ONLINE APPENDIX

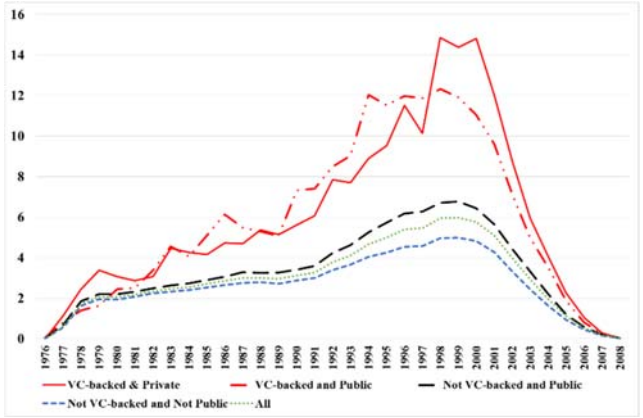
APPENDIX 1—Ownership Breakdown of Patents Granted by the USPTO

Table A1—Ownership Breakdown of Patents Granted by the USTPO (%)

	Pre-2002	2002	2003	2004	2005	2006	2007	2008
U.S. Government	0.99	0.61	0.58	0.56	0.53	0.49	0.50	0.46
U.S. Universities	3.17	2.23	2.19	2.07	2.10	2.11	2.10	1.96
U.S. Non VC-backed Corporations	47.21	44.43	43.93	43.42	43.77	42.84	41.41	40.46
U.S. VC-backed Corporations	*3.28*	*4.94*	*5.39*	*5.32*	*5.69*	*6.32*	*6.77*	*6.80*
Foreign Governments	0.26	0.07	0.06	0.05	0.04	0.03	0.05	0.02
Foreign Corporations	45.09	47.71	47.86	48.58	47.87	48.20	49.18	50.30
U.S. VC-backed Corporations/ U.S. Corporations	6.49	10.01	10.93	10.91	11.50	12.85	14.05	14.39

The table summarizes the ownership breakdown of patents granted by the USTPO during the 1991-2008 period. The table includes information on patents granted to U.S. or foreign institutions, and excludes information on patents granted to U.S. and foreign individuals. Source: Author's calculations and the USTPO.[1]

Figure A1. Citations to Patents Granted by USTPO by Type of Owner



The figure plots average number of citations received by patents within 3 years of the grant date by type of owner during the 1976-2008 period. On average, within 3 years of the grant date, patents granted to VC-backed companies receive 5.77 citations, whereas patents awarded to other types of assignees are cited 2.90 times The classification of patents is based on information from SDC on VC-backed companies and manually matched by author to USTPO files, and on information from Kogan, Papanikolau, Seru and Stoffman (2017) on patents granted to public companies.

[1] The breakout by ownership category of patents grants are available at the USTPO here: https://www.uspto.gov/web/offices/ac/ido/oeip/taf/reports_topo.htm.

APPENDIX 2—Matching Procedure and Statistics

The matching procedure relies on a nearest-neighbor matching of propensity scores, originally developed by Rosembaum and Rubin (1983) (see Roberts and Whited, 2012). The matching begins with annual probit regressions at the company level of a binary variable indicating whether a particular company in the sample of USTPO patentees is a portfolio company, based on the measures of technological scale, base, and focus, as well as location dummies, which control for any time-invariant differences between portfolio companies and other companies in the patent sample. The probits are estimated annually on the cross section of companies that have filed at least one patent by that period. I present the coefficient estimates of the 32 annual probits and their *p* value of the chi-squared test and R^2 in the different columns of Panel A in Table A2 below (I label these coefficients as "pre"). They reveal that the specification captures a significant amount of variation in portfolio selection, as indicated by the average R^2 of 0.17 across the years.

I then use the predicted probabilities from this estimation, the propensity scores, and the location dummies to perform a single nearest-neighbor match, with a replacement that forces the match to be in the same state. That is, each portfolio company is paired with a non-portfolio company in the patent data that is in the same state and whose propensity score is closest, in an L^1-norm sense. Following Smith and Todd (2005), I match with a replacement to improve the accuracy of the match at the cost of lower power. I also require that successful matches fall in the common support of estimated propensity scores, as in Lemmon and Roberts (2010). This requirement results in 1.1% annual portfolio companies (on average) for which I am unable to find a corresponding match. I report the number of annual portfolio companies and matched non-portfolio companies in Panel B of Table A.1 below.

The matching process removes meaningful differences along observables from portfolio companies and their annual non-portfolio matches. The matching ensures that the parallel trends assumption is satisfied (along observables), making sure I do not confound the potential portfolio joining effect on portfolio exchanges with the effects of technology and geographical clustering. Panel B in Table A2 below shows the majority of differences in the estimated propensity scores between portfolio companies and their matches are inconsequential. Across all years, the maximal difference between the matched propensity scores is 2%, whereas the 95th percentile is 1%. Further, I include in the different columns of Panel A in Table A2 and under the label "post", the *p* value of the chi-squared test and R^2 estimation results of the 32 annual probits restricted to the matched sample.[2] They show that across all years, and relative to the pre column, the R^2 falls to 0 and the *p* value of the chi-squared test dramatically increases to 1, implying that we cannot reject the null hypothesis that all of the coefficient estimates of the independent variables are zero.

[2] I note that the magnitudes of the coefficients decline significantly from the pre-match estimation to the post-match estimation, ensuring that the findings are not simply an artefact of a decline in the degrees of freedom.

Table A2—Propensity Score Matching Diagnostic Tests

Panel A—Probit Regressions

	1976	1976	1977	1977	1978	1978	1979	1979	1980	1980	1981	1981	1982	1982	1983	1983	1984	1984
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
χ^2 (p)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
R^2	0.22	0.00	0.16	0.04	0.17	0.01	0.16	0.04	0.17	0.05	0.17	0.07	0.17	0.02	0.17	0.03	0.17	0.02
Obs.	1,621	120	3,262	226	5,049	305	7,142	396	9,026	471	11,880	627	14,629	786	16,756	950	19,067	1,158

	1985	1985	1986	1986	1987	1987	1988	1988	1989	1989	1990	1990	1991	1991	1992	1992
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
χ^2(p)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
R^2	0.17	0.02	0.18	0.01	0.18	0.01	0.18	0.01	0.17	0.01	0.17	0.01	0.17	0.01	0.16	0.01
Obs.	21,364	1,374	24,965	1,578	28,802	1,792	32,228	2,026	35,905	2,264	39,390	2,492	43,207	2,710	47,249	2,930

	1993	1993	1994	1994	1995	1995	1996	1996	1997	1997	1998	1998	1999	1999	2000	2000
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
χ^2(p)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
R^2	0.17	0.01	0.17	0.01	0.17	0.01	0.16	0.01	0.17	0.01	0.17	0.01	0.18	0.01	0.19	0.01
Obs.	51,852	3,192	56,479	3,532	61,649	3,934	67,529	4,306	74,950	4,866	81,782	5,512	89,167	6,226	96,480	7,146

	2001	2001	2002	2002	2003	2003	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
χ^2(p)	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
R^2	0.19	0.01	0.19	0.01	0.18	0.01	0.19	0.01	0.18	0.01	0.18	0.01	0.18	0.01	0.18	0.01
Obs.	104,217	8,040	110,973	8,728	116,681	9,262	121,245	9,638	124,582	9,786	125,969	9,994	126,347	10,034	126,359	10,032

