SUPPLEMENTARY TABLES

Supplementary Table 1. Univariate and multivariate Cox proportional hazards regression analysis of breast cancer (BRCA) overall survival (OS) outcomes.

Variables	Patient number	Univariate		Multivariate	
		HR (95% CI)	p value	HR (95% CI)	p value
Age (year)					
< 60	533	reference	0.0001	reference	0.000165 ***
> 60	461	1.97 (1.40 – 2.77)		1.966 (1.383 – 2.795)	
Gender					
Male	11	reference	0.956		
Female	983	0.945 (0.132 – 6.78)			
Tumor stage					
Stage I/II	740	reference	1.2e-08 ***	reference	0.000116 ***
Stage III/IV	236	2.791 (1.96 – 3.97)	0.0189 *	3.4 (1.825 – 6.34)	0.055078
Stage X	18	2.56 (1.17 – 5.6)		3.503 (0.97 – 12.61)	
T					
T1/T2	841	reference	0.0019*	reference	0.496934
T3/T4	150	1.85 (1.25 – 2.73)	0.527	0.834 (0.494 – 1.4)	0.039511 *
TX	3	0.527 (0.072 – 3.84)		0.098 (0.01 – 0.89)	
N					
N0/N1	799	reference	4.75e-05 ***	reference	0.407585
N2/N3	176	2.32 (1.547 – 3.484)	3.73e-05 ***	0.784 (0.44 – 1.39)	0.022777 *
NX	19	3.97 (2.06 – 7.65)		2.79 (1.154 – 6.76)	
M					
M0	834	reference	1.08e-09 ***	reference	0.62
M1	20	5.296 (3.09 – 9.05)	0.262	1.2 (0.5 – 2.6)	
MX	140	1.396 (0.778 – 2.5)			
PSMD1 expression					
Low	497	reference	0.064		
High	497	1.4 (0.98 – 2)			
PSMD2 expression					
Low	497	reference	0.457		
High	497	1.137 (0.81 – 1.59)			
PSMD3 expression					
Low	497	reference	0.421		
High	497	1.149 (0.81 – 1.61)			
PSMD7 expression					
Low	497	reference	0.343		
High	497	1.178 (0.84 – 1.7)			
PSMD10 expression					
Low	497	reference	0.0035 **	reference	0.001508 **
High	497	1.68 (1.188 – 2.396)		1.798 (1.251 – 2.585)	
PSMD12 expression					
Low	497	reference	0.168		
High	497	1.27 (0.9 – 1.792)			
PSMD14 expression					
Low	497	reference	0.127		
High	497	1.3 (0.93 – 1.836)			

Factors showing significant relationships with OS from a univariate analysis were then used for a multi-variate analysis. HR, hazard ratio; CI, confidence interval; * p<0.05.

Supplementary Table 2. Pathway analysis of genes co-expressed with 26S proteasome delta subunit, non-ATPase 1 (PSMD1) from public breast cancer (BRCA) databases using the MetaCore platform (with p<0.01 set as the cutoff value).

