Energy demand and factor substitution in Vietnam: evidence from two recent enterprise surveys

Additional file 1

Table S1: Break-down of sources of energy and values (million VND)

Variable	Obs	Freq.	Mean	Std. Dev.	Min	Max
Total Energy Cost	149,959	100	1,933.622	3,4057.1	0.01	8,317,880
Electricity	145,211	96.83	1,153.74	30,933.8	0.01	8,317,880
Gasoline	43,040	28.70	622.9846	12,470.43	0.01	1,611,818
Coal	2,219	1.48	6,125.561	45,893.58	0.8	1,953,225
Diesel	28,066	18.72	2,449.106	20,211.21	0.04	1,276,100
LNG/LPG	9,913	6.61	1,340.248	17,477.47	0.1	988,300

Table S2: Observations by ownership type

Code	Description	Freq.	Percent	Cum.
1	SoE, centrally owned	721	0.48	0.48
2	SoE, locally owned	1,059	0.71	1.19
3	Joint stock with government owning more than 50% share	2,154	1.44	2.62
4	SoE, others	259	0.17	2.8
5	Cooperatives	9,849	6.57	9.36
6	Private firms	22,153	14.77	24.14
7	Partnership	53	0.04	24.17
8	Private firms with government owning less than 50% share	67,995	45.34	69.51
9	Joint-stock companies without government holdings	29,157	19.44	88.96
10	Joint-stock companies with government holding less than 50% share	1,721	1.15	90.11
11	100% foreign owned	12,958	8.64	98.75
12	Joint venture with foreign companies	406	0.27	99.02
13	Other types of joint venture	1,474	0.98	100
Total		149,959	100	

Table S3: Observations by industrial sector

Code	Industry	Freq.	Percent	Cum.
1	Administration	3,199	2.13	2.13
2	Agriculture	9,818	6.55	8.68
3	Communication	3,287	2.19	10.87
4	Construction	23,042	15.37	26.24
5	Education	947	0.63	26.87
6	Energy	986	0.66	27.53
7	Entertainment	199	0.13	27.66
8	Finance	1,494	1	28.66
9	Health-care	583	0.39	29.04
10	Manufacturing	36,736	24.5	53.54
11	Mining	1,872	1.25	54.79
12	Other Services	528	0.35	55.14
13	Real Estates	1,800	1.2	56.34
14	Retailing	34,794	23.2	79.55
15	Sciences	7,248	4.83	84.38
16	Self Employment and Others	479	0.32	84.7
17	Services	13,338	8.89	93.59
18	Transportation	8,696	5.8	99.39
19	Water and Sanitation	913	0.61	100
Total		149,959	100	

Table S4: Summary statistics (million VND)

Variable	Obs	Mean	Std. Dev.	Min	Max
Revenue	149,959	101,342.7	1,594,244	0.1	4.02E+08
Capital	149,959	53,668.29	1,310,580	0.2	2.63E+08
Labor Cost	149,959	7,605.653	46,965.33	0.1	5,986,876
Energy Cost	149,959	1,933.622	34,057.1	0.01	8,317,880
Material Cost	149,647	75,405.64	1,582,132	0.1	1.97E+08

Table S5: Cross-price elasticity of energy demand, by sector, estimated at sectoral means

Ownership Code	ε_{EK}	ε_{EL}	ε_{EE}	ε_{EM}
Administration	-0.5401	-14.7085	-12.5023	0.1178
Agriculture	0.0006	-1.2220	-1.5319	-0.0568
Communication	-0.0468	-3.7440	-3.6251	0.0064
Construction	-0.0824	-4.0595	-3.9212	0.0045
Education	-0.0133	-2.2223	-2.3612	-0.0182
Energy	0.0039	-0.9471	-1.3127	-0.0877
Entertainment	-0.0510	-2.9510	-3.0126	-0.0102
Finance	-0.1997	-11.1205	-9.9816	0.0570
Health-care	-0.0121	-1.6830	-1.9101	-0.0346
Manufacturing	0.0130	-1.1224	-1.4844	-0.0610
Mining	0.0007	-0.9945	-1.3674	-0.0759
Others	0.0186	-1.3544	-1.6865	-0.0456
Real Estates	-0.1557	-1.4129	-1.5586	-0.0455
Retailing	-0.0035	-1.4317	-1.7836	-0.0440
Sciences	-0.2379	-8.3620	-7.3794	0.0535
Self Employment	-0.0014	-1.0510	-1.4096	-0.0719
Services	0.0082	-0.9093	-1.2813	-0.0868
Transportation	0.0040	-1.0830	-1.4288	-0.0670
Water	0.0065	-1.1598	-1.4869	-0.0603