Panel B—Difference in Propensity Score Distribution

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
N	70	123	163	202	241	318	403	482	585	690	794.	898	1,019.	1,138	1,250	1,361	1,469	1,599	1,771
N-matched	60	118	159	198	237	314	399	475	579	687	789	896	1,013	1,132	1,246	1,355	1,465	1,596	1,766
Mean	0.004	0.003	0.003	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
Std. Dev.	0.009	0.010	0.008	0.008	0.005	0.005	0.005	0.004	0.005	0.006	0.007	0.004	0.006	0.005	0.004	0.005	0.003	0.004	0.004
Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Max	0.045	0.074	0.076	0.065	0.056	0.045	0.058	0.063	0.070	0.076	0.074	0.060	0.077	0.080	0.064	0.076	0.064	0.067	0.074
p50	0.000	0.000	0.018	0.018	0.005	0.009	0.010	0.006	0.005	0.005	0.003	0.005	0.003	0.003	0.002	0.002	0.002	0.002	0.001
p99	0.045	0.048	0.036	0.041	0.030	0.023	0.020	0.017	0.030	0.030	0.039	0.025	0.039	0.018	0.012	0.011	0.009	0.014	0.009
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008					
N	1,971	2,159	2,435	2,761	3,121	3,581	4,026	4,366	4,633	4,822	4,940	4,999	5,018	5,018					
N-matched	1,967	2,153	2,433	2,756	3,113	3,573	4,020	4,364	4,631	4,819	4,938	4,997	5,017	5,016					
Mean	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
Std. Dev.	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.002	0.002	0.002	0.001	0.002	0.002	0.002					
Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
Max	0.069	0.072	0.074	0.061	0.079	0.079	0.061	0.065	0.045	0.060	0.049	0.069	0.077	0.067					
p50	0.001	0.001	0.001	0.01	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000					
p99	0.007	0.005	0.005	0.008	0.008	0.008	0.006	0.006	0.003	0.003	0.002	0.002	0.002	0.001					

This table presents propensity score matching diagnostics. The matching process begins with annual probit regressions at the company level of a binary variable indicating whether a particular company in the sample of USTPO patentees is a portfolio company on the measures of technological: scale (i.e., number of filed patents), base (i.e., distribution across 2-digit technology classes of citations made to prior innovations), and focus (i.e., 3-digit technology class mode of filings), as well as location dummies, which control for any time-invariant differences between portfolio companies and non-portfolio companies. The probits are estimated annually on the cross section of companies that have filed at least one patent by that period. Panel A presents the R^2 and the *p* value of the chi-squared test for joint parameter significance of the probit models under the label "pre". The second step in the propensity score matching procedures is to use the predicted probabilities from these estimations, the propensity scores, together with the location dummies, and perform single nearest-neighbor matches with replacement, forcing the match to be in the same state. Panel B presents the distribution of estimated propensity scores for the portfolio companies (treatment) and their matched (control) non-portfolio companies, and the difference in estimated propensity scores. The R^2 and the *p* value of the chi-squared test for joint parameter significance of the probits estimated on the subsample of matched treatment and control observations after matching are presented in Panel A under the label "post".

APPENDIX 3—Robustness Checks: Event Time Analysis

Table A3.1—Sample Restrictions

Dependent Variable	(1) Relative Citations Received	(2) Relative Citations Made	(3) Relative Overall Citations	(4) Relative Patents Sold	(5) Relative Patents Bought	(6) Relative Patent Sales	(7) Relative Inventor Emigrates	(8) Relative Inventor Immigrants	(9) Relative Inventor Exchanges	(10) Relative Alliances	(11) Relative Mergers and Acquisitions
Panel A—Excluding California											
Post	0.011*	0.069**	0.080***	0.006***	0.009**	0.002	0.005	0.007**	0.010***	0.000	0.000
	(0.007)	(0.029)	(0.030)	(0.002)	(0.004)	(0.002)	(0.003)	(0.003)	(0.004)	(0.000)	(0.000)
Post× Event-Trend	0.016***	-0.014*	0.002	0.003**	0.002	-0.000	-0.004***	-0.003***	0.002	0.000***	0.001***
	(0.006)	(0.007)	(0.009)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)
Obs.	66,759	66,759	66,759	66,759	66,759	66,759	66,759	66,759	66,759	66,759	66,759
R-2	0.250	0.287	0.290	0.184	0.196	0.228	0.628	0.659	0.641	0.468	0.439
Panel B—Excluding Massachusetts											
Post	0.020***	0.069***	0.088***	0.005***	0.010***	0.014***	0.005***	0.009***	0.013***	0.000	-0.000
	(0.008)	(0.026)	(0.027)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.000)	(0.000)
Post× Event-Trend	0.024***	-0.027**	-0.003	0.002***	0.001	0.004***	-0.001*	-0.007***	-0.006***	0.001***	0.001***
	(0.006)	(0.013)	(0.014)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444	103,444
R-2	0.193	0.290	0.265	0.201	0.181	0.217	0.155	0.166	0.181	0.480	0.414
Panel C—Excluding California and Massachusetts											
Post	0.012*	0.089**	0.101**	0.007***	0.009**	0.016***	0.002	0.005	0.007*	0.000	0.000
	(0.007)	(0.039)	(0.040)	(0.002)	(0.004)	(0.006)	(0.003)	(0.003)	(0.004)	(0.000)	(0.001)
Post× Event-Trend	0.015***	-0.016	-0.001	0.002**	0.002	0.004*	-0.001	-0.004***	-0.004***	0.000*	0.001***
	(0.005)	(0.010)	(0.011)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	48,650	48,650	48,650	48,650	48,650	48,650	48,650	48,650	48,650	48,650	48,650
R-2	0.260	0.284	0.287	0.230	0.190	0.238	0.131	0.195	0.193	0.495	0.429
Panel D—Excluding Sun and KPCB											
Post	0.018***	0.057**	0.076***	0.004**	0.009***	0.013***	0.004***	0.008***	0.011***	0.000	-0.000
	(0.007)	(0.022)	(0.024)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.000)	(0.000)
Post× Event-Trend	0.023***	-0.025**	-0.003	0.002***	0.001	0.004***	-0.001*	-0.006***	-0.005***	0.001***	0.001***
	(0.005)	(0.011)	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	119,589	119,589	119,589	119,589	119,589	119,589	119,589	119,589	119,589	119,589	119,589
R-2	0.194	0.290	0.266	0.183	0.188	0.218	0.518	0.592	0.571	0.487	0.421
Panel E—Balanced Panel of Joiner and VC Pairs											
Post	0.012	0.078***	0.090***	0.005**	0.008***	0.014***	0.005**	0.011***	0.015***	-0.000	-0.000
	(0.010)	(0.025)	(0.027)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)	(0.000)	(0.000)
Post×Event-Trend	0.031***	-0.028*	0.003	0.003***	0.002***	0.005***	-0.001*	-0.006***	-0.005***	0.001***	0.001***
	(0.008)	(0.016)	(0.018)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	96,228	96,228	96,228	96,228	96,228	96,228	96,228	96,228	96,228	96,228	96,228
R-2	0.196	0.300	0.271	0.183	0.205	0.228	0.485	0.569	0.542	0.476	0.414

