owner is a foreigner. Log Foreign Minority Ownership is the logarithm of 1+the percent ownership share belonging to foreigners after the share of the largest owner is excluded; Domestic Minority Ownership is calculated similarly. Firm Age is the difference between the end year in our sample and the date of incorporation. Sales, Operating Revenue, and Assets are all in 2005 constant euros. Employment is the number of full-time employees of the firm. Industry-fixed effects at the 2-digit NACE level. See Appendix C for detailed explanations.

Table A.3: Number of Firms by Country: Raw and Merged Data

Country	Firm-Level Var.	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007 Update	2008 Update	Per 10,000 of population 2006
AT	Total Assets		26	53	76	106	222	508	1298	34528	69273	77388	55074	52551	93
(raw)	Operating Rev.						1	6	119	983	2527	2762	2308	1765	3
	Ownership					5715		84314		104780		122988		176208	148
AT	Total Assets		12	28	37	50	116	299	785	24754	50454	56763	57468	52263	68
(merged)	Operating Rev.							3	50	504	1402	1590	2306	1709	2
	Ownership					1		12274		27995		50031			60
BE	Total Assets	19561	80329	188445	210523	226870	243274	262668	281696	301652	282802	324790	301854	292922	308
(raw)	Operating Rev.	8934	34200	76884	88393	90675	93291	96269	97313	99029	82637	85207	68749	62048	81
	Ownership					9457		299840		320843		341000		379459	324
BE	Total Assets	17329	74152	175254	195704	211199	226730	245092	262641	279990	288193	295435	303207	292387	280
(merged)	Operating Rev.	7668	30439	68146	78533	80311	82587	85169	85678	86551	78370	71117	68893	61702	67
	Ownership					3943		223938		260080		278761		209531	265
CH	Total Assets	12	76	191	287	352	398	443	545	581	626	629	629	36	1
(raw)	Operating Rev.	17	88	209	304	373	417	457	558	593	650	638	505	37	1
	Ownership					2390		29346		32609		31886		33966	42
CH	Total Assets	10	49	136	196	234	267	301	355	370	380	373	206	36	<1
(merged)	Operating Rev.	14	59	151	211	251	283	314	368	380	397	380	210	37	1
	Ownership					12		244		334		372		181	<1
DE	Total Assets	57	137	386	1872	4407	10874	21695	50517	93960	215026	280720	226848	220603	34
(raw)	Operating Rev.	54	133	373	1746	3838	9293	18335	35084	53184	62894	46436	119673	112607	6
	Ownership					48371		494703		797281		833243		1063201	101
DE	Total Assets	20	52	159	827	2187	5970	12624	32646	63710	151406	197879	227755	220202	24
(merged)	Operating Rev.	19	48	148	735	1775	4693	9797	19394	29565	34099	25866	119564	112292	3
	Ownership					751		9173		59436		193244		38612	23
DK*	Total Assets	1	6	16	100	3343	7517	26353	114694	131993	144309	160818	155946	149088	296
(raw)	Operating Rev.		3	8	40	908	1935	7621	32562	35580	35721	33781	28249	25023	62
	Ownership					3167		112711		141766		167228		186174	308
DK*	Total Assets		3	14	89	3124	6996	24776	108337	123638	135398	147138	160270	148847	271
(merged)	Operating Rev.		2	7	34	832	1759	7035	30161	32509	32512	30027	28980	24853	55
	Ownership					71		21700		110046		131839		139922	242
ES	Total Assets	72733	198713	245443	289772	333638	434360	533227	620388	709507	732724	623275	376367	363802	141
(raw)	Operating Rev.	67636	191224	233847	274789	315232	409187	493715	564530	637882	661790	570485	361027	343356	129
	Ownership					16545		407895		683643		858303		975697	195
ES	Total Assets	52628	156820	193230	228461	263744	347457	411669	450400	474353	467671	405212	371104	358723	92
(merged)	Operating Rev.	49423	152119	185461	218045	250442	328336	384087	416854	438706	436338	381171	355757	338374	86
	Ownership					9086		217017		391136		401910		2186	91
FI	Total Assets	1962	12305	33095	39572	43213	46984	51788	58813	63819	70704	76001	53160	53464	144
(raw)	Operating Rev.	1900	12009	32354	38697	42214	45714	50079	56445	61015	67210	72167	51589	51861	137
	Ownership					3071		63913		71412		84355		80800	160
FI	Total Assets	1256	8198	22727	27345	29960	32813	36374	41339	44732	48103	51400	54758	53166	98
(merged)	Operating Rev.	1219	8009	22255	26789	29318	31973	35150	39641	42722	45835	48816	52619	51565	93
	Ownership					1041		27080		33200		44424		36097	84
FR	Total Assets			337874	472885	513170	564313	624135	685484	775205	840977	872235	465868	3712	138
(raw)	Operating Rev.			325277	456359	494303	542249	598333	655912	739707	799939	828422	445735	3519	131
	Ownership					28988		848405		910559		974227		1062292	154
FR	Total Assets			222695	313825	342374	379132	422486	464933	521232	555990	566987	347092	2562	90
(merged)	Operating Rev.			213141	301094	327627	361597	401913	441408	493838	526195	537146	329916	2428	85
	Ownership					10929		362572		453597		521021		346324	82
GB*	Total Assets	22494	88888	336280	625526	743161	849593	968352	1151118	1448453	1559654	1659400	981121	932832	274
(raw)	Operating Rev.	8874	35975	115921	188954	211336	227614	245922	273265	332544	329056	333728	198663	171137	55
	Ownership					26240		1211150		1631909		1994926		2303090	329
GB*	Total Assets	18710	75250	268558	452543	518870	576725	642494	751083	895441	953103	1004915	1070567	933359	166
(merged)	Operating Rev.	7128	29418	94863	150048	164422	174355	185530	203572	226461	225659	221189	216702	170004	37
	Ownership					16770		548718		782685		931759		885242	154
GR	Total Assets	875	3558	13459	14856	16525	18176	19965	22197	24249	25911	26311	3402	3299	24
(raw)	Operating Rev.	851	3490	13156	14559	16191	17814	19476	21677	23766	25295	25702	3310	3249	23
	Ownership					2345		23850		26965		28073		28792	25
GR	Total Assets	677	2860	11255	12383	13639	14905	16174	17719	18897	19819	20174	16477	3262	18
(merged)	Operating Rev.	665	2816	11066	12192	13430	14671	15860	17398	18629	19497	19880	16249	3212	18
	Ownership					1293		13048		16328		18038		15593	16
IE*	Total Assets	6808	12850	16346	38180	63029	75918	85583	94871	105584	108743	108440	72500	70970	255
(raw)	Operating Rev.	369	639	791	2104	4317	6007	6799	7621	9006	10728	10775	8342	8647	25
	Ownership					775		24362		117072		141005		155438	332
IE*	Total Assets	6235	11882	14860	32100	51181	60245	66334	71808	77933	78206	75186	74153	70850	177
(merged)	Operating Rev.	313	540	670	1747	3484	4901	5438	5951	6982	8117	7955	8400	8535	19
	Ownership					348		16548		69032		73188		28080	172