Table S6: Calculated Allen's elasticities of substitution (left) and price elasticities (right) at sectoral means

	K	L	E	M	K	L	E	M
				Administration				
K	-9.4067				-0.6906			
L	-0.6105	-3.7115			-0.0448	-1.7217		
E	-7.3564	-31.7062	-409.1804		-0.5401	-14.7085	-12.5023	
M	-1.4629	1.6388	3.8556	-1.7352	-0.1074	0.7602	0.1178	-0.7498
				Agriculture				
K	-19.4399				-0.4771			
L	0.8175	-1.4179			0.0201	-0.7056		
E	0.0251	-2.4557	-20.6487		0.0006	-1.2220	-1.5319	
M	-2.1851	1.3464	-0.7662	-1.9335	-0.0536	0.6700	-0.0568	-0.7805
				Communication				
K	-8.1435				-0.6974			
L	-0.1664	-2.1464			-0.0143	-0.9442		
E	-0.5467	-8.5108	-93.2837		-0.0468	-3.7440	-3.6251	
M	-1.4818	1.3758	0.1655	-1.6660	-0.1269	0.6052	0.0064	-0.7257
				Construction				
K	-13.5015				-0.6093			
L	0.2693	-2.1961			0.0122	-0.9780		
E	-1.8247	-9.1161	-103.7995		-0.0824	-4.0595	-3.9212	
M	-1.6919	1.3687	0.1185	-1.4443	-0.0764	0.6095	0.0045	-0.6814
				Education				
K	-10.2609				-0.6633			
L	-0.0241	-1.5481			-0.0016	-0.7542		
E	-0.2065	-4.5618	-49.3193		-0.0133	-2.2223	-2.3612	
M	-1.6523	1.3344	-0.3803	-1.9361	-0.1068	0.6501	-0.0182	-0.7751
				Energy				
K	-51.1328				0.2717			
L	3.5776	-1.5659			-0.0190	-0.7976		
E	-0.7247	-1.8592	-13.5674		0.0039	-0.9471	-1.3127	
M	-4.0601	1.4999	-0.9063	-2.0796	0.0216	0.7640	-0.0877	-0.8301
				Entertainment				
K	-15.9135				-0.5582			
L	0.4882	-1.8809			0.0171	-0.8698		
E	-1.4545	-6.3813	-71.9887		-0.0510	-2.9510	-3.0126	
M	-1.8341	1.3458	-0.2444	-1.5130	-0.0643	0.6224	-0.0102	-0.6969
				Finance				
K	-25.6767				-0.3675			
L	0.5802	-3.6536			0.0083	-1.5904		
E	-13.9537	-25.5467	-317.1559		-0.1997	-11.1205	-9.9816	
M	-2.0412	1.5315	1.8099	-1.2312	-0.0292	0.6666	0.0570	-0.6389
				Healthcare				
K	-15.8348				-0.5540			
L	0.4055	-1.3463			0.0142	-0.6945		
E	-0.3464	-3.2623	-33.6565		-0.0121	-1.6830	-1.9101	
M	-1.9952	1.3344	-0.6096	-2.0207	-0.0698	0.6884	-0.0346	-0.7928

Table S6: Elasticities (continued)