No.	Map	*p*-Value	Network objects from active data
1	Cell cycle_Role of APC in cell cycle regulation	4.58E-16	BUB1, CDC18L (CDC6), Tome-1, Geminin, Emi1, Cyclin A, Aurora-A, PLK1, Aurora-B, CDC20, Cyclin B, MAD2a, Securin, ORC1L, CKS1
2	Cell cycle_The metaphase checkpoint	1.10E-13	BUB1, SPBC25, CENP-A, Aurora-A, PLK1, Aurora-B, HEC, CDC20, HZwint-1, CENP-F, MAD2a, Survivin, CENP-E, AF15q14
3	Cell cycle_Spindle assembly and chromosome separation	6.96E-13	Importin (karyopherin)-alpha, TPX2, CSE1L, Aurora-A, KNSL1, Aurora-B, HEC, CDC20, Tubulin alpha, Cyclin B, MAD2a, Separase, Securin
4	Cell cycle_Start of DNA replication in early S phase	1.10E-11	CDC18L (CDC6), Geminin, DP1, MCM4, MCM3, Cyclin E, MCM10, ORC6L, MCM4/6/7 complex, MCM2, ORC1L, CDC45L
5	DNA damage_Intra S-phase checkpoint	8.17E-10	PCNA, CDC18L (CDC6), BLM, FANCD2, DTL (hCdt2), Histone H2AX, MCM4, MCM3, Cyclin A, Chk1, MCM7, MCM10, MCM2, Histone H3, CDC45L
6	Cell cycle_Chromosome condensation in prometaphase	1.08E-09	CAP-C, Cyclin A, CAP-G/G2, Aurora-A, Aurora-B, CAP-E, Cyclin B, TOP2, Histone H3
7	Regulation of degradation of deltaF508-CFTR in CF	3.98E-08	Csp, HSP70, RNF4, UFD1, SUMO-2, Derlin1, UCHL1, Hdj-2, SUMO-3, HSC70
8	Cigarette smoke-mediated regulation of NRF2-antioxidant pathway in airway epithelial cells	5.08E-07	PRDX1, TXNRD1, NRF2, SRX1, GCL reg, ME1, TALDO, DJ-1
9	Cell cycle_Initiation of mitosis	3.22E-06	Nucleolin, PLK1, KNSL1, Cyclin B2, FOXM1, Kinase MYT1, Histone H3
10	Cell cycle_Transition and termination of DNA replication	3.22E-06	TOP2 alpha, PCNA, Bard1, Cyclin A, MCM2, TOP2, FEN1
11	DNA damage_ATM/ATR regulation of G2/M checkpoint: cytoplasmic signaling	5.62E-06	UBE2C, JAB1, Chk1, Aurora-A, PLK1, Aurora-B, DCK, Histone H3, 14-3-3
12	Cell cycle_Role of SCF complex in cell cycle regulation	7.15E-06	Emi1, Cyclin E, Chk1, PLK1, RING-box protein 1, NEDD8, CKS1
13	Abnormalities in cell cycle in SCLC	7.15E-06	PCNA, Cyclin A, Cyclin E, Aurora-B, Histone H3, Cyclin E2, CKS1
14	Cell cycle_Role of Nek in cell cycle regulation	1.44E-05	TPX2, Aurora-A, PI3K cat class IA, HEC, Tubulin alpha, MAD2a, Histone H3
15	IGF signaling in lung cancer	1.49E-05	4E-BP1, Histone H2AX, PI3K cat class IA, SOS, RHEB2, Survivin, mTOR, GRB2
16	DNA damage_ATM/ATR regulation of G2/M checkpoint: nuclear signaling	1.78E-05	CDC18L (CDC6), Histone H2AX, Cyclin A, Chk1, PLK1, Cyclin B, Cyclin B2, TTK
17	Immune response_Antigen presentation by MHC class I, classical pathway	7.00E-05	PSMB5, HSP70, TAP1 (PSF1), IDE, Nardilysin, TAP, PSMB2, TAP2 (PSF2)
18	NRF2 regulation of oxidative stress response	7.00E-05	Thioredoxin, PRDX1, TXNRD1, NRF2, GCL reg, PI3K cat class IA, SOD1, DJ-1
19	Oxidative stress_Role of ASK1 under oxidative stress	7.00E-05	HPK38, UNRIP, Thioredoxin, PRDX1, MT-TRX, 14-3-3 zeta/delta, SOD1, 14-3-3
20	Growth factors in regulation of oligodendrocyte precursor cells survival in multiple sclerosis	9.25E-05	4E-BP1, 14-3-3 beta/alpha, CD80, PI3K cat class IA, 14-3-3 zeta/delta, Caspase-3, mTOR
21	Development_Growth hormone signaling via PI3K/AKT and MAPK cascades	9.25E-05	4E-BP1, ATF-2, Elk-4, SOS, RHEB2, mTOR, GRB2
22	DNA damage_Role of Brca1 and Brca2 in DNA repair	1.03E-04	PCNA, FANCD2, Histone H2AX, Rad51, MSH6, Bard1
23	Immune response_IFN-alpha/beta signaling via PI3K and NF-κB pathways	1.60E-04	PCNA, 4E-BP1, Cyclin A, Cyclin E, GBP1, p19, PI3K cat class IA, DHFR, RSAD2, ISG15
24	Cell cycle_Cell cycle (generic schema)	1.66E-04	E2F5, DP1, Cyclin A, Cyclin E, Cyclin B
25	Signal transduction_PTEN pathway	1.68E-04	PCNA, PI3K cat class IA, SOS, Caspase-3, RHEB2, mTOR, GRB2

Supplementary Table 3. Pathway analysis of genes co-expressed with 26S proteasome delta subunit, non-ATPase 2 (PSMD2) from public breast cancer databases using the MetaCore platform (with p<0.01 set as the cutoff value).