Panel F—Excluding Joiners with With-in Portfolio Alliances											
Post	0.018***	0.057**	0.075***	0.004***	0.010***	0.014***	0.004***	0.008***	0.012***	-0.000	
	(0.007)	(0.023)	(0.024)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.000)	
Post×Event-Trend	0.024***	-0.028**	-0.004	0.002***	0.001	0.004***	-0.001*	-0.006***	-0.005***	0.001***	
	(0.006)	(0.011)	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	
Obs.	119,133	119,133	119,133	119,133	119,133	119,133	119,133	119,133	119,133	119,133	
R-2	0.196	0.289	0.265	0.182	0.187	0.217	0.153	0.164	0.177	0.421	
Panel G—Restricting Portfolio Companies to Mature Firms											
Post	0.002	0.077***	0.079***	-0.000	0.010***	0.009***	0.001	0.005**	0.005**	0.000	-0.000
	(0.004)	(0.027)	(0.027)	(0.000)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.000)	(0.000)
Post×Event-Trend	0.005	-0.006	-0.001	0.000	0.002	0.002*	0.000	-0.002***	-0.002**	0.000	0.000***
	(0.004)	(0.005)	(0.007)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	121,553	121,553	121,553	121,553	121,553	121,553	121,553	121,553	121,553	121,553	121,553
R-2	0.146	0.234	0.213	0.096	0.197	0.196	0.135	0.173	0.170	0.518	0.457

This table reports the coefficients and standard errors (in parentheses) from estimating equation (2) on the different proxies of portfolio exchanges. An observation is a joiner and VC pair cross time (year). The explanatory variables of interest are Post, an indicator variable that equals one after the joiner enters the VC portfolio for the first time, and Post×Event-Trend, which equals 0 before the joiner enters the VC portfolio for the first time, and indicates the first through sixth years after the Joiner enters the portfolio. All panels include calendar year fixed effects and joiner and VC pair fixed effects. Standard errors are heteroskedasticity robust and clustered at the joiner and VC pair level*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A3.2—Alternative Methodologies

Dependent Variable	(1) Relative Citations Received	(2) Relative Citations Made	(3) Relative Overall Citations	(4) Relative Patents Sold	(5) Relative Patents Bought	(6) Relative Patent Sales	(7) Relative Inventor Emigrates	(8) Relative Inventor Immigrants	(9) Relative Inventor Exchanges	(10) Relative Alliances	(11) Relative Mergers and Acquisitions
Panel A—Differential Trends across Industries											
Post	0.017**	0.062***	0.080***	0.004***	0.009***	0.014***	0.005***	0.009***	0.013***	0.000	-0.000
	(0.007)	(0.024)	(0.025)	(0.001)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.000)	(0.000)
Post× Event-Trend	0.022***	-0.025**	-0.002	0.002***	0.001	0.003**	-0.000	-0.005***	-0.005***	0.001***	0.001***
	(0.006)	(0.011)	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	121,552	121,552	121,552	121,552	121,552	121,552	121,552	121,552	121,552	121,552	121,552
R-2	0.199	0.293	0.271	0.189	0.191	0.223	0.188	0.186	0.196	0.475	0.425
Panel B—Differential Trends across Joiners' Home States											
Post	0.019***	0.067***	0.086***	0.004***	0.009***	0.013***	0.004***	0.008***	0.012***	0.000	-0.000
	(0.007)	(0.024)	(0.026)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.000)	(0.000)
Post× Event-Trend	0.024***	-0.020**	0.004	0.002***	0.001	0.003**	-0.001*	-0.006***	-0.005***	0.001***	0.001***
	(0.005)	(0.010)	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	121,417	121,417	121,417	121,417	121,417	121,417	121,417	121,417	121,417	121,417	121,417
R-2	0.199	0.301	0.274	0.195	0.193	0.225	0.188	0.187	0.197	0.475	0.433
Panel C—Differential Trends across VCs' Home States											
Post	0.016**	0.058***	0.074***	0.004***	0.009***	0.013***	0.005***	0.008***	0.012***	0.000	-0.000
	(0.007)	(0.022)	(0.023)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.000)	(0.000)
Post× Event-Trend	0.024***	-0.027**	-0.003	0.002***	0.001	0.003***	-0.001*	-0.006***	-0.005***	0.001***	0.001***
	(0.006)	(0.011)	(0.013)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	121,445	121,445	121,445	121,445	121,445	121,445	121,445	121,445	121,445	121,445	121,445
R-2	0.198	0.293	0.270	0.186	0.190	0.221	0.158	0.167	0.182	0.473	0.428
Panel D—Different Levels of Clustering											
Post	0.018***	0.060***	0.078***	0.004***	0.009***	0.014***	0.005***	0.008***	0.012***	0.000	0.000
VC level	(0.006)	(0.025)	(0.027)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.000)	(0.000)
Joiner level	(0.009)	(0.030)	(0.032)	(0.002)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)	(0.000)	(0.000)
VC and Joiner level	(0.007)	(0.022)	(0.023)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.000)	(0.000)
Post×Event-Trend	0.024***	-0.025**	-0.001	0.002***	0.001	0.004***	-0.001*	-0.006***	-0.005***	0.001***	0.001***
VC level	(0.007)	(0.011)	(0.009)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Joiner level	(0.007)	(0.014)	(0.015)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
VC and Joiner level	(0.005)	(0.011)	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	121,553	121,553	121,553	121,553	121,553	121,553	121,553	121,553	121,553	121,553	121,553
Panel E—Ignoring Time Series Information											
Post	0.068***	0.084***	0.151***	0.010***	0.012***	0.022***	0.006***	0.006***	0.012***	0.002***	0.003***
	(0.010)	(0.015)	(0.018)	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Obs.	23,630	23,630	23,630	23,630	23,630	23,630	23,630	23,630	23,630	23,630	23,630

R-2	0.502	0.632	0.600	0.509	0.510	0.515	0.524	0.559	0.554	0.578	0.572
Panel F—Controlling for VC Portfolio Size											
Post	0.006	0.048**	0.055**	0.004**	0.009***	0.013***	0.004**	0.008***	0.011***	-0.000	-0.000
	(0.006)	(0.021)	(0.022)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)	(0.000)	(0.000)
Post× Event-Trend	0.022***	-0.027**	-0.005	0.002***	0.001	0.004***	-0.001**	-0.006***	-0.005***	0.001***	0.001***
	(0.005)	(0.011)	(0.012)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
VC Portfolio Size	0.005***	0.006***	0.011***	0.000*	0.000*	0.000**	0.000***	0.000*	0.000***	0.000***	0.000***
	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Obs.	121,417	121,417	121,417	121,417	121,417	121,417	121,417	121,417	121,417	121,417	121,417
R-2	0.199	0.301	0.274	0.195	0.193	0.225	0.188	0.187	0.197	0.475	0.433

Panel G—Placebo Tests Using Randomly Picked Joining Event Years

	(1)		(2)		(3)		(4)	
Dep. Variable	Average Coefficient		Average Standard Deviation		Average *p*-value		Non-Rejection Rate at 5% Level	
	Post	Trend	Post	Trend	Post	Trend	Post	Trend
Relative citations received	0.000	0.000	0.013	0.001	0.481	0.465	0.022	0.038
Relative citations made	0.000	0.000	0.017	0.001	0.469	0.476	0.038	0.041
Relative overall citations	0.000	0.000	0.022	0.001	0.491	0.495	0.038	0.042
Relative patents sold	0.000	0.000	0.002	0.000	0.476	0.484	0.048	0.047
Relative patents bought	0.000	0.000	0.002	0.000	0.496	0.493	0.048	0.035
Relative patent sales	0.000	0.000	0.003	0.000	0.501	0.490	0.047	0.043
Relative emigrates	0.000	0.000	0.001	0.000	0.485	0.487	0.031	0.049
Relative immigrants	0.000	0.000	0.002	0.000	0.485	0.496	0.043	0.034
Relative inventor exchanges	0.000	0.000	0.002	0.000	0.488	0.501	0.035	0.039
Relative alliances	0.000	0.000	0.000	0.000	0.492	0.508	0.046	0.039
Relative mergers and acquisitions	0.000	0.000	0.000	0.000	0.486	0.485	0.043	0.049

Panels A-F in this table reports the coefficients and standard errors (in parentheses) from estimating Eq. (2) on the different proxies of relative portfolio exchanges. An observation is a joiner and VC pair cross time (year). The explanatory variables of interest are Post, an indicator variable that equals one after the joiner enters the VC portfolio for the first time, and Post×Event-Trend, which equals 0 before the financing event and indicates the first through sixth years after the joiner enters the portfolio. Standard errors are heteroskedasticity robust and clustered at the joiner and VC pair level, except in Panel D where I report results using different levels of clustering as specified in the rows. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Panel G reports results from 1000 placebo tests where I randomly pick the years of joining events for the pairs in the sample.