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Table A.3: (Continued) Number of Firms by Country: Raw and Merged Data

Country	Firm-Level Var.	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007 Update	2008 Update	Per 10,000 of population 2006
IT	Total Assets	22160	54489	93967	110900	125013	143883	231230	226458	520281	543467	554622	270116	255305	94
(raw)	Operating Rev.	21909	54152	93340	110055	123685	141370	227546	221807	509651	533243	544656	263905	247841	92
	Ownership					21275		175263		273522		612954		694936	104
IT	Total Assets	7533	19359	35801	43054	49366	59277	105778	102160	242833	272205	279504	270468	252948	47
(merged)	Operating Rev.	7444	19270	35597	42747	48915	58042	104110	99957	238598	268453	274126	264242	245511	47
	Ownership					4984		44604		103676		267034		100428	45
NL	Total Assets	50801	85201	97370	104501	113204	132875	202376	240828	279993	274051	258171	41363	5	158
(raw)	Operating Rev.	1186	1994	2561	2849	3040	4180	6227	7144	8247	8267	7022	1664	2	4
	Ownership					6237		208977		305552		353143		381189	216
NL	Total Assets	46117	79882	92032	99394	107286	125336	189749	215482	234955	223100	207289	38975	2	127
(merged)	Operating Rev.	817	1343	1717	1897	2031	2884	4316	4597	4879	4641	3906	1052	1	2
	Ownership					1504		107893		202576		200893		38965	123
NO*	Total Assets	5995	47706	85587	93949	104125	113251	122785	132336	144430	158112	182457	144559	137100	392
(raw)	Operating Rev.	5248	42351	76037	82720	90761	98055	105845	114061	123430	128826	138531	115365	109572	298
	Ownership					3776		129933		165992		189868		197470	408
NO*	Total Assets	4775	40739	74339	81429	90037	98022	106345	114808	124337	137486	143781	144367	135959	309
(merged)	Operating Rev.	4278	36940	67232	72989	79925	86264	93218	100585	107996	113314	115448	114558	108478	248
	Ownership					2334		96648		113299		130846		70075	281
PT	Total Assets	13148	17748	20054	31368	35424	33564	47322	69054	77966	271040	287698	45427	42879	272
(raw)	Operating Rev.	12444	16799	19067	29620	33348	31853	44940	65467	73127	245844	258535	42336	40010	244
	Ownership					2043		43292		69333		90155		305247	85
PT	Total Assets	4056	5696	7805	12809	16612	18452	26952	36373	34996	47458	46440	45116	42561	44
(clean)	Operating Rev.	3882	5440	7425	12077	15469	17260	25311	34239	32766	44316	43305	42007	39703	41
	Ownership					529		9587		18028		45361		501	43
SE	Total Assets	487	35243	145459	156686	167357	179121	190538	201805	216114	231682	249319	183178	182354	275
(raw)	Operating Rev.		24734	136694	147072	156429	165855	174998	184657	195918	207929	221725	165711	165853	245
	Ownership					8571		240415		231389		242834		257628	268
SE	Total Assets	347	23616	106586	115048	123294	132960	142018	151122	162610	175507	187688	199550	181181	207
(merged)	Operating Rev.		16784	99916	107588	114811	122598	130062	138059	147525	158019	167873	177686	164661	185
	Ownership					4343		133308		143506		167198		163587	184
TOTAL	Total Assets	217094	637275	1614025	2191053	2492937	2854323	3388968	3952102	4928315	5556291	5742274	2957229	2838761	143
(raw)	Operating Rev.	129422	417791	1126519	1438261	1586650	1794835	2096568	2338222	2903662	3210373	3180572	1510409	1419868	79
	Ownership					188966		4398369		5884627		7066188		8281587	176
TOTAL	Total Assets	159693	498570	1225479	1615244	1823157	2085403	2449465	2821991	3324781	3604479	3686164	3470157	2828650	92
(merged)	Operating Rev.	82870	303227	807795	1026726	1133043	1292203	1487313	1637912	1908611	1997164	1949795	1880614	1408661	48
	Ownership					57939		1844352		2784954		3455919		2147787	86