No.	Map	*p*-Value	Network objects from active data
1	Cell cycle_Role of APC in cell cycle regulation	5.61E-20	Nek2A, BUB1, MAD2b, CDC18L (CDC6), Tome-1, Emi1, Cyclin A, Aurora-A, PLK1, Aurora-B, CDC25A, CDC20, SKP2, Cyclin B, MAD2a, Securin, ORC1L, CDK2, CKS1
2	Cell cycle_The metaphase checkpoint	9.51E-16	Nek2A, BUB1, MAD2b, SPBC25, CENP-A, Aurora-A, PLK1, Aurora-B, HEC, CDCA1, CDC20, HZwint-1, CENP-F, MAD2a, Survivin, CENP-E, AF15q14
3	Cell cycle_Spindle assembly and chromosome separation	9.84E-14	Nek2A, Importin (karyopherin)-alpha, TPX2, CSE1L, Aurora-A, KNSL1, Aurora-B, HEC, CDC20, Tubulin alpha, Cyclin B, MAD2a, Separase, Securin, Tubulin (in microtubules)
4	Cell cycle_Cell cycle (generic schema)	8.83E-13	CDC25C, CDK4, DP1, p107, Cyclin A, Cyclin E, CDC25A, Cyclin B, E2F2, CDC25B, E2F4, CDK2
5	Cell cycle_Chromosome condensation in prometaphase	8.83E-13	CAP-H/H2, Condensin, CAP-C, Cyclin A, CNAP1, CAP-G/G2, Aurora-A, CAP-D2/D3, Aurora-B, CAP-E, Cyclin B, TOP2
6	DNA damage_Intra S-phase checkpoint	1.45E-12	TOPBP1, CDC18L (CDC6), BLM, FANCD2, DTL (hCdt2), Chk2, MCM4, MCM3, Cyclin A, Chk1, FANCI (KIAA1794), PP1-cat, CDC25A, MCM7, MCM10, PP1-cat alpha, CDC7, MCM2, CDK2, CDC45L
7	Cell cycle_Start of DNA replication in early S phase	2.63E-11	CDC18L (CDC6), DP1, MCM4, MCM3, Cyclin E, MCM10, ORC6L, MCM4/6/7 complex, CDC7, MCM2, ORC1L, CDK2, CDC45L
8	Cell cycle_Role of SCF complex in cell cycle regulation	1.2E-10	Cullin 1, CDK4, Emi1, Cyclin E, Skp2/TrCP/FBXW, Chk1, PLK1, CDC25A, SKP2, NEDD8, CDK2, CKS1
9	Reproduction_Progesterone-mediated oocyte maturation	6.99E-10	CDC25C, BUB1, MEK1(MAP2K1), Cyclin B1, Aurora-A, PLK1, c-Raf-1, GSK3 beta, Adenylate cyclase, CDC20, SOS, CDC25B, Kinase MYT1
10	Cell cycle_ESR1 regulation of G1/S transition	1.58E-09	Cullin 1, CDK4, Cyclin A2, E2F4/DP1 complex, Cyclin A, Cyclin E, Skp2/TrCP/FBXW, CDC25A, SKP2, E2F4, CDK2, CKS1
11	DNA damage_ATM/ATR regulation of G2/M checkpoint: nuclear signaling	3.6E-09	CDC25C, CDC18L (CDC6), Cyclin B1, Chk2, Cyclin A, DNMT1, Chk1, PLK1, GTSE1, Cyclin B, Cyclin B2, TTK, CDK2
12	Cell cycle_Role of Nek in cell cycle regulation	7.47E-09	Nek2A, Tubulin beta, Tubulin gamma, Cyclin B1, TPX2, Aurora-A, PI3K cat class IA, HEC, Tubulin alpha, MAD2a, Tubulin (in microtubules)
13	DNA damage_ATM/ATR regulation of G2/M checkpoint: cytoplasmic signaling	1.93E-08	CDC25C, UBE2C, Cyclin B1, Chk2, PP2A regulatory, Chk1, Aurora-A, PLK1, PP1-cat, Aurora-B, CDC25A, CDC25B, 14-3-3
14	Cell cycle_Regulation of G1/S transition (part 2)	2.39E-08	CDK4, Cyclin A2, E2F4/DP1 complex, DP1, p107, Cyclin A, Cyclin E, GSK3 beta, E2F4, CDK2
15	Abnormalities in cell cycle in SCLC	3.53E-08	CDK4, Cyclin B1, Cyclin A, Cyclin E, Aurora-B, SKP2, E2F2, Cyclin E2, CDK2, CKS1
16	Cell cycle_Initiation of mitosis	1.68E-07	CDC25C, Lamin B, Cyclin B1, PLK1, KNSL1, Cyclin B2, CDC25B, FOXM1, Kinase MYT1
17	Cell cycle_Nucleocytoplasmic transport of CDK/Cyclins	2.04E-07	CDK4, Importin (karyopherin)-alpha, Cyclin B1, Cyclin A, Cyclin E, GSK3 beta, CDK2
18	Immune response_IFN-alpha/beta signaling via PI3K and NF-κB pathways	2.07E-07	CDK4, I-κB, MEK1/2, I-TAC, p107, Cyclin A, p70 S6 kinases, Cyclin E, PI3K cat class IA, c-Raf-1, GSK3 beta, p107/E2F4, CDC25A, eIF4G1/3, E2F4, CDK2
19	Translation_Regulation of EIF2 activity	6.24E-07	GSK3 alpha/beta, Casein kinase II, beta chain (Phosvitin), MEK1/2, Casein kinase I, PP1-cat, PI3K cat class IA, c-Raf-1, SOS, PP1-cat alpha, eIF2B5
20	Regulation of degradation of deltaF508-CFTR in CF	8.12E-07	HSP90, Csp, Sti1, HSP70, Aha1, SAE1, SUMO-2, NPL4, VCP, SUMO-3
21	Cell cycle_Influence of Ras and Rho proteins on G1/S Transition	2.23E-06	CDK4, MEK1(MAP2K1), Cyclin A2, DIA1, Cyclin E, PI3K cat class IA, c-Raf-1, GSK3 beta, SKP2, LIMK2, CDK2
22	Cell cycle_Transition and termination of DNA replication	2.31E-06	TOP2 alpha, Ribonuclease H1, Cyclin A, MCM2, TOP2, POLD reg (p50), FEN1, CDK2
23	Possible regulation of HSF-1/ chaperone pathway in Huntington's disease	5.55E-06	HSP90, GSK3 alpha/beta, PLA2, HSP70, PLK1, SUMO-2, HSP90 beta
24	Cell cycle_Regulation of G1/S transition (part 1)	5.95E-06	CDK4, Chk2, PP2A regulatory, Cyclin A, Cyclin E, Skp2/TrCP/FBXW, GSK3 beta, CDC25A, CDK2
25	LRRK2 in neurons in Parkinson's disease	1.65E-05	AP-2 alpha subunits, HSP90, MEK1/2, GSK3 beta, MARK2, AP2A1, Tubulin (in microtubules), 14-3-3

Supplementary Table 4. Pathway analysis of genes co-expressed with 26S proteasome delta subunit, non-ATPase 3 (*PSMD3*) from public breast cancer databases using the MetaCore platform (with *p*<0.01 set as the cutoff value).