APPENDIX 4: Alternative Matching Methodologies

I present results using two alternative matching methodologies.

Match based on the level of secured venture capital and technology

For a given joiner and VC pair in my sample, I match joiners with other companies that secured a similar amount of venture capital during the same year and are technologically similar as measured by a propensity score based on number of patents and technological focus (as measured by the 3 digit technology class in which company patents the most).

I report the results, summary statistics, and match diagnostics using this alternative methodology in tables A4.1, A4.2, and A4.3 below. The results in columns 1-6 and 10-11 of Panel B in Table A4.1 are similar to the main results of the paper (Table 2): after the joiners first enter the portfolio of the VC, relative portfolio exchanges increase by an average of 20% relative to the unconditional mean (see Table A4.2).

The methodology relies on a nearest-neighbor matching of propensity scores (see Roberts and Whited, 2012) and begins with annual probit regressions at the company level of a binary variable indicating whether a particular company in the sample of VC-backed companies that patent at the USTPO is a joiner, on the measures of technological scale and focus, as well as the secured amount of venture capital. The probits are estimated annually on the cross section of companies that have filed at least one patent by that period and secured venture capital that period. I present the coefficient estimates of the 22 annual probits and their *p* value of the chi-squared test and R^2 in the different columns of Panel A in Table A4.3 below (I label these coefficients as "pre"). The specification captures a significant amount of variation in portfolio selection: average R^2 of 0.17 across the years.

I then use the predicted probabilities from this estimation and the propensity scores to perform a single nearest-neighbor match, with a replacement. That is, each joiner is paired with a matched company in the patent and SDC data whose propensity score is closest, in an L^1-norm sense. Following Smith and Todd (2005), I match with a replacement to improve the accuracy of the match at the cost of lower power. I also require that successful matches fall in the common support of estimated propensity scores, as in Lemmon and Roberts (2010). I report the number of Joiners and matched companies in Panel B of Table A4.3 below.

Panel B Table A4.3 shows that this alternative match is of good quality: mean differences in the propensity score are very small, and the 99th percentile of the difference is on average small. Across all years, the maximal difference between the matched propensity scores is 4.5%. Further, across all years, and relative to the pre column, the R^2 in the post column is higher and the *p* value of the chi-squared test increases towards 1, implying that we cannot reject the null hypothesis that all of the coefficient estimates of the independent variables are zero. Relative to the main methodology, this new match is, however, less comprehensive in terms of the technological characteristics of companies. I was able to match only on number of patents and 3-digit technological focus, instead of also matching on the distribution of citing classes as I did in the original match, due to lack of convergence.

Table A.3.3 shows the limitations of this alternative match. First, there is limited information on amounts of venture capital investments, in particular for the early years in the sample (prior to 1985) and for the years 1996 and 1997. Overall, there is no funding information for approximately 35% of the sample (compare "number of joiners" and "number of joiners with known amount" reported in Panel B of Table A4.3). Second, the likelihood of finding a technological match among venture capital backed companies for the companies in the sample is roughly 50% (see rows "Matching ratio Joiners" and "Matching ratio funding events" in Table A4.3). The low likelihood is partly a consequence of the relatively small universe of potential matches—i.e. there are only 4,813 venture capital backed companies that patent during 1985-2008, which is much smaller than the 117,046 patent assignees that constitute the universe of potential matches of the original matching exercise).

Table A4.1—Portfolio Exchanges Using Alternative Match Based On The Level Of Secured Venture Capital And Technology

Dependent Variable	(1) Citations Received	(2) Citations Made	(3) Overall Citations	(4) Patents Sold	(5) Patents Bought	(6) Patent Sales	(7) Emigrates	(8) Immigrates	(9) Worker Exchanges	(10) Alliances	(11) Mergers and Acquisitions
Panel A—Baseline Estimations: Portfolio Exchanges											
Post	0.050***	0.184***	0.234***	0.005*	0.014***	0.019***	0.007	0.002	0.002	0.000	0.001*
	(0.014)	(0.062)	(0.063)	(0.003)	(0.005)	(0.006)	(0.006)	(0.003)	(0.005)	(0.000)	(0.001)
Post×Event-Trend	0.027***	-0.041*	-0.013	0.004**	0.000	0.005	-0.009***	-0.003***	-0.008***	0.001**	0.002***
	(0.008)	(0.023)	(0.024)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.002)	(0.000)	(0.001)
Obs.	36,700	36,700	36,700	36,700	36,700	36,700	36,700	36,700	36,700	36,700	36,700
R-2	0.188	0.296	0.277	0.167	0.162	0.186	0.179	0.143	0.163	0.473	0.461
Panel B—Relative Estimations: Relative Portfolio Exchanges											
Post	0.038***	0.119	0.157**	0.005	0.014**	0.019***	-0.003	-0.000	-0.002	-0.001	0.001
	(0.014)	(0.074)	(0.075)	(0.003)	(0.006)	(0.006)	(0.002)	(0.003)	(0.003)	(0.001)	(0.001)
Post×Event-Trend	0.030***	-0.026	0.004	0.004*	0.002	0.005	-0.001	-0.003***	-0.002**	0.000	0.001***
	(0.008)	(0.024)	(0.025)	(0.002)	(0.002)	(0.003)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Obs.	36,700	36,700	36,700	36,700	36,700	36,700	36,700	36,700	36,700	36,700	36,700
R-2	0.187	0.268	0.256	0.166	0.160	0.185	0.133	0.170	0.180	0.548	0.483

This table reports the coefficients and standard errors (in parentheses) from estimating equation (2) on the different proxies of portfolio exchanges. An observation is a joiner and VC pair cross time (year). The sample is restricted to joiners for which I can find a matching company (based on the technology and value of secured venture capital) in the set of VC-backed firms that patent. The explanatory variables of interest are Post, an indicator variable that equals one after the joiner enters the VC portfolio for the first time, and Post×Event-Trend, which equals 0 before the joiner enters the VC portfolio for the first time, and indicates the first through sixth years after the joiner enters the portfolio. The dependent variables are specified at the top of each column. Standard errors are heteroskedasticity robust and clustered at the joiner and VC pair level.*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A4.2—Summary Statistics for Metrics of Relative Portfolio Exchanges Using Match Based On The Level Of Secured Venture Capital And Technology

	Observations	Mean	Std. Dev.	Min	Max
Relative Citations Received	36,700	0.051	1.69	-12.00	263.00
Relative Citations Made	36,700	0.150	3.43	-235.00	249.00
Relative Overall Citations	36,700	0.200	3.83	-236.00	263.00
Relative Patents Sold	36,700	0.012	0.23	-4.00	13.00
Relative Patents Bought	36,700	0.011	0.31	-11.00	22.00
Relative Patent Sales	36,700	0.024	0.42	-4.00	26.00
Relative Emigrates	36,700	0.002	0.08	-4.00	4.00
Relative Immigrates	36,700	0.004	0.12	-2.00	6.00
Relative Worker Exchanges	36,700	0.006	0.14	-4.00	6.00
Relative Alliances	36,700	0.001	0.04	-1.00	1.00
Relative Mergers And Acquisitions	36,700	0.004	0.07	-1.00	1.00

This table presents the summary statistics of the metrics of relative portfolio exchanges using the alternative match. The number of observations is substantially reduced relative to the whole sample due to data restrictions in the construction of the new match (see detailed explanation above). Observations are at the joiner and VC pair cross time.