Notes: "Raw," data are the number of firms with non-missing data as available in the original data source. "Merged," data show the number of firms with non-missing data after we merge ownership data with financial data and apply our sample selection criteria as discussed in detail in Appendix C. The financial data for 2007 and 2008 was updated during the paper revision using the list of firms from the "merged" master dataset up to 2006 (see NBER working paper version of this paper; NBER wp 15900). The column marked "Per 10,000 of population 2006" reports the number of firms in 2006 reporting year in AMADEUS per 10 thousand of the country population in 2006.

*Firms in countries marked with asterisk do not have sales data in AMADEUS. The country name abbreviations denote Austria (AT), Belgium (BE), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Ireland (IE), Italy (IT), Netherlands (NL), Norway(NO), Portugal (PT), Spain (ES), Sweden (SE), Switzerland (CH), and the United Kingdom (GB).

Appendix B: A Model of International Diversification

We present a stylized static model which highlights how internationally diversified investors may be relatively more willing to take on domestic risk. For simplicity, we consider a two country framework where the two countries are symmetric, except for different volatilities of output. The notation for the foreign country is similar to that of the domestic country, except the variables are labeled with a "*." Assume that each of the two countries has two types of investors: small investors (households) has an amount S^i available for financial investment while large (institutional) investors has an amount S^I. Investors can chose to invest in a safe asset with gross return R and in two types of "representative" firms with exogenous output ("fruit on trees"). One type of firm has low variance of output (and thus dividends) while the other type has high variance. We assume there is one unit of equity available to investors ("one tree") for each type of firm.

We assume each representative low (high) variance firm has output Y_L (Y_H) normalized to have mean 1. The variance of low volatility output is $(\sigma_L^Y)^2$ while that of high volatility output is $(\sigma_H^Y)^2$. Output is sold to investors and the price of one unit of low (high) variance output is $1/\mu_L$ ($1/\mu_H$). With our normalization this is also the market value of each type of production ("tree"). The expected gross returns to investing in, say, low volatility output, is then μ_L while the standard deviation of the return from investing in one unit of output is

$$\sigma_L = \sigma_L^Y/\mu_L \ , \tag{B-1}$$

and

$$\sigma_H = \sigma_H^Y/\mu_H \ . \tag{B-2}$$

Next, we assume a simple structure for dividends. This is equivalent to making assumptions on the exogenous output, but simplifies notation. We then postulate a mean variance trade-off for investors and solve for both home and foreign investors' demands for different types of output. Investors take the mean returns from invest-

ing in home and foreign high- and low-volatility output as given. Finally, we use the market clearing conditions to determine the mean returns and solve for the general equilibrium.

We denote the gross dividends from investing in the low variance firm by X_L $(= Y_L/\mu_L)$ and dividends from investing in high variance firms with X_H $(= Y_H/\mu_H)$. We assume that firm shocks are composed of an aggregate shock ϵ and a idiosyncratic firm shock ϵ_L (ϵ_H) that is specific to low (and high) variance firms. The shocks are best thought of as productivity shocks.[1] Given these assumptions, we can write the dividends as:

$$X_L = \mu_L + \gamma_L \times \epsilon + \epsilon_L \ ,$$

and

$$X_H = \mu_H + \gamma_H \times \epsilon + \epsilon_H \ .$$

The country-wide shock ϵ affects all firms but the effect differs between low and high variance firms due to the respective γ parameters. All shocks are identically independently distributed (i.i.d.) across firms with the following mean and variances: $\epsilon \sim (0, \sigma^2)$; $\epsilon_L \sim (0, \sigma_L^2)$; $\epsilon_H \sim (0, \sigma_H^2)$. The i.i.d. assumption implies: $cov(\epsilon, \epsilon_L) = 0$; $cov(\epsilon, \epsilon_H) = 0$; $cov(\epsilon_L, \epsilon_H) = 0$. We assume shocks in the foreign country have a similar structure and all foreign shocks are independent of domestic shocks.