	K	L	E	M	K	L	E	M
				Manufacturing				
K	-16.2546				-0.5521			
L	0.7638	-1.7684			0.0259	-0.7754		
E	0.3838	-2.5597	-18.9014		0.0130	-1.1224	-1.4844	
M	-1.9083	1.3370	-0.7772	-1.5859	-0.0648	0.5862	-0.0610	-0.7121
				Mining				
K	-28.4083				-0.2788			
L	1.8727	-1.7156			0.0184	-0.7877		
E	0.0675	-2.1660	-15.2067		0.0007	-0.9945	-1.3674	
M	-2.5677	1.3860	-0.8437	-1.6719	-0.0252	0.6364	-0.0759	-0.7375
				Other Services				
K	-12.5823				-0.6256			
L	0.4014	-1.8280			0.0200	-0.7882		
E	0.3744	-3.1410	-25.5691		0.0186	-1.3544	-1.6865	
M	-1.7081	1.3264	-0.6919	-1.5504	-0.0849	0.5719	-0.0456	-0.7025
				Real Estates				
K	43.5704				-2.0960			
L	-4.6931	-0.9100			0.2258	-0.4581		
E	3.2356	-2.8064	-21.8039		-0.1557	-1.4129	-1.5586	
M	1.0524	1.0214	-0.6370	-1.2900	-0.0506	0.5142	-0.0455	-0.6104
				Retailing				
K	-23.3694				-0.4006			
L	1.5653	-2.0541			0.0268	-0.8633		
E	-0.2050	-3.4064	-28.7553		-0.0035	-1.4317	-1.7836	
M	-2.1400	1.3563	-0.7101	-1.3001	-0.0367	0.5700	-0.0440	-0.6508
				Sciences				
K	-9.4963				-0.6830			
L	-0.2535	-2.9736			-0.0182	-1.3117		
E	-3.3079	-18.9564	-225.9833		-0.2379	-8.3620	-7.3794	
M	-1.4949	1.4846	1.6392	-1.5603	-0.1075	0.6549	0.0535	-0.7089
				Self Employment				
K	-33.6533				-0.1510			
L	2.1823	-1.5904			0.0098	-0.7717		
E	-0.3010	-2.1662	-16.5913		-0.0014	-1.0510	-1.4096	
M	-2.9043	1.4045	-0.8462	-1.8017	-0.0130	0.6814	-0.0719	-0.7664
				Services				
K	-21.8633				-0.4298			
L	1.2906	-1.6968			0.0254	-0.7656		
E	0.4152	-2.0153	-12.5707		0.0082	-0.9093	-1.2813	
M	-2.2702	1.3708	-0.8515	-1.7555	-0.0446	0.6185	-0.0868	-0.7499
				Transportation				
K	-20.9019				-0.4475			
L	1.0732	-1.5706			0.0230	-0.7411		
E	0.1866	-2.2952	-17.2020		0.0040	-1.0830	-1.4288	
M	-2.2152	1.3536	-0.8068	-1.7778	-0.0474	0.6387	-0.0670	-0.7532
				Water and Sanitation				
K	-17.5673				-0.5197			
L	0.7239	-1.5041			0.0214	-0.7210		
E	0.2205	-2.4195	-19.1172		0.0065	-1.1598	-1.4869	
M	-2.0558	1.3411	-0.7758	-1.8487	-0.0608	0.6429	-0.0603	-0.7640

Table S7: Cross-price elasticity of energy demand, by firm ownership, estimated at subsample means

Ownership Code	ε_{EK}	ε_{EL}	ε_{EE}	ε_{EM}
1	-0.0033	-1.4002	-1.7385	-0.0490
2	-0.0130	-1.5887	-1.8695	-0.0403
3	-0.0025	-1.3064	-1.6351	-0.0509
4	-0.0085	-1.4916	-1.7734	-0.0426
5	-0.0016	-1.2993	-1.6101	-0.0516
6	0.0064	-1.0710	-1.4386	-0.0663
7	-0.0201	-2.7536	-2.8173	-0.0085
8	0.0048	-1.4132	-1.7413	-0.0440
9	-0.0050	-1.6072	-1.9029	-0.0372
10	-0.0009	-1.3145	-1.6529	-0.0499
11	0.0084	-1.3867	-1.6995	-0.0451
12	-0.0005	-1.0371	-1.4209	-0.0704
13	0.0035	-1.5958	-1.8826	-0.0366

Ownership codes and description are provided in Table S2.