TableA4.3— Propensity Score Matching Diagnostic Tests: Match Based On The Level Of Secured Venture Capital And Technology

Panel A-- Probit Regressions

	1985	1985	1986	1986	1987	1987	1988	1988	1989	1989	1990	1990	1991	1991	1992	1992	1993	1993	1994	1994	1995	1995
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
χ^2(p)	0.305	0.836	0.787	0.051	0.08	0.194	0.848	0.850	0.098	0.909	0.300	0.886	0.033	0.831	0.164	0.203	0.00	0.00	0.055	0.978	0.003	0.792
R^2	0.208	0.102	0.149	0.997	0.371	0.816	0.170	0.123	0.240	0.102	0.198	0.116	0.290	0.134	0.240	0.227	0.607	0.607	0.284	0.073	0.362	0.123
Obs.	83	58	97	86	57	20	44	34	93	61	91	65	74	33	75	52	41	40	66	37	84	53

	1998	1998	1999	1999	2000	2000	2001	2001	2002	2002	2003	2003	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
χ^2(p)	0.089	0.405	0.388	0.613	0.160	0.926	0.082	0.941	0.000	0.716	0.032	0.844	0.008	0.351	0.100	0.588	0.629	0.994	0.062	0.996	0.191	0.996
R^2	0.154	0.091	0.101	0.060	0.099	0.035	0.363	0.043	0.132	0.049	0.103	0.048	0.115	0.070	0.098	0.067	0.090	0.056	0.148	0.062	0.149	0.045
Obs.	242	251	375	441	535	684	466	520	419	457	512	533	543	565	506	493	444	348	339	239	168	100

Panel B—Number of Observations and Differences in Propensity Score Distribution

	1985	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Joiners	190	160	160	158	185	139	102	109	110	118	186	364	501	721	513	433	449	452	381	279	233	144
Joiners Known Amount	149	132	116	115	135	91	85	90	81	89	109	277	388	535	386	327	339	330	227	182	129	65
Joiners Matched	36	40	13	18	31	27	17	28	4	18	25	118	198	305	238	213	240	250	225	157	112	48
Matching Ratio Joiners	0.24	0.30	0.11	0.16	0.23	0.30	0.20	0.31	0.05	0.20	0.23	0.43	0.51	0.57	0.62	0.65	0.71	0.76	0.99	0.86	0.87	0.74
Funding Events	341	290	275	270	343	221	165	184	200	216	278	571	810	1,171	856	721	807	743	559	395	335	187
Funding Events Known Amount	294	256	216	217	284	159	146	158	161	173	176	459	667	920	678	586	626	569	410	268	198	91
Funding Events Known Amount Matched	60	78	20	35	55	47	30	30	7	27	34	172	289	494	367	376	441	398	316	226	162	59
Matching Ratio Funding Events	0.20	0.30	0.09	0.16	0.19	0.30	0.21	0.19	0.04	0.16	0.19	0.37	0.43	0.54	0.54	0.64	0.70	0.70	0.77	0.84	0.82	0.65
Difference Propensity Score																						
Mean	0.013	0.010	0.014	0.014	0.009	0.010	0.016	0.014	0.031	0.018	0.013	0.004	0.003	0.002	0.002	0.004	0.004	0.002	0.002	0.002	0.003	0.008
Std. Dev.	0.013	0.011	0.009	0.011	0.010	0.010	0.011	0.011	0.016	0.016	0.011	0.005	0.005	0.003	0.003	0.007	0.007	0.003	0.005	0.004	0.004	0.009
Min	0.001	0.001	0.004	0.01	0.001	0.00	0.001	0.000	0.007	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Max	0.043	0.047	0.036	0.035	0.042	0.043	0.042	0.041	0.040	0.049	0.041	0.023	0.030	0.014	0.016	0.048	0.033	0.026	0.044	0.026	0.020	0.045
p50	0.009	0.007	0.012	0.010	0.005	0.007	0.015	0.011	0.040	0.014	0.010	0.003	0.001	0.001	0.001	0.004	0.001	0.001	0.001	0.001	0.002	0.006
p99	0.043	0.047	0.036	0.035	0.042	0.043	0.042	0.041	0.040	0.049	0.041	0.022	0.029	0.013	0.016	0.035	0.027	0.020	0.018	0.024	0.018	0.045

This table presents number of observations and propensity score matching diagnostics. The matching process begins with annual probit regressions at the company level of a binary variable indicating whether a particular company in the sample of VC-backed companies that patent at the USTPO is a joiner, on the measures of technological: scale (i.e., number of filed patents), and focus (i.e., 3-digit

technology-class mode of filings), as well as the secured amount of venture capital. The probits are estimated annually on the cross section of companies that have filed at least one patent by that period and secured venture capital that period. Panel A presents the R^2 and the p-value of the chi-squared test for joint parameter significance of the probit models under the label "pre". The second step in the propensity score matching procedures is to use the predicted probabilities from these estimations, the propensity scores, and perform single nearest-neighbor matches with replacement. Panel B presents the distribution of estimated propensity scores for the joiners (treatment) and their matches, and the difference in estimated propensity scores. The R^2 and the p value of the chi-squared test for joint parameter significance of the probits estimated on the subsample of matched treatment and control observations after matching are presented in Panel A under the label "post".

Match Based On The Level Of Secured Venture Capital, Technology, Firm Age And Location

For a given joiner and VC pair in my sample, I match joiners with other companies that secured a similar amount of venture capital during the same year, are technologically similar as measured by a propensity score based on number of patents and technological focus (as measured by 3 digit technology class in which company patents the most), have the same age (relative to the founding year) and are located in the same state.

I report results, summary statistics, and match diagnostics using this alternative methodology in tables A4.4, A4.5, and A4.6, below. The results in columns 1-6 and 10-11 of Panel B in Table A.3.4 are similar to the main results of the paper (Table 2): after the joiners first enter the portfolio of the VC, relative portfolio exchanges increase by an average of 55% relative to the unconditional mean (see Table A4.5).

The methodology relies on a nearest-neighbor matching of propensity scores (see Roberts and Whited, 2012) and begins with annual probit regressions at the company level of a binary variable indicating whether a particular company in the sample of VC-backed companies that patent at the USTPO is a joiner, on the measures of technological scale and focus, the amount of venture capital as well as location and firm-age dummies. The probits are estimated annually on the cross section of companies that have filed at least one patent by that period and secured venture capital that period. I present the coefficient estimates of the 11 annual probits and their *p* value of the chi-squared test and R^2 in the different columns of Panel A in Table A4.6 below (I label these coefficients as "pre"). The specification captures a significant amount of variation in portfolio selection: average R^2 of 0.15 across the years.

I then use the predicted probabilities from this estimation and the propensity scores to perform a single nearest-neighbor match, with a replacement that forces the match to be in the same state. That is, each joiner is paired with a matched company in the patent and SDC data whose propensity score is closest, in an L^1-norm sense. Following Smith and Todd (2005), I match with a replacement to improve the accuracy of the match at the cost of lower power. I also require that successful matches fall in the common support of estimated propensity scores, as in Lemmon and Roberts (2010). I report the number of joiners and matched companies in Panel B of Table A4.6 below.