There is a fixed cost κ of investing abroad such that small investors will only invest domestically. A small home investor can invest a share λ_L^i in domestic low variance firms and a share λ_H^i in high variance firms while large home investors can invest a share λ_L^I in domestic low variance firms, a share λ_H^I in high variance firms, and a share λ_{HF}^I in foreign high variance firms. Companies do not have access to low variance technology in the foreign country. We assume this is due to frictions in information or communication.[2]

A small investor maximizes his or her utility, U_i, from investing a given amount

[1] Note that aggregate shocks can also be thought of country or industry specific.
[2] See Iacoviello and Minetti (2010).

of savings. We assume that the utility for each dollar invested can be couched in terms of mean and variance consistent with approximating utility with a quadratic utility function, and the optimal investment shares being independent of the total amount invested. This approximation is reasonable as we only model the allocation of given savings (because we do not observe savings a more ambitious approach would serve little purpose for us).

Thus the small investor maximizes (with respect to λ_L^i and λ_H^i):

$$U^i = (1-\lambda_L^i-\lambda_H^i)R+\lambda_L^i\times\mu_L+\lambda_H^i\times\mu_H-\mathrm{Var}(\,\epsilon+\lambda_L^i(\gamma_L\times\epsilon+\epsilon_L)+\lambda_H^i(\gamma_H\times\epsilon+\epsilon_H))\ ,$$

where R is the gross safe world rate of return. We assume the country-wide shock ϵ enters the utility function directly, in addition to its effect on production. We refer to this as "background noise" (this may enter the decision problem, for example, because country-wide shocks also affect wage income of the domestic investor).

A large investor can invest also in foreign firms and hence maximizes

$$\begin{aligned} U^I &= (1-\lambda_L^I-\lambda_H^I-\lambda_{HF}^I)R+\lambda_L^I\times\mu_L+\lambda_H^I\times\mu_H+\lambda_{HF}^I\times\mu_H^* \\ &- \mathrm{var}(\epsilon+\lambda_L^I(\gamma_L\times\epsilon+\epsilon_L)+\lambda_H^I(\gamma_H\times\epsilon+\epsilon_H)+\lambda_{HF}^I(\gamma_H^*\times\epsilon^*+\epsilon_H^*))\ . \end{aligned} \tag{B-3}$$

Using the abbreviation V^i for the variance of the portfolio of small savers, we find:

$$\begin{aligned} V^i &= \mathrm{Var}(\epsilon+\lambda_L^i(\gamma_L\times\epsilon+\epsilon_L)+\lambda_H^i(\gamma_H\times\epsilon+\epsilon_H)) \\ &= \sigma^2(1+\gamma_L\times\lambda_L^i+\gamma_H\times\lambda_H^i)^2+\sigma_L^2(\lambda_L^i)^2+\sigma_H^2(\lambda_H^i)^2\ . \end{aligned}$$

Taking the first order condition for optimum wrt. λ_L^i, we find

$$\lambda_L^i = \frac{(\mu_L-R)/2-\gamma_L(1+\gamma_H\times\lambda_H^i)\times\sigma^2}{\sigma^2\times\gamma_L^2+\sigma_L^2} \tag{B-4}$$

and by symmetry

$$\lambda_H^i = \frac{(\mu_H-R)/2-\gamma_H(1+\gamma_L\times\lambda_L^i)\times\sigma^2}{\sigma^2\times\gamma_H^2+\sigma_H^2}\ . \tag{B-5}$$

We have

$$V^I = \text{var}\big[\epsilon + \lambda_L^I(\gamma_L \times \epsilon + \epsilon_L) + \lambda_H^I(\gamma_H \times \epsilon + \epsilon_H) + \lambda_{HF}^I(\gamma_H^* \times \epsilon^* + \epsilon_H^*)\big]$$

so

$$V^I = \sigma^2 \left\{(1+\gamma_L \times \lambda_L^I + \gamma_H \times \lambda_H^I)^2\right\} + \sigma^{*2}(\gamma_H^*)^2(\lambda_{HF}^I)^2 + \sigma_L^2\,(\lambda_L^I)^2 + \sigma_H^2\,(\lambda_H^I)^2 + \sigma_H^{*2}(\lambda_{HF}^I)^2$$

The derivative of V^I wrt. λ_L^I and λ_H^I are similar to those found earlier, so

$$\lambda_L^I = \frac{(\mu_L - R)/2 - \gamma_L(1 + \gamma_H \times \lambda_H^I) \times \sigma^2}{\sigma^2 \times \gamma_L^2 + \sigma_L^2} \ , \tag{B-6}$$

and

$$\lambda_H^I = \frac{(\mu_H - R)/2 - \gamma_H(1 + \gamma_L \times \lambda_L^I) \times \sigma^2}{\sigma^2 \times \gamma_H^2 + \sigma_H^2} \ . \tag{B-7}$$

The share invested abroad is

$$\lambda_{HF}^I = \frac{\mu_H^* - R}{2 \times (\sigma^{*2} \times \gamma_H^{*2} + \sigma_H^{*2})} \tag{B-8}$$

The market clearing conditions for low and high-variance output, respectively, are:

$$S^i \lambda_L^i + S^I \lambda_L^I = 1/\mu_L \ , \tag{B-9}$$

and

$$S^i \lambda_H^i + S^I \lambda_H^I + S^{*I} \lambda_{HF}^{*I} = 1/\mu_H \ , \tag{B-10}$$

where S^{*I} denotes the savings of large foreign investors, and λ_{HF}^{*I} denotes the investments share of these investors in the home economy.