No.	Map	*p*-Value	Network objects from active data
1	Cell cycle_Role of APC in cell cycle regulation	3.21E-11	Nek2A, CDC18L (CDC6), CDH1, Tome-1, Aurora-A, PLK1, Aurora-B, CDC25A, Cyclin B, MAD2a, ORC1L, CDK2
2	Cell cycle_Spindle assembly and chromosome separation	4.92E-11	Nek2A, Importin (karyopherin)-alpha, TPX2, CSE1L, DCTN2, Aurora-A, Aurora-B, Tubulin alpha, Cyclin B, MAD2a, Separase, Tubulin (in microtubules)
3	Cell cycle_Role of Nek in cell cycle regulation	6.49E-10	Nek2A, Tubulin beta, Tubulin gamma, Cyclin B1, TPX2, Aurora-A, Tubulin alpha, MAD2a, Histone H1, Histone H3, Tubulin (in microtubules)
4	DNA damage_Intra S-phase checkpoint	2.89E-09	CDC18L (CDC6), CDH1, DTL (hCdt2), Chk2, MCM4, PP1-cat, CDC25A, MCM7, Brca1, PP1-cat alpha, MCM2, Histone H3, CDK2, GCN5, CDC45L
5	DNA damage_ATM/ATR regulation of G2/M checkpoint: cytoplasmic signaling	1.39E-08	UBE2C, Cyclin B1, Chk2, PP2A regulatory, Aurora-A, PLK1, PP1-cat, Aurora-B, CDC25A, Brca1, Histone H3, 14-3-3
6	Cell cycle_Transition and termination of DNA replication	2.28E-08	TOP2 alpha, Brca1, TOP1, MCM2, TOP2, POLD reg (p50), FEN1, DNA ligase I, CDK2
7	Cell cycle_Chromosome condensation in prometaphase	5.90E-08	CAP-H/H2, Aurora-A, Aurora-B, TOP1, Cyclin B, TOP2, Histone H1, Histone H3
8	Cytoskeleton remodeling_Keratin filaments	5.33E-07	Tubulin beta, Keratin 8, Tubulin gamma 1, Keratin 18, Keratin 19, Tubulin alpha, Keratin 8/18, GRB2, Tubulin (in microtubules)
9	Transcription_Negative regulation of HIF1A function	3.57E-06	HSP90, Calpain 1(mu), HSP70, RUVBL2, Casein kinase I delta, Sirtuin7, HSP90 beta, MCM7, VCP, MCM2, PSMA7
10	Cell cycle_The metaphase checkpoint	6.04E-06	Nek2A, Aurora-A, PLK1, Aurora-B, HZwint-1, MAD2a, Survivin, CENP-E
11	Regulation of degradation of deltaF508-CFTR in CF	1.14E-05	HSP90, Csp, Sti1, HSP70, Aha1, NPL4, Derlin1, VCP
12	Cell cycle_Start of DNA replication in early S phase	2.61E-05	CDC18L (CDC6), MCM4, MCM2, ORC1L, Histone H1, CDK2, CDC45L
13	LRRK2 in neurons in Parkinson's disease	3.23E-05	AP-2 alpha subunits, HSP90, MARK2, AP2A1, Tubulin (in microtubules), Beta-adaptin 2, 14-3-3
14	DNA damage_ATM/ATR regulation of G2/M checkpoint: nuclear signaling	3.44E-05	CDC18L (CDC6), Cyclin B1, CDH1, Chk2, PLK1, Brca1, Cyclin B, CDK2
15	Signal transduction_mTORC1 downstream signaling	4.58E-05	SCD, p70 S6 kinase2, MVK, p70 S6 kinases, UBF, SIN1, MAF1, ATG13, ULK1
16	Apoptosis and survival_Regulation of apoptosis by mitochondrial proteins	4.71E-05	Calpain 1(mu), PKC-delta, Metaxin 1, Smac/Diablo, RAD9A, 14-3-3 zeta/delta, PP1-cat alpha, PP2C, LETM1, RAD9, SOD1, CDK2
17	Regulation of lipid metabolism_Regulation of lipid metabolism via LXR, NF-Y and SREBP	8.45E-05	AMPK gamma subunit, SCD, FASN, LDLR, ACACA, ACLY, RARalpha
18	Translation_Regulation of EIF2 activity	8.45E-05	PKR, Casein kinase I, PP1-cat, H-Ras, PP1-cat alpha, eIF2AK1, GRB2
19	DNA damage_ATM-dependent double-strand break foci	9.86E-05	STARING, PRMT1, NPL4, Histone H2A, Brca1, VCP, BRG1, Histone H3, GCN5
20	Apoptosis and survival_Endoplasmic reticulum stress response pathway	1.72E-04	Calpain 1(mu), I-κB, TRAF2, PP1-cat, Derlin1, GRP78, PP1-cat alpha, ERP5
21	Regulation of degradation of wtCFTR	1.99E-04	HSP90, Csp, NPL4, Derlin1, VCP
22	NETosis in SLE	2.06E-04	DNase I, Histone H2, Histone H2A, PKC, Histone H1, Histone H3
23	SCAP/SREBP Transcriptional Control of Cholesterol and FA Biosynthesis	2.56E-04	ELOVL1, SCD, FASN, ERG1, MVK, ACACA, ACLY
24	Mechanisms of resistance to EGFR inhibitors in lung cancer	2.56E-04	HSP90, E-cadherin, H-Ras, Claudin-7, ErbB2, Survivin, GRB2
25	Transport_Induction of Macropinocytosis	2.96E-04	HSP90, ARF1, BAIAP2, SHIP2, H-Ras, 14-3-3 zeta/delta, PDGF-B, PKC, RhoGDI alpha

Supplementary Table 5. Pathway analysis of genes co-expressed with 26S proteasome delta subunit, non-ATPase 7 (*PSMD7*) from public breast cancer databases using the MetaCore platform (with $p<0.01$ set as the cutoff value).