Panel B Table A.3.6 shows that this alternative match is of good quality: mean differences (and 99th percentile) in the propensity score are very small. Variable-by-variable diagnostics are not reported to conserve space. I note, however, that the good quality of the match does come at the expense of loss in observations as explained in more detailed below. In addition, relative to the main methodology, this new match is less comprehensive in terms of the technological characteristics of companies. I was able to match only on number of patents and 3-digit technological focus, instead of also matching on the distribution of citing classes as I did in the original match, due to lack of convergence. In addition, I had to sacrifice the accuracy of the match in terms of technological focus: a match at the three-digit technological class level proved too onerous, thus, this alternative match on technology focus was implemented at the two-digit technological class.

Table A4.6 shows additional limitations of this alternative match. First, there is limited information on amounts of venture capital investments. Second, the likelihood of finding a technological match among venture capital-backed companies for the companies in the sample is low, partly because venture capital-backed companies are a relatively small universe of potential matches. Third, the methodology does not converge for years prior to 1998 (the main issue was perfect prediction of treatment given the combined effect of all the matching requirements). After these restrictions, the number of observations decreases by 84% relative to the sample used in the main set of results (19,843 relative to 121,553).

Table A4.4—Relative Portfolio Exchanges using New Match

Dependent Variable	(1) Citations Received	(2) Citations Made	(3) Overall Citations	(4) Patents Sold	(5) Patents Bought	(6) Patent Sales	(7) Emigrates	(8) Immigrates	(9) Worker Exchanges	(10) Alliances	(11) Mergers And Acquisitions
Panel A—Baseline Estimations: Portfolio Exchanges											
Post	0.042**	0.236**	0.278***	0.014***	0.018***	0.032***	0.009	0.007*	0.000	0.001	0.002**
	(0.018)	(0.102)	(0.104)	(0.004)	(0.006)	(0.009)	(0.009)	(0.004)	(0.008)	(0.001)	(0.001)
Post×Event-Trend	0.008	-0.079**	-0.071*	0.006	-0.001	0.005	-0.013***	-0.004***	-0.011***	0.001*	0.000
	(0.007)	(0.037)	(0.037)	(0.004)	(0.002)	(0.005)	(0.003)	(0.001)	(0.003)	(0.000)	(0.001)
Obs.	19,843	19,843	19,843	19,843	19,843	19,843	19,843	19,843	19,843	19,843	19,843
R-2	0.324	0.291	0.298	0.173	0.158	0.197	0.165	0.148	0.148	0.506	0.515
Panel B—Relative Estimations: Relative Portfolio Exchanges											
Post	0.032*	0.128	0.160	0.014***	0.017***	0.031***	-0.001	-0.003	-0.004	0.001	0.002
	(0.018)	(0.099)	(0.100)	(0.004)	(0.006)	(0.009)	(0.003)	(0.005)	(0.005)	(0.001)	(0.001)
Post×Event-Trend	0.010	-0.063*	-0.054	0.006	-0.000	0.005	-0.002**	-0.002	-0.003	0.001*	0.000
	(0.007)	(0.037)	(0.037)	(0.004)	(0.002)	(0.005)	(0.001)	(0.002)	(0.002)	(0.000)	(0.001)
Obs.	19,843	19,843	19,843	19,843	19,843	19,843	19,843	19,843	19,843	19,843	19,843
R-2	0.319	0.261	0.267	0.173	0.157	0.197	0.128	0.189	0.198	0.516	0.522

This table reports the coefficients and standard errors (in parentheses) from estimating equation (2) on the different proxies of portfolio exchanges. An observation is a joiner and VC pair cross time (year). The explanatory variables of interest are Post, an indicator variable that equals one after the joiner enters the VC portfolio for the first time, and Post×Event-Trend, which equals 0 before the joiner enters the VC portfolio for the first time, and indicates the first through sixth years after the joiner enters the portfolio. The dependent variables are specified at the top of each column. Standard errors are heteroskedasticity robust and clustered at the joiner and VC pair level.*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A4.5—Summary Statistics for Metrics of Relative Portfolio Exchanges Using New Match

	Observations	Mean	Std. Dev.	Min	Max
Relative Citations Received	19,843	0.030	0.93	-9.00	97.00
Relative Citations Made	19,843	0.192	4.15	-150.00	249.00
Relative Overall Citations	19,843	0.222	4.27	-150.00	249.00
Relative Patents Sold	19,843	0.013	0.25	-1.00	13.00
Relative Patents Bought	19,843	0.010	0.26	-3.00	22.00
Relative Patent Sales	19,843	0.024	0.42	-1.00	26.00
Relative Emigrates	19,843	0.001	0.07	-3.00	3.00
Relative Immigrates	19,843	0.006	0.14	-2.00	6.00
Relative Worker Exchanges	19,843	0.006	0.15	-3.00	6.00
Relative Alliances	19,843	0.001	0.04	0.00	1.00
Relative Mergers And Acquisitions	19,843	0.003	0.06	-1.00	1.00

This table presents the summary statistics of the metrics of relative portfolio exchanges using the new match. The number of observations is substantially reduced relative to the whole sample due to sample restrictions in the construction of the new match (see detailed explanation above). Observations are at the joiner and VC pair cross time.

Table A4.6— Propensity Score Matching Diagnostic Tests

Panel A-- Probit Regressions

	1998	1998	1999	1999	2000	2000	2001	2001	2002	2002	2003	2003
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
χ^2(p)	0.530	0.495	0.00349	0.859	0.000153	0.595	0.00661	0.913	4.20e-05	0.799	0.00121	0.889
R^2	0.119	0.0948	0.174	0.0628	0.158	0.0471	0.115	0.0460	0.170	0.0561	0.121	0.0524
Obs.	227	148	356	223	490	350	477	290	410	246	510	336

	2004	2004	2005	2005	2006	2006	2007	2007	2008	2008
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
χ^2(p)	0.00508	0.970	1.41e-07	0.799	0.144	0.999	0.0108	0.981	0.0178	0.832
R^2	0.108	0.0456	0.164	0.0539	0.0922	0.0412	0.159	0.0677	0.211	0.191
Obs.	544	335	517	290	447	203	332	113	184	53

Panel B-- Difference in Propensity Score Distribution

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number Of Joiners	364	501	721	513	433	449	452	381	279	233	144
Number Of Joiners With Known Amount	277	388	535	386	327	339	330	227	182	129	65
Number Of Joiners Matched	72	104	168	142	115	156	160	140	96	55	26
Matching Ratio Joiners	0.26	0.27	0.31	0.37	0.35	0.46	0.48	0.62	0.53	0.43	0.40
Number Of Funding Events	571	810	1,171	856	721	807	743	559	395	335	187
Number Of Funding Events With Known Amount	459	667	920	678	586	626	569	410	268	198	91
Number Of Funding Events With Known Amount Matched	109	173	298	249	214	273	268	203	135	79	37
Matching Ratio Funding Events	0.24	0.26	0.32	0.37	0.37	0.44	0.47	0.50	0.50	0.40	0.41
Difference in Propensity Score											
Mean	0.015	0.018	0.014	0.014	0.016	0.015	0.016	0.016	0.014	0.018	0.013
Std. Dev.	0.013	0.013	0.012	0.014	0.011	0.013	0.014	0.013	0.013	0.013	0.014
Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Max	0.048	0.046	0.049	0.050	0.046	0.050	0.050	0.049	0.050	0.048	0.045
p50	0.011	0.014	0.010	0.009	0.013	0.010	0.011	0.011	0.009	0.014	0.008
p99	0.048	0.045	0.048	0.049	0.043	0.049	0.049	0.047	0.050	0.048	0.045

This table presents number of observations and propensity score matching diagnostics. The matching process begins with annual probit regressions at the company level of a binary variable indicating whether a particular company in the sample of VC-backed companies that patent at the USTPO is a joiner, on the measures of technological: scale (i.e., number of filed patents), and focus (i.e., 3-digit technology-class mode of filings), as well as firm age and location dummies, and secured amount of venture capital. The probits are estimated annually on the cross section of companies that have filed at least one patent by that period and that also secured venture capital that period. Panel A presents the R^2 and the p-value of the chi-squared test for joint parameter significance of the probit models under the label "pre". The second step in the propensity score matching procedures is to use the predicted probabilities from these estimations, the propensity scores, and perform single nearest-neighbour matches with replacement. Panel B presents the distribution of estimated propensity scores for the portfolio companies (treatment) and their matches, and the difference in estimated propensity scores. The R^2 and the p value of the chi-squared test for joint parameter significance of the probits estimated on the subsample of matched treatment and control observations after matching are presented in Panel A under the label "post".