The nine equations, together with the equivalent equations for the foreign country, (two resource constraints, five equations for investment shares, and the relations between means and variances) form a set of non-linear equations which can be solved for mean returns and investment shares.

We numerically solved the model with the following values:

Exogenous values for model simulation

	S^i	S^I	σ	σ_L^Y	σ_H^Y	γ_L	γ_H	R
Home	10	10	0.3	0.2	0.3	0.05	0.1	1.05
Foreign	10	10	0.1	0.2	0.3	0.05	0.1	1.05

which yields the solutions:

	μ_L	μ_H	λ_L^i	λ_H^i	λ_L^I	λ_H^I	λ_{HF}^I
Home	1.064	1.069	0.047	0.0002	0.047	0.0002	0.039
Foreign	1.055	1.057	0.047	0.028	0.047	0.028	0.093

Notes: Variances are not displayed as they are trivially determined from equations (B-1) and (B-2).

We do not observe mean returns and risk premiums in our data but for our choice of exogenous variables, the solutions for the risk premium $\mu - R$ are reasonable (i.e., positive, higher for high volatility output than for low volatility output, and higher in the home country with higher aggregate "background" volatility).

Our simple model sketch is designed to interpret patterns of foreign investment and implies by design that domestic small investors only invest in domestic firms given the fixed cost of investing abroad. The model implies that domestic investment in high volatility firms is small (shares of 0.0002 for both small and large investors) relative to own-country investment in high volatility firms in the foreign economy (shares of 0.028) with lower background noise. The more interesting implication of the model is the clear difference between domestic investment abroad and foreign investment in the home economy. Large investors abroad behave similarly to large domestic investors, but the high domestic background noise makes foreign investment in the domestic economy much larger. This shows that our simple framework captures the positive correlation between regional volatility and foreign investment, although our static framework cannot model the dynamic patterns found in our data.

In reality, and outside of our model, entrepreneurs who create firms will typically need to hold some equity in the firm—whether it is of high- or low-variance type.[3] In our regressions, we include a dummy that is unity if the largest owner is foreign and the left-out dummy, which is captured by the constants, is then the largest domestic owner. We implicitly interpret the constant as capturing domestic entrepreneurs. A reasonable assumption, we believe, is that domestic entrepreneurs typically are individuals who happen on a business idea, independently of whether this leads to high or low variance output. By contrast, domestic minority investors seek out low-variance investments and, therefore, domestic minority ownership will have a negative coefficient. The model deliver the solution that high-volatility firms are partly owned by foreign investors although the foreigners' choice between being minority owner or largest owner is not modeled. (Our empirical analysis reveals that foreigners most often prefer to be the largest owner for reasons such as information or control.)

[3]This is due to moral hazard. A standard reference is Holmstrom and Tirole (1997).

Appendix C: Data

Sample Selection

AMADEUS is a database of firm-level information such as sales, employment, and assets for 41 countries with varying coverage. The database totals over 15 million public and private companies of large, medium, and small size with listed companies comprising only a small fraction of about 10 thousand companies.[4] A company which has subsidiaries is required to prepare consolidated accounts; however, we use only *unconsolidated* accounts to avoid double counting.[5]

We focus on 16 countries with 9.9 million unique firms, of which many have missing outcomes and/or assets. Once we require firms to have at least 1 year of assets and 1 year of an outcome—either sales, operating revenue, or employment, we have 4.7 million firms. From this sample we drop all financial firms, firms that in any year have assets less than 1,000 euros, employment negative, zero, or larger than 2 million, negative sales, or negative operating revenue. We drop firms that do not have ownership information and firms below the 0.1th percentile and above the 99.9th percentile in the distribution of sales to assets, operating revenue to assets, and employment to assets in any year. For the ratio of revenue to sales, we drop firms above the 95th percentile in order to eliminate firms with high financial income.

[4]While collecting firm-level data, BvD takes advantage of legal requirements for European companies to file their accounts at official government registries. The data are then organized in a standardized format.

[5]Even though the number of consolidated accounts is less than 1% of all accounts, it is important to use just the unconsolidated accounts. AMADEUS categorizes all companies as subsidiaries regardless of the percentage of ownership: In standard accounting, a company A will be classified as a subsidiary of a company B if company B owns more than 50% of company A, while in AMADEUS company A will be called a subsidiary even company B owns a 1 percent stake. There can be direct subsidiaries and also indirect subsidiaries owned by the direct subsidiaries. For example, BMW has 186 recorded subsidiaries, 54 of which are outside Europe (like BMW United States) and hence not in our data set. 77 out of the remaining 132 are direct subsidiaries owned more than 50% by the parent company. The remaining 55 companies are subsidiaries of these 77 companies. Another example is LEGO, that has 38 subsidiaries where only 3 of these are directly owned while the rest are subsidiaries of these 3. By using unconsolidated accounts outcomes do not include the outcome of parents and subsidiaries. By looking at the consolidated accounts of the 3 direct subsidiaries, we verified that the sum of sales and employment of the indirect subsidiaries is less than the numbers reported in the consolidated accounts of the 3 direct subsidiaries. (It will not be an exact match because we do not have data for subsidiaries outside Europe).