No.	Map	*p*-Value	Network objects from active data
1	Cell cycle_Role of APC in cell cycle regulation	2.73E-11	BUB1, CDH1, Geminin, Emi1, Cyclin A, Aurora-A, PLK1, PKA-cat (cAMP-dependent), Cyclin B, MAD2a, Securin, CKS1
2	Cell cycle_ESR1 regulation of G1/S transition	2.64E-08	CDK4, Cyclin A2, E2F4/DP1 complex, p130, Cyclin A, ERK1/2, E2F4, ERK2 (MAPK1), CKS1, CDK6
3	Cell cycle_Regulation of G1/S transition (part 2)	4.24E-08	CDK4, Cyclin A2, E2F4/DP1 complex, p130, DP1, Cyclin A, ERK1/2, E2F4, CDK6
4	Cell cycle_Cell cycle (generic schema)	5.29E-08	CDK4, E2F5, p130, DP1, Cyclin A, Cyclin B, E2F4, CDK6
5	Cell cycle_Spindle assembly and chromosome separation	2.09E-07	Importin (karyopherin)-alpha, Aurora-A, HEC, Tubulin alpha, Cyclin B, MAD2a, Securin, Ran, Tubulin (in microtubules)
6	Cell cycle_The metaphase checkpoint	4.73E-07	BUB1, SPBC25, CENP-A, Aurora-A, PLK1, HEC, HZwint-1, MAD2a, CENP-E
7	The role of aberrations in CDKN2 locus and CDK4 in familial melanoma	6.81E-07	CDK4, E2F4/DP1 complex, E2F5, p130, DP1, E2F5/DP1 complex, E2F4, CDK6
8	Possible regulation of HSF-1/ chaperone pathway in Huntington's disease	1.08E-06	HSP90, PLA2, HSP70, HSP90 alpha, PLK1, ERK1 (MAPK3), p23 co-chaperone
9	Putative role of Estrogen receptor and Androgen receptor signaling in progression of lung cancer	4.23E-06	MEK1(MAP2K1), E-cadherin, p38 MAPK, ERK1 (MAPK3), G-protein alpha-i family, Caspase-3, ERK1/2, ERK2 (MAPK1), SRD5A1, 14-3-3
10	Signal transduction_Adenosine A3 receptor signaling pathway	6.26E-06	HIF1A, MEK1/2, p38 MAPK, G-protein alpha-i family, G-protein alpha-i3, G-protein alpha-i2, ERK1/2, PKC, G-protein alpha-q/11
11	Transport_RAN regulation pathway	6.57E-06	NTF2, NUP54, Importin (karyopherin)-alpha, RanBP1, NUP153, Ran
12	Cell cycle_Role of SCF complex in cell cycle regulation	1.19E-05	CDK4, p130, Emi1, Chk1, PLK1, NEDD8, CKS1
13	NRF2 regulation of oxidative stress response	1.71E-05	Casein kinase II, alpha chains, MEK1(MAP2K1), Thioredoxin, PRDX1, TXNRD1, GCL reg, ERK1 (MAPK3), PKC, ERK2 (MAPK1)
14	Cell cycle_Chromosome condensation in prometaphase	1.79E-05	CAP-C, Cyclin A, CAP-G/G2, Aurora-A, CAP-E, Cyclin B
15	Cell cycle_Role of Nek in cell cycle regulation	2.39E-05	Tubulin beta, Aurora-A, HEC, Tubulin alpha, MAD2a, Ran, Tubulin (in microtubules)
16	The role of KEAP1/NRF2 pathway in skin sensitization	2.39E-05	HSP70, Thioredoxin, E-cadherin, TXNRD1, ERK1 (MAPK3), ERK1/2, ERK2 (MAPK1)
17	Immune response_Antigen presentation by MHC class II	2.64E-05	HSP90, Cathepsin L, Dectin-1, HSP90 alpha, Cathepsin V, p38 MAPK, Legumain, MARCH1, ERK1/2, HSC70, PKC, MAP1LC3B, Tubulin (in microtubules)
18	Development_S1P1 receptor signaling via beta-arrestin	3.63E-05	MEK1(MAP2K1), ERK1 (MAPK3), G-protein alpha-i family, G-protein alpha-i3, G-protein alpha-i2, ERK1/2, ERK2 (MAPK1)
19	Development_Regulation of telomere length and cellular immortalization	4.43E-05	HSP90, hnRNP C, TRF2, PTOP, hRap1, Staufen, p23 co-chaperone
20	G protein-coupled receptors signaling in lung cancer	4.94E-05	PGE2R4, Galpha(i)-specific peptide GPCRs, G-protein alpha-i family, TGF-alpha, PKA-cat (cAMP-dependent), Galanin, Galpha(q)-specific peptide GPCRs, CXCR4, ERK1/2, G-protein alpha-q/11
21	HSP70 and HSP40-dependent folding in Huntington's disease	5.30E-05	HSP90, HSP70, HSP90 alpha, PSMD1, Hdj-2, HSC70
22	DNA damage_ATM/ATR regulation of G2/M checkpoint: cytoplasmic signaling	7.93E-05	p38alpha (MAPK14), Chk1, Aurora-A, PLK1, p38 MAPK, DCK, ERK2 (MAPK1), 14-3-3
23	HCV-dependent cytoplasmic signaling leading to HCC	8.45E-05	MEK1(MAP2K1), p38 MAPK, PKA-cat (cAMP-dependent), ERK1/2, PKC, ERK2 (MAPK1)
24	Non-genomic signaling of ESR2 (membrane) in lung cancer cells	1.05E-04	MEK1(MAP2K1), ERK1 (MAPK3), N-Ras, G-protein alpha-i family, TGF-alpha, PKA-cat (cAMP-dependent), ERK1/2, ERK2 (MAPK1)
25	Signal transduction_CXCR4 signaling via MAPKs cascades	1.05E-04	MEK1(MAP2K1), MEK1/2, p38 MAPK, N-Ras, G-protein alpha-i family, G-protein alpha-i2, CXCR4, ERK1/2

Supplementary Table 6. Pathway analysis of genes co-expressed with 26S proteasome delta subunit, non-ATPase 10 (*PSMD10*) from public breast cancer databases using the MetaCore platform (with $p<0.01$ set as the cutoff value).