APPENDIX 5-PIR Adoption Across US States

Uniform Laws Annotated
Uniform Prudent Investor Act 1994

Unif.Prudent Investor Act Refs & Annos
Currentness

Editors' Notes

TABLE OF JURISDICTIONS WHEREIN ACT HAS BEEN ADOPTED

Jurisdiction	Laws	Effective Date	Statutory Citation
Alabama.....	2006, c. 216	1-1-2007	Code 1975, §§ 19-3B-901 to 19-3B-906.
Alaska.....	1998, c. 43	5-23-1998	AS §§ 13.36.225 to 13.36.290.
Arizona.....	2008, c. 247	1-1-2009	A.R.S. §§ 14-10901 to 14-10909.
Arkansas.....	2001, Act 151	2-8-2001	A.C.A. §§ 24-2-610 to 24-2-619.
California.....	1995, c. 63	1-1-1996	West's Ann. Cal. Probate Code, §§ 16045 to 16054.
Colorado.....	1995, S.B. 95-121	7-1-1995	West's C.R.S.A. §§ 15-1.1-101 to 15-1.1-115.
Connecticut.....	1997, P.A. 97-140	6-13-1997 *	C.G.S.A. §§ 45a-541 to 45a-541*l*.
District of Columbia.....	2004, c. 15-104	3-10-2004	D.C. Official Code, 2001 Ed. §§ 19-1309.01 to 19-1309.06.
Florida.....	1993, c. 93-257	10-1-1993	West's F.S.A. §§ 518.11, 518.112.
Hawaii.....	1997, c. 26	4-14-1997	H.R.S. §§ 554C-1 to 554C-12.
Idaho.....	1997, c. 14	7-1-1997	I.C. §§ 68-501 to 68-514.

Illinois.....	1992, P.A. 87-715	1-1-1992	S.H.A. 760 ILCS 5/5, 5/5.1.
Indiana.....	1999, P.L. 137-1999	7-1-1999	West's A.I.C. §§ 30-4-3.5-1 to 30-4-3.5-13.
Iowa.....	1999, H.F. 663	7-1-2000	I.C.A. §§ 633A.4301 to 633A.4309.
Kansas.....	2000, c. 80	7-1-2000	K.S.A. 58-24a01 to 58-24a19.
Maine.....	2004, c. 618	7-1-2005	18-B M.R.S.A. §§ 901 to 908.
Massachusetts.....	1998, c. 398	12-4-1998 *	M.G.L.A. c. 203C, §§ 1 to 11.
Michigan.....	1998, P.A. 386	4-1-2000	M.C.L.A. §§ 700.1501 to 700.1512.
Minnesota.....	1996, c. 314	1-1-1997	M.S.A. § 501C.9091.
Mississippi.....	2006, c. 474	7-1-2006	Code 1972, §§ 91-9-601 to 91-9-627.
Missouri.....	2004, H.B. No. 1511	1-1-2005	V.A.M.S. §§ 469.900 to 469.913.
Montana.....	2013, ch. 264	10-1-2013	M.C.A. 72-38-901 to 72-38-906.
Nebraska.....	2003, LB 130	1-1-2005	R.R.S. 1943, §§ 30-3883 to 30-3889.
Nevada.....	2003, c. 355	10-1-2003	NRS 164.700 to 164.775.
New Hampshire.....	2004, c. 130	10-1-2004	RSA 564-B:9-901 to 564-B:9-907.

New Jersey.....	1997, c. 26	6-5-1997	N.J.S.A. 3B:20-11.1 to 3B:20-11.12.
New Mexico.....	1995, c. 210	7-1-1995	NMSA 1978, §§ 45-7-601 to 45-7-612.
New York.....	1994, c. 609	1-1-1995	McKinney's EPTL 11-2.3.
North Carolina.....	2005, c. 192	1-1-2006	G.S. §§ 36C-9-901 to 36C-9-907.
North Dakota.....	2007, c. 549	8-1-2007	NDCC 59-17-01 to 59-17-06.
Ohio.....	2006, H.B. 416	1-1-2007	R.C. §§ 5809.01 to 5809.08.
Oklahoma.....	1995, c. 351	11-1-1995	60 Okl.St.Ann. §§ 175.60 to 175.72.
Oregon.....	2005, c. 348	6-29-2005 *	ORS 130.750 to 130.775.
Pennsylvania.....	1999, c. 1999-28	6-25-1999 *	20 Pa. C.S.A. §§ 7201 to 7214.
Rhode Island.....	1996, c. 276	8-6-1996 *	Gen. Laws 1956, §§ 18-15-1 to 18-15-13.
South Carolina.....	2005, c. 66	1-1-2006	Code 1976, § 62-7-933.
Tennessee.....	2002, c. 696	7-1-2002	T.C.A. §§ 35-14-101 to 35-14-114.
Texas.....	2003, c. 1103	1-1-2004	V.T.C.A. Property Code §§ 117.001 to 117.012.
Utah.....	2004, c. 89	7-1-2004	U.C.A. 1953, 75-7-901 to 75-7-907.

Vermont.....	2009, P.A. 20	7-1-2009	14A V.S.A. §§ 901 to 908.
Virgin Islands.....	2004, No. 6678	8-12-2004 *	9 V.I.C. §§ 701 to 714.
Virginia.....	1999, c. 772	1-1-2000	Code 1950, §§ 64.2-780 to 64.2-791.
Washington.....	1995, S.S.B. 5333	7-23-1995	West's RCWA 11.100.010 to 11.100.140.
West Virginia.....	1996, S.B. 294	7-1-1996	Code, 44-6C-1 to 44-6C-15.
Wisconsin.....	2004, c. 283	4-30-2004	W.S.A. 881.01.
Wyoming.....	2003, c. 124	7-1-2003	Wyo.Stat.Ann. §§ 4-10-901 to 4-10-913.

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PREFATORY NOTE

Over the quarter century from the late 1960's the investment practices of fiduciaries experienced significant change. The Uniform Prudent Investor Act (UPIA) undertakes to update trust investment law in recognition of the alterations that have occurred in investment practice. These changes have occurred under the influence of a large and broadly accepted body of empirical and theoretical knowledge about the behavior of capital markets, often described as "modern portfolio theory."

This Act draws upon the revised standards for prudent trust investment promulgated by the American Law Institute in its Restatement (Third) of Trusts: Prudent Investor Rule (1992) [hereinafter Restatement of Trusts 3d: Prudent Investor Rule; also referred to as 1992 Restatement].

Objectives of the Act. UPIA makes five fundamental alterations in the former criteria for prudent investing. All are to be found in the Restatement of Trusts 3d: Prudent Investor Rule.

(1) The standard of prudence is applied to any investment as part of the total portfolio, rather than to individual investments. In the trust setting the term "portfolio" embraces all the trust's assets. UPIA § 2(b).