Although we drop all financial firms, many nominally non-financial companies have significant investment income. An extreme example is Warren Buffett's Berkshire Hathaway, that started as a textile firm and became an investment company over time. We also eliminate firms with sales larger than operating revenue. Overall, these filters allow us to get rid of phantom firms, tax-fronts, etc. In addition, we drop firms where growth of sales, operating revenue, or employment is more than 100 percent for larger companies (100 employees), more than 300 percent for medium-sized companies (20-100 employees), and more than 500 (1000)% for smaller companies with 11-20 (0-10) employees. If employment is missing we drop firms with growth rates over 2000%.

Firms that acquire other companies may experience "spurious" increases in assets, sales, and employees. For example, if two firms with 100 employees merge to a firm with 200 employees which continue to operate as one of the original firms this will appear as a growth rate of 100% for the continuing firm and –100% for the acquired firm. However, there might have been no change in employment of the combined firm. We use the global ZEPHYR database from the BvD which contains "deal records;" i.e., in each M&A, the target, the acquiring party or parties, the dates when the deal was announced and completed, and the type of the deal (e.g., Acquisition, Acquisition of 15%, Merger, Joint Venture, etc.). The ZEPHYR data can easily be matched with our data because a BvD company identifier is included in both databases. We eliminate acquirer firms which may have spurious growth following an acquisition. After this selection process we end up with a sample of a little over 1 million unique firms.

To give an example how each step eliminates firms consider 2006 in which we have 3 million firms with at least 1 year of assets and outcome. Out of these, 100,000 do not report ownership information and 500,000 firms have assets less than 1000 euros. 100,000 are financial firms and 1 million has faulty records such as no, or negative, employment. Another 100,000 firms are dropped due to our procedures explained above that filters out firms in the tails, etc., which brings us to 1.2 million firms.

One might worry about selection issues where firms that report ownership information are unrepresentative. Figure A.9 shows the distribution of assets for all available firms in 2006, and for firms that report ownership information and for the non-reporting firms. The distribution of assets is very similar across these groups indicating that the firms which report ownership are similar to the sample as a whole.

Our firms represent a wide range of industries. We drop firms in certain industries for robustness checks as detailed in the paper. The classification of 2 digit NACE industries are as follows:

Code	Name of the Level 2 NACE sector
AA	Agriculture, hunting, and forestry
BA	Fishing
CA	Mining and quarrying of energy producing materials
CB	Mining and quarrying, except of energy producing materials
DA	Manufacturing of food products, beverages, and tobacco
DB	Manufacturing of textile products
DC	Manufacturing of leather products
DD	Manufacturing of wood products
DE	Manufacturing of pulp, paper products, publishing and printing
DF	Manufacturing of coke, refined petroleum products, and nuclear fuel
DG	Manufacturing of chemical products
DH	Manufacturing of rubber and plastic products
DI	Manufacturing of other non-metallic mineral products
DJ	Manufacturing of basic metals and fabricated metal products
DK	Manufacturing of machinery and equipment n.e.c.
DL	Manufacturing of electrical and optical equipment;
DM	Manufacturing of transport equipment
DN	Manufacturing n.e.c.
EA	Electricity, gas and water
FA	Construction
GA	Wholesale and retail trade; repair
HA	Hotels and restaurants
IA	Transport, storage, and communication
JA	Financial intermediation
KA	Real estate, renting, and business activities
LA	Public administration and defence, compulsory social security
MA	Education
NA	Health and social work
OA	Other community, social and personal service activities
PA	Activities of households
QA	Extra-territorial organizations and bodies (such as UN, EC, etc)

What does Foreign Ownership capture and why does it change over time?

As explained in the data section, we construct foreign ownership FO using the information from the AMADEUS Ownership database. We verified that this database completely includes the information in the ZEPHYR database of Mergers and Acquisitions and adds to this since foreign ownership can change over time due to other reasons then M&As.

Let us consider some examples. Example 1 is the French steel company ***Usinor SA*** which is now part of the world's largest steel company *ArcelorMittal*. Based on the information from the AMADEUS Ownership database the FO for the Usinor SA was 2.9% in 2000, 97.58% in 2002, and 100% in 2006 and 2008. In 2000, FO consists of two identified non-French owners (*Lucchini International SA* and *Gruppo Lucchini*, both Italian) and the company had a significant stake owned by "public" (>70%), which we assume consists of French small investors. In 2002 the company has just two owner records: *Arcelor SA* (Luxembourg) with 97.58% and "public" with 2%. In 2006 the company changes the name to *Arcelor France* and the single owner is *Arcelor SA* (Luxembourg) with a 100 percent stake. In 2008 the company changes the name to *ArcelorMittal France* with the same owner and stake. The BvD ID of the company remains unchanged in all 4 Ownership vintages despite the name changes.

Using this BvD ID for *Usinor SA*, we can locate the records for this company in ZEPHYR we find a single record where *Usinor SA* was involved in the deal "Acquisition 97.58%" by the *Arcelor SA* of Luxembourg, announced on 12/12/2001 and completed on 14/03/2002.

Example 2 is the French lawn care company ***Top Green SAS*** (www.topgreen.com). Based on the information in the AMADEUS Ownership database FO for the *Top Green SAS* was 50% in 2004, 67% in 2006, and 66% in 2008. From 2004 to 2008, FO consists of one identified non-French owner *DLF Trifolium A/S* of Denmark which holds stakes in the French company. The only other owner is the French firm

Vilmorin Clause et Compagnie.