No.	Map	p-Value	Network objects from active data
1	HSP70 and HSP40-dependent folding in Huntington's disease	9.52E-07	HSP90, Ubiquitin, HSP70, HSP90 alpha, PSMD1, Hdj-2, HSC70
2	DNA damage_Nucleotide excision repair	3.58E-06	ERCC8, ERCC6, PCNA, HMG14, Centrin-2, TFIIS, Histone H2A, E2N(UBC13), NEDD4, NEDD8
3	CFTR folding and maturation (normal and CF)	1.21E-05	HSP70, Calnexin, HSP105, HSP90 alpha, Hdj-2, p23 co-chaperone
4	Immune response_Antigen presentation by MHC class II	1.43E-05	HSP90, Cathepsin L, 14-3-3 beta/alpha, HSP90 alpha, Cathepsin V, PI3K cat class IA, JNK(MAPK8-10), p38 MAPK, LAMP2, MARCH1, HSC70, SPPL2a
5	Regulation of degradation of deltaF508-CFTR in CF	2.32E-05	HSP90, Ubiquitin, HSP70, RNF4, HSP105, Hdj-2, HSC70
6	Cell cycle_Role of SCF complex in cell cycle regulation	3.89E-05	Ubiquitin, p130, Emi1, Skp2/TrCP/FBXW, Wee1, NEDD8
7	Immune response_BAFF-induced non-canonical NF-kB signaling	4.77E-05	Ubiquitin, SUMO-1, UBE1C, Skp2/TrCP/FBXW, E2N(UBC13), NEDD8
8	Development_Positive regulation of WNT/Beta-catenin signaling in the cytoplasm	5.15E-05	PP2C alpha, GSKIP, SIAH1, HSP105, JNK(MAPK8-10), SMAD4, PP2A catalytic, RNF146, 14-3-3
9	Tricarbonic acid cycle	6.45E-05	SDHA, SUCLG1, SDHB, CISY, SUCB1, IDH3B, DLDH, SCS-A
10	Role of XBP1 protein in multiple myeloma	6.70E-05	SERP1, DnaJB9, PSMA6, GRP78, ERP5
11	Role of GIP in pathogenesis of type 2 diabetes	7.06E-05	Ubiquitin, RAP-1A, p38alpha (MAPK14), MEK1/2, JNK(MAPK8-10), p38 MAPK, PP2A catalytic
12	Possible regulation of HSF-1/ chaperone pathway in Huntington's disease	8.63E-05	HSP90, HSP70, HSP90 alpha, JNK(MAPK8-10), p23 co-chaperone
13	DNA damage_ATM/ATR regulation of G2/M checkpoint: cytoplasmic signaling	1.39E-04	JAB1, p38alpha (MAPK14), p38 MAPK, JNK2(MAPK9), DCK, PP2A catalytic, 14-3-3
14	Transcription_Negative regulation of HIF1A function	1.57E-04	HSP90, PRDX4, Ubiquitin, HSP70, FBXW7, LAMP2, Elongin C, HSC70
15	Proteolysis_Role of Parkin in the Ubiquitin-Proteasomal Pathway	1.70E-04	SIAH1, HSP70, FBXW7, UBC7, Tubulin alpha
16	G-protein signaling_G-Protein alpha-12 signaling pathway	1.90E-04	MEK1(MAP2K1), RAP-1A, 14-3-3 beta/alpha, PI3K cat class IA, JNK(MAPK8-10), p38 MAPK
17	Immune response_HSP60 and HSP70/ TLR signaling pathway	2.00E-04	Ubiquitin, HSP70, I-kB, MEK1/2, JNK(MAPK8-10), p38 MAPK, E2N(UBC13)
18	Translation_Regulation of EIF4F activity	2.00E-04	MEK1(MAP2K1), eIF4H, PI3K cat class IA, p38 MAPK, PP2A catalytic, RHEB2, eIF4E
19	Development_Glucocorticoid receptor signaling	2.09E-04	HSP90, SUMO-1, HSP70, NCOA2 (GRIP1/TIF2), p23 co-chaperone
20	G-protein signaling_Ras family GTPases in kinase cascades	2.54E-04	MEK1(MAP2K1), RAP-1A, p38alpha (MAPK14), JNK(MAPK8-10), p38 MAPK
21	Immune response_TLR5, TLR7, TLR8 and TLR9 signaling pathways	3.15E-04	Ubiquitin, I-kB, MEK1/2, PI3K cat class IA, JNK(MAPK8-10), p38 MAPK, E2N(UBC13)
22	Immune response_IL-33 signaling pathway	3.15E-04	Ubiquitin, p38alpha (MAPK14), I-kB, MEK1/2, PI3K cat class IA, Histone H2A, JNK(MAPK8-10)
23	Signal transduction_AKT signaling	3.83E-04	HSP90, PCNA, I-kB, PI3K cat class IA, PP2A catalytic, RHEB2
24	ESR1 (membrane) 36 kDa isoform signaling in breast cancer	3.83E-04	HSP90, E-cadherin, MEK1/2, PI3K cat class IA, JNK(MAPK8-10), CXCR4
25	DNA damage_p53 activation by DNA damage	3.89E-04	TTC5 (Strap), p38alpha (MAPK14), 14-3-3 theta, JNK(MAPK8-10), p38 MAPK, PP2A catalytic, 14-3-3

Supplementary Table 7. Pathway analysis of genes co-expressed with 26S proteasome delta subunit, non-ATPase 12 (*PSMD12*) from public breast cancer databases using the MetaCore platform (with $p<0.01$ set as the cutoff value).