Table S8: Cross-price elasticity of energy demand, by revenue range, estimated at subsample means

	ε_{EK}	ε_{EL}	ε_{EE}	ε_{EM}
S1	0.0030	-1.0516	-1.4302	-0.0681
S2	0.0071	-1.2085	-1.5558	-0.0554
S3	0.0081	-1.3292	-1.6594	-0.0480
S4	0.0048	-1.4826	-1.7901	-0.0410
S5	0.0020	-1.5903	-1.8818	-0.0369
S6	0.0010	-1.6112	-1.8982	-0.0363
S7	0.0011	-1.5622	-1.8570	-0.0381
S8	-0.0006	-1.5060	-1.8126	-0.0406
S9	-0.0013	-1.4198	-1.7434	-0.0445
S10	-0.0019	-1.1808	-1.5537	-0.0582

The full dataset was divided into 10 deciles, from S1 to S10, based on the revenue size, each containing roughly 10% of the total number of observations.

Table S9: Full estimation results

	Uncons. OLS (1)	Uncons. FE (2)	Uncons. RE (3)	Cons. OLS (4)	Cons. DiD (5)
LnCapital	0.2334***	0.2580***	0.2039***	0.0886***	0.2024***
LnLabor	0.8673***	0.7705***	0.5978***	0.4048***	0.4918***
LnEnergy	0.0268	0.0811***	0.0962***	0.1232***	0.0306***
LnMaterial	0.1684***	0.1588***	0.0619	0.3835***	0.2752***
LnKLnL	0.0301***	0.0176***	-0.0080*	0.0412***	-0.0027
LnKLnE	0.0016	0.0033**	0.0056***	0.0054	0.0043*
LnKLnM	-0.0298***	-0.0329***	-0.0246***	-0.0173***	-0.0437***
LnLLnE	-0.0319***	-0.0322***	-0.0271***	-0.0330***	-0.0206***
LnLLnM	-0.0432***	-0.0368***	-0.0192**	-0.0362***	-0.0305***
LnELnM	0.0237***	0.0175***	0.0097***	0.0022	0.0114***
LnK^2	-0.0109***	-0.0034***	0.0083***	-0.0147***	0.0210***
LnL^2	-0.005	0.0051	0.0132**	0.0140***	0.0269***
LnE^2	0.0083***	0.0040***	0.0006	0.0128***	0.0025*
LnM^2	0.0450***	0.0443***	0.0255***	0.0257***	0.0314***
Firm ownership type (Reference is type 1)					
2	-0.0976	-0.1165	-0.0832	-0.1998**	
3	0.1857*	0.0959	-0.0863	0.1650**	
4	0.0456	0.0713	0.2154	-0.0973	
5	0.2681*	0.1770**	-0.1791	-0.2733***	
6	0.7025***	0.6481***	-0.0311	0.1841*	
7	-0.0857	-0.0618	-0.1629	-0.4976***	
8	0.2431**	0.2014***	-0.1151	-0.1212*	
9	-0.0357	-0.0812	-0.0891	-0.2725***	
10	0.0923	0.0377	-0.0868	0.1155*	
11	0.018	-0.0313	-0.1136	-0.0860	
12	-0.0113	0.0132	0.0315	0.0913	
13	0.0966	0.0531	-0.0986	-0.0228	
Year	-0.0741**	-0.0443***	0.0135**	-0.0266	
Constant	148.9433**	89.2404***	-24.5424**	55.2025	-0.0182*
Obs	149,647	149,647	149,647	149,647	37,647
σ_u		1.0229	1.3102		
σ_e		.5131	.5131		
ρ		.7990	.8670		
R2	0.7614		0.2572		
R2-adj	0.7613		0.2571		

* p<0.1, ** p<0.05, *** p<0.01
Robust standard errors clustered by province.
Model 1-3 are unconstrained. Model 4-5 are constrained by the homothetic conditions.
Firm ownership was mostly unchanged during the two surveys, therefore not included in the estimation of model 5.

Table S10: Estimated cost shares θ with different models, estimated at sample means

	Uncons. OLS (1)	**Uncons. FE** (2)	**Uncons. RE** (3)	**Cons. OLS** (4)	**Cons. DiD** (5)
K	0.0317	0.0844	0.0615	0.0313	0.1370
L	0.5094	0.4365	0.5131	0.4453	0.4898
E	0.0957	0.0398	0.0700	0.0657	0.0399
M	0.5290	0.2302	0.5024	0.4576	0.3334