(2) The tradeoff in all investing between risk and return is identified as the fiduciary's central consideration. UPIA § 2(b).

(3) All categoric restrictions on types of investments have been abrogated; the trustee can invest in anything that plays an appropriate role in achieving the risk/return objectives of the trust and that meets the other requirements of prudent investing. UPIA § 2(e).

(4) The long familiar requirement that fiduciaries diversify their investments has been integrated into the definition of prudent investing. UPIA § 3.

(5) The much criticized former rule of trust law forbidding the trustee to delegate investment and management functions has been reversed. Delegation is now permitted, subject to safeguards. UPIA § 9.

Literature. These changes in trust investment law have been presaged in an extensive body of practical and scholarly writing. See especially the discussion and reporter's notes by Edward C. Halbach, Jr., in Restatement of Trusts 3d: Prudent Investor Rule (1992); see also Edward C. Halbach, Jr., Trust Investment Law in the Third Restatement, 27 Real Property, Probate & Trust J. 407 (1992); Bevis Longstreth, Modern Investment Management and the Prudent Man Rule (1986); Jeffrey N. Gordon, The Puzzling Persistence of the Constrained Prudent Man Rule, 62 N.Y.U.L. Rev. 52 (1987); John H. Langbein & Richard A. Posner, The Revolution in Trust Investment Law, 62 A.B.A.J. 887 (1976);

Note, The Regulation of Risky Investments, 83 Harvard L. Rev. 603 (1970). A succinct account of the main findings of modern portfolio theory, written for lawyers, is Jonathan R. Macey, An Introduction to Modern Financial Theory (1991) (American College of Trust & Estate Counsel Foundation). A leading introductory text on modern portfolio theory is R.A. Brealey, An Introduction to Risk and Return from Common Stocks (2d ed. 1983).

Legislation. Most states have legislation governing trust-investment law. This Act promotes uniformity of state law on the basis of the new consensus reflected in the Restatement of Trusts 3d: Prudent Investor Rule. Some states have already acted. California, Delaware, Georgia, Minnesota, Tennessee, and Washington revised their prudent investor legislation to emphasize the total-portfolio standard of care in advance of the 1992 Restatement. These statutes are extracted and discussed in Restatement of Trusts 3d: Prudent Investor Rule § 227, reporter's note, at 60-66 (1992).

Drafters in Illinois in 1991 worked from the April 1990 "Proposed Final Draft" of the Restatement of Trusts 3d: Prudent Investor Rule and enacted legislation that is closely modeled on the new Restatement. 760 ILCS § 5/5 (prudent investing); and § 5/5.1 (delegation) (1992). As the Comments to this Uniform Prudent Investor Act reflect, the Act draws upon the Illinois statute in several sections. Virginia revised its prudent investor act in a similar vein in 1992. Virginia Code § 26-45.1 (prudent investing) (1992). Florida revised its statute in 1993. Florida Laws, ch. 93-257, amending Florida Statutes § 518.11 (prudent investing) and creating § 518.112 (delegation). New York legislation drawing on the new Restatement and on a preliminary version of this Uniform Prudent Investor Act was enacted in 1994. N.Y. Assembly Bill 11683-B, Ch. 609 (1994), adding Estates, Powers and Trusts Law § 11-2.3 (Prudent Investor Act).

Remedies. This Act does not undertake to address issues of remedy law or the computation of damages in trust matters. Remedies are the subject of a reasonably distinct body of doctrine. See generally Restatement (Second) of Trusts §§ 197-226A (1959) [hereinafter cited as Restatement of Trusts 2d; also referred to as 1959 Restatement].

Implications for charitable and pension trusts. This Act is centrally concerned with the investment responsibilities arising under the private gratuitous trust, which is the common vehicle for conditioned wealth transfer within the family. Nevertheless, the prudent investor rule also bears on charitable and pension trusts, among others. "In making investments of trust funds the trustee of a charitable trust is under a duty similar to that of the trustee of a private trust." Restatement of Trusts 2d § 389 (1959). The Employee Retirement Income Security Act (ERISA), the federal regulatory scheme for pension trusts enacted in 1974, absorbs trust-investment law through the prudence standard of ERISA § 404(a)(1)(B), 29 U.S.C. § 1104(a). The Supreme Court has said: "ERISA's legislative history confirms that the Act's fiduciary responsibility provisions 'codif[y] and mak[e] applicable to [ERISA] fiduciaries certain principles developed in the evolution of the law of trusts.' " *Firestone Tire & Rubber Co. v. Bruch*, 489 U.S. 101, 110-11 (1989) (footnote omitted).

Other fiduciary relationships. The Uniform Prudent Investor Act regulates the investment responsibilities of trustees. Other fiduciaries--such as executors, conservators, and guardians of the property--sometimes have responsibilities over assets that are governed by the standards of prudent investment. It will often be appropriate for states to adapt the law governing investment by trustees under this Act to these other fiduciary regimes, taking account of such changed circumstances as the relatively short duration of most executorships and the intensity of court supervision of conservators and guardians in some jurisdictions. The present Act does not undertake to adjust trust-investment law to the special circumstances of the state schemes for administering decedents' estates or conducting the affairs of protected persons.

Although the Uniform Prudent Investor Act by its terms applies to trusts and not to charitable corporations, the standards of the Act can be expected to inform the investment responsibilities of directors and officers of charitable corporations. As the 1992 Restatement observes, "the duties of the members of the governing board of a charitable corporation are generally similar to the duties of the trustee of a charitable trust." Restatement of Trusts 3d: Prudent Investor Rule § 379, Comment *b*, at 190 (1992). See also id. § 389, Comment *b*, at 190-91 (absent contrary statute or other provision, prudent investor rule applies to investment of funds held for charitable corporations).

JURISDICTIONS ADOPTING UNIFORM ACT IN MANNER PRECLUDING COMPARATIVE NOTES

Not infrequently a jurisdiction will substantially adopt the major provisions of a Uniform Act and, yet, depart from the official text in such a manner that the various instances of substituted, omitted, and added matter cannot be clearly indicated by statutory notes. Where this has occurred for a particular jurisdiction, the General Statutory Notes found near the beginning of the Uniform Act will so state. In such a case, there will not be any notes for that jurisdiction under the headings "Action in Adopting Jurisdictions" and "Variations from Official Text" in the individual sections of the Uniform Act.

LAW REVIEW AND JOURNAL COMMENTARIES

A Judicial and Economic Analysis of Attorney's Fees in Trust Litigation and the Resulting Inequitable Treatment of Trust Beneficiaries. Charles Epps Ipock, 43 St. Mary's L.J. 855 (2012).

Defeating the duty to disappoint equally--the total return trust. Robert B. Wolf. 32 Real Prop. Prob. & Tr.J. 45 (1997).

ILIT Trustees: Bridge out ahead…Lock in your navigation system now. Melvini A. Warshaw. 24-July/Aug. Prob. & Prop. 32 (2010).

Is there a Uniform Trust Act in your future? David M. English. 14 Prob. & Prop. 25 (Jan.-Feb. 2000).

Promoting Trustee Adherence to the Fiduciary Duty of Impartiality: A Case for Enacting Unitrust Conversion Statutes in Conjunction with Equitable Adjustment Statutes. Kristi Arakaki. 28 U.Haw.L.Rev. 105 (Winter 2005).

Speculations on the Idea of "Speculation" in Trust Investing: An Essay. Joel C. Dobris. 39 Real Prop. Prob. & Tr.J. 439 (Fall 2004).

Footnotes

* Date of approval.

Unif. Prudent Investor Act Refs & Annos, ULA PRUDENT INV Refs & Annos