No.	Map	*p*-Value	Network objects from active data
1	Cell cycle_Role of APC in cell cycle regulation	2.62E-23	Nek2A, BUB1, CDC18L (CDC6), CDH1, Tome-1, Geminin, Emi1, Cyclin A, Aurora-A, PLK1, Aurora-B, CDC25A, CDC20, SKP2, Cyclin B, MAD2a, Securin, ORC1L, CDK2, CKS1
2	Cell cycle_The metaphase checkpoint	3.68E-17	Nek2A, INCENP, BUB1, SPBC25, CENP-A, Aurora-A, PLK1, Aurora-B, HEC, CDCA1, CDC20, HZwint-1, CENP-F, MAD2a, Survivin, CENP-E, AF15q14
3	DNA damage_Intra S-phase checkpoint	2.96E-15	PCNA, CDC18L (CDC6), BLM, CDH1, FANCD2, DTL (hCdt2), Histone H2AX, Chk2, MCM4, MCM3, Cyclin A, Chk1, FANCI (KIAA1794), CDC25A, MCM7, MCM10, CDC7, MCM2, Histone H3, CDK2, CDC45L
4	Cell cycle_Spindle assembly and chromosome separation	5.66E-15	Nek2A, Importin (karyopherin)-alpha, TPX2, CSE1L, Aurora-A, KNSL1, Aurora-B, HEC, CDC20, Tubulin alpha, Cyclin B, MAD2a, Separase, Securin, Tubulin (in microtubules)
5	DNA damage_ATM/ATR regulation of G2/M checkpoint: nuclear signaling	1.36E-12	CDC25C, WDHD1, CDC18L (CDC6), Cyclin B1, CDH1, HSF1, Histone H2AX, Chk2, Cyclin A, Chk1, PLK1, Cyclin B, Cyclin B2, TTK, CDK2
6	Cell cycle_Start of DNA replication in early S phase	2.27E-12	CDC18L (CDC6), Geminin, MCM4, MCM3, Cyclin E, MCM10, ORC6L, MCM4/6/7 complex, CDC7, MCM2, ORC1L, CDK2, CDC45L
7	Cell cycle_Cell cycle (generic schema)	3.57E-12	CDC25C, CDK4, E2F5, p107, Cyclin A, Cyclin E, CDC25A, Cyclin B, E2F2, CDC25B, CDK2
8	Cell cycle_Chromosome condensation in prometaphase	3.57E-12	INCENP, CAP-C, Cyclin A, CNAP1, CAP-G/G2, Aurora-A, CAP-D2/D3, Aurora-B, Cyclin B, TOP2, Histone H3
9	DNA damage_ATM/ATR regulation of G2/M checkpoint: cytoplasmic signaling	1.07E-11	CDC25C, UBE2C, Cyclin B1, JAB1, BORA, Chk2, Chk1, Aurora-A, PLK1, Aurora-B, CDC25A, DCK, CDC25B, Histone H3, 14-3-3
10	Abnormalities in cell cycle in SCLC	1.25E-11	CDK4, PCNA, Cyclin B1, Cyclin A, Cyclin E, Aurora-B, SKP2, E2F2, Histone H3, Cyclin E2, CDK2, CKS1
11	Cell cycle_Role of SCF complex in cell cycle regulation	2.83E-10	CDK4, Emi1, Cyclin E, Skp2/TrCP/FBXW, Chk1, PLK1, CDC25A, SKP2, NEDD8, CDK2, CKS1
12	Cell cycle_Role of Nek in cell cycle regulation	9.73E-10	Nek2A, Tubulin beta, Tubulin gamma, Cyclin B1, TPX2, Aurora-A, HEC, Tubulin alpha, MAD2a, Histone H3, Tubulin (in microtubules)
13	Cell cycle_Initiation of mitosis	1.59E-09	CDC25C, Lamin B, Cyclin B1, PLK1, KNSL1, Cyclin B2, CDC25B, FOXM1, Kinase MYT1, Histone H3
14	Cell cycle_ESR1 regulation of G1/S transition	2.91E-09	CDK4, Cyclin A2, NCOA3 (pCIP/SRC3), Cyclin A, Cyclin E, Skp2/TrCP/FBXW, CDC25A, SKP2, CRM1, CDK2, CKS1
15	Cell cycle_Nucleocytoplasmic transport of CDK/Cyclins	5.40E-08	CDK4, Importin (karyopherin)-alpha, Cyclin B1, Cyclin A, Cyclin E, CRM1, CDK2
16	DNA damage_ATM/ATR regulation of G1/S checkpoint	4.62E-07	CDK4, PCNA, Histone H2AX, Chk2, Cyclin A, Cyclin E, Chk1, CDC25A, CDK2, RFWD3
17	Mitogenic action of Estradiol / ESR1 (nuclear) in breast cancer	1.01E-06	CDK4, NCOA3 (pCIP/SRC3), WIP1, Cyclin E, SGOL2, CDC25A, Cyclin E2, CDK2
18	Possible regulation of HSF-1/ chaperone pathway in Huntington's disease	1.53E-06	HSP90, PLA2, HSP70, HSF1, HSP90 alpha, PLK1, p23 co-chaperone
19	Cell cycle_Role of 14-3-3 proteins in cell cycle regulation	2.18E-06	CDC25C, Chk2, 14-3-3 theta, Chk1, CDC25A, 14-3-3 zeta/delta, CDC25B
20	Cell cycle_Sister chromatid cohesion	3.06E-06	PCNA, Rad21, Cyclin B, DCC1, Separase, Securin, Histone H3
21	DNA damage_Nucleotide excision repair	5.95E-06	ERCC6, PCNA, DTL (hCdt2), EZH2, UFD1, Histone H2A, DNA polymerase kappa, Histone H2B, NEDD8, Histone H4, Histone H3
22	Cell cycle_Transition and termination of DNA replication	7.60E-06	TOP2 alpha, PCNA, Cyclin A, MCM2, TOP2, FEN1, CDK2
23	Regulation of degradation of deltaF508-CFTR in CF	1.50E-05	HSP90, Csp, Sti1, HSP70, SAE1, HSP105, UFD1, Derlin1
24	Reproduction_Progesterone-mediated oocyte maturation	1.83E-05	CDC25C, BUB1, Cyclin B1, Aurora-A, PLK1, CDC20, CDC25B, Kinase MYT1
25	Immune response_IFN-alpha/beta signaling via PI3K and NF-kB pathways	2.03E-05	CDK4, PCNA, 4E-BP1, p107, Cyclin A, Cyclin E, p19, DHFR, CDC25A, eIF4E, CDK2, ISG15