Using the BvD ID for *Top Green SAS* we locate the records for this company in ZEPHYR and obtain a single record where *Top Green SAS* was involved in the deal "Acquisition increased from 50% to 67%" by *DLF Trifolium A/S* which was announced on 19/09/2006. As a result, the stake of *DLF* in *Top Green SAS* went up from 50% to 67% between 2004 and 2006. The 1% sale by *DLF* between 2006 and 2008 is not found in ZEPHYR.

Example 3 is the French software firm ***PTV Online*** (www.ptv-vision.fr). Based on information in the AMADEUS Ownership database FO for *PTV Online* was 40% in 2004 and 100% in 2006. In 2004, *FO* consists of one identified non-French owner *PTV Planung Transport Verkehr AG (PTV AG)* of Germany, owning 40%. The additional two owners of the company in 2004 are the French company *01Direct* with 40% and an individual, Mr. Stern, with 20%.

Using the BvD ID for *PTV Online* we locate the records for this company in ZEPHYR and obtain a single record where *PTV Online* was involved in the deal "Acquisition increased from 40% to 100%" by *PTV AG* which was announced and completed on 12/9/2005. *PTV AG* is a global company with the head office is located in Karlsruhe which specializes in traffic and logistics software, and transport consulting and has branches in 11 countries.

The examples demonstrate that ownership information in ZEPHYR is clearly reflected in our FO variable, but there is some additional information in the AMADEUS Ownership database which ZEPHYR misses. The following examples show companies that had changes in FO based on the Ownership database but which do not appear in ZEPHYR.

The French defense company ***NHIndustries SAS*** (NHI) is, according to the company website, the prime contractor for design and development, industrialization, production and logistic support of the naval/tactical helicopter NH90 used by the armed forces of several European NATO countries. Based on information in the AMADEUS Ownership database FO for *NHI* was 37% in 2002, 68% in 2004,

68.01% in 2006, and 68.51% in 2008. In 2002, *FO* consists of two identified non-French owners: *Agusta Westland* (Italy) with 32% and *Stork Fokker Aerospace NV* (The Netherlands) with 5%. The other owner of the company is the French company *Eurocopter France* with 32%. In 2004 FO becomes 68% due to the divestment of *Eurocopter France* in favor of the German company *Eurocopter Deutschland GmbH*. In 2006 an Italian firm *Finmeccanica - Societa' Per Azioni* appears as a new owner with a small stake and in 2008 the stake of *Stork NV* increases to 6%.

The French fashion and perfume company ***Parfums Nina Ricci SA*** (www.ninaricci.com) has operated since 1932 and is a private company. Based on information in the AMADEUS Ownership database FO for *Nina Ricci SA* was 50% in 2000 and 2002, 51% in 2004, and 0% in 2006 and 2008. In 2000–2004 the company was 50% owned by *Jorba BV* of the Netherlands and a Spanish company Antonio Puig SA appears to hold a minority stake of around 1% in 2004. The domestic owners are *Paco Rabanne Parfums* with 36% and *Puig France* and *Puig International SA* with 5% each. From 2006 on the only owner of the company is the French *Puig France* with a 100% stake. According to the company website, *Parfums Nina Ricci SA* now operates as a subsidiary of *Puig Prestige Beaute* (France).

Regions Excluded from Region-Level Regressions

Underdeveloped and Small Regions

We exclude relatively *small and poor regions* Hainaut (BE32) and East Middle Sweden (SE12) with the average GDP per capita less than the 15th percentile in the distribution within the corresponding country.

We exclude region Algarve (PT15) with *high share of agriculture*, specifically a share of agriculture larger than the 85th percentile in the distribution across all regions.

Outlier Regions

We exclude regions which experienced a change in ownership above 20% dur-

ing our sample period, including Friuli-Venezia Giulia (ITD4) and Upper Norrland (SE33).

Some regions are outliers in partial correlation plots in a particular year only. These regions might have coverage related issues because certain years look very different from others and we eliminated those. These are Antwerpen (BE21), Luxembourg (Belgium) (BE34), Emilia-Romagna (ITD5), Marche (ITE3), Abruzzo (ITF1), Sardegna (ITG2), Rhône-Alpes (FR71), and Provence-Alpes-Côte d'Azur (FR82).

Appendix D: Sampling

This appendix explains the sampling schemes used in Table 6 of the main text in more detail and repeats the results of Table 6 (which shows volatility of operating revenue) using the volatility of value added as the dependent variable. In Panel B, the last three columns draw firms from each country in an amount proportional to the given country's average 2002-2008 real GDP (from the World Bank) as a share total GDP of the countries included in the regression sample. The sample of countries differ for each of the outcomes: we use the 16 countries with the best coverage for operating revenue and, due to data availability, leave out Greece and Ireland from the value added regressions. The weights are reported in Table D.1.