Supplementary Table 8. Pathway analysis of genes co-expressed with 26S proteasome delta subunit, non-ATPase 14 (PSMD14) from public breast cancer databases using the MetaCore platform (with p<0.01 set as the cutoff value).

No.	Map	*p*-Value	Network objects from active data
1	Cell cycle_The metaphase checkpoint	4.46E-14	Nek2A, BUB1, SPBC25, CENP-A, Aurora-A, PLK1, Aurora-B, HEC, CDCA1, HZwint-1, MAD2a, Survivin, CENP-H, CENP-E, AF15q14
2	Cell cycle_Role of APC in cell cycle regulation	3.39E-12	Nek2A, BUB1, Tome-1, Geminin, Emi1, Cyclin A, Aurora-A, PLK1, Aurora-B, Cyclin B, MAD2a, Securin, CKS1
3	Cell cycle_Spindle assembly and chromosome separation	5.44E-12	Nek2A, Importin (karyopherin)-alpha, TPX2, CSE1L, Aurora-A, KNSL1, Aurora-B, HEC, Tubulin alpha, Cyclin B, MAD2a, Securin, Tubulin (in microtubules)
4	DNA damage_ATM/ATR regulation of G2/M checkpoint: cytoplasmic signaling	1.68E-11	UBE2C, Cyclin B1, JAB1, 14-3-3 gamma, BORA, Chk2, Chk1, Aurora-A, PLK1, PP1-cat, Aurora-B, DCK, Nucleolysin TIAR, Histone H3, 14-3-3
5	Cell cycle_Role of Nek in cell cycle regulation	2.23E-08	Nek2A, Tubulin beta, Cyclin B1, TPX2, Aurora-A, HEC, Tubulin alpha, MAD2a, Histone H3, Tubulin (in microtubules)
6	DNA damage_Intra S-phase checkpoint	5.98E-08	PCNA, DTL (hCdt2), Chk2, PP1-cat gamma, Cyclin A, RIF1, Claspin, Chk1, FANCI (KIAA1794), PP1-cat, MCM10, CDC7, Histone H3, CDC45L
7	Cell cycle_Chromosome condensation in prometaphase	1.01E-07	Cyclin A, CAP-G/G2, Aurora-A, Aurora-B, CAP-E, Cyclin B, TOP2, Histone H3
8	DNA damage_G2 checkpoint in response to DNA mismatches	1.71E-07	PCNA, MutSalpha complex, Chk2, MSH6, PMS1, Claspin, Chk1, EXO1, MSH2
9	DNA damage_ATM/ATR regulation of G2/M checkpoint: nuclear signaling	7.73E-07	Cyclin B1, Chk2, Ku70, Cyclin A, Claspin, Chk1, PLK1, Cyclin B, Cyclin B2, TTK
10	Regulation of degradation of deltaF508-CFTR in CF	1.98E-06	Csp, HSP70, Aha1, HSP105, SUMO-2, Derlin1, UCHL1, Hdj-2, HSC70
11	Cell cycle_Sister chromatid cohesion	3.77E-06	PCNA, Rad21, Cyclin B, DCC1, RFC3, Securin, Histone H3
12	Oxidative stress_Role of ASK1 under oxidative stress	4.54E-06	HPK38, SOD2, UNRIP, 14-3-3 gamma, Thioredoxin, PRDX1, MT-TRX, Glutaredoxin, SOD1, 14-3-3
13	Cell cycle_Initiation of mitosis	9.36E-06	Cyclin B1, Nucleolin, PLK1, KNSL1, Cyclin B2, FOXM1, Histone H3
14	Transport_RAN regulation pathway	1.06E-05	NUP54, SUMO-1, Importin (karyopherin)-alpha, NUP58, RanBP1, CRM1
15	Abnormalities in cell cycle in SCLC	2.05E-05	PCNA, Cyclin B1, Cyclin A, Aurora-B, Histone H3, Cyclin E2