Table D.1: Country Share of Total GDP in all Countries Used for Given Sample, %

Country	Samples defined by Non-missing Firm Outcome	
	Operating Revenue	Value Added
Austria	2.3	2.3
Belgium	2.8	2.9
Switzerland	2.9	3.0
Germany	20.6	21.3
Denmark	1.9	2.0
Spain	8.3	8.6
Finland	1.5	1.5
France	15.7	16.3
Great Britain	16.5	17.1
Greece	1.8	–
Ireland	1.5	–
Italy	13.1	13.5
Netherlands	4.7	4.9
Norway	2.3	2.3
Portugal	1.4	1.5
Sweden	2.8	2.8

In column (4) of panel (B) of Table D.2 (and Table 6 of the main text), we draw a random 3% stratified sample firms from each country. We draw from each country with a probability equal to the share of that country in aggregate average GDP. Choosing 3% allows us to draw from the countries with relatively poor coverage (Austria, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Switzerland)

without replacement.

In column (5) of panel (B) of Table D.2 (and Table 6 of the main text), we draw a random 25% sample. The method is similar to that of the previous column, except we draw with replacement from the countries with poor coverage. This approach is similar to that of Arnold, Nicoletti, and Scarpetta (2008).

In column (6), we repeat the stratified sampling of the previous column, but we further choose firms using the propensity score matching technique in order to make the composition of the firms drawn comparable across countries in term of observable variables. First, we identify the country, Germany, with the poorest firm coverage relative to average GDP.[6] Then, for each country i with better coverage relative to GDP, we draw random samples of companies which are similar to the companies in our benchmark country based on propensity score matching on the observable variables: volatility of outcome, company size, age, foreign ownership, and industry of operation.

[6]Germany has 6,358 usable companies which is 2.25 companies per billion of average GDP.

Table D.2: Firm-Level Volatility and Foreign Ownership: Robustness–Value Added

Sample: All firms, 2002–2008

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent Variable: Log Volatility of firm outcome					
Volatility Measure	Std. dev. of firm outcome growth, SD					
Firm Outcome	*Value Added*					
	Panel A: Types of Companies					
Firm Sub-sample	Exporters	Limited Liability	Foreign Owned	Independent Companies	Majority stake >50%	Excluding Public Sectors
Log Foreign Ownership	.052***	.064***	.023***	.066***	.060***	.068***
	(.005)	(.003)	(.004)	(.010)	(.003)	(.003)
Log Total Assets	–.027***	–.019***	–.026***	–.016***	–.036***	–.020***
	(.004)	(.001)	(.006)	(.003)	(.002)	(.001)
Log Firm Age	–.287***	–.264***	–.278***	–.277***	–.199***	–.269***
	(.010)	(.003)	(.013)	(.009)	(.007)	(.003)
Firms	43021	533095	24647	82675	129591	566677
	Panel B: Selection Issues					
Firm Sub-sample	Good Coverage Countries	Poor Coverage Countries	CEE Countries	3% Random Sample	25% Random Sample with Replacement	25% Random P.S.Matching Sample
Log Foreign Ownership	.068***	.077***	.063***	.080***	.074***	.062***
	(.003)	(.008)	(.010)	(.008)	(.003)	(.008)
Log Total Assets	–.015***	–.063***	–.062***	–.011*	–.025***	–.009**
	(.001)	(.004)	(.009)	(.006)	(.002)	(.004)
Log Firm Age	–.277***	–.193***	–.291***	–.181***	–.177***	–.211***
	(.003)	(.009)	(.028)	(.015)	(.005)	(.011)
Firms	532589	53503	8418	17049	146530	33877
Country Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Eff.	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors are clustered at the firm level and reported in parentheses. *** , **, * and † denote significance at the 1%, 5%, 10%, and 15% levels, resp. SD is the standard deviation of growth of firm outcome over 2002–2008. The explanatory variables are for 2002. Outcomes are in in 2005 constant euros. The EXPORTERS sample consists of firms reporting non-zero export revenue in 2002. The LIMITED LIABILITY sample are public or private limited liability companies; the excluded companies correspond to partnerships, sole proprietorships, and cooperatives. The FOREIGN OWNED sample is composed of firms with non-zero foreign ownership. The INDEPENDENT COMPANIES sample consists of firms classified by BvD as "independent" (no shareholder owning more than 50%). The MAJORITY STAKE >50% sample includes firms where the ownership percentage of largest owner is over 50%. The EXCLUDING PUBLIC SECTORS sample drops firms in government and public-regulated sectors, which are: Electricity, gas and water (NACE1=E), Public administration and defence, compulsory social security (NACE1=L), Other community, social and personal service activities (NACE1=O), Extra-territorial organizations and bodies (NACE1=Q). The columns Good/Poor Coverage Countries split the sample into companies from countries with relatively good AMADEUS firm coverage (Belgium, Denmark, Finland, France, Norway, Spain, Sweden, and the United Kingdom) and from countries with relatively poor coverage (Austria, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Switzerland). Central and Eastern European (CEE) countries are Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, and Slovakia. The 3% Random Sample is a 3% stratified sample where the number of firms from each country is proportional to the GDP of that country. The 25% Random Sample with Replacement is a 25% stratified sample, where firms from poor coverage countries are drawn with replacement. The 25% Random P.S. Matching Sample is a 25% random sample where we select the country with the smallest number of firms relative to GDP, and then we sample the same number of firms, relative to GDP, for all other countries using propensity score matching on company size, age, industry and foreign ownership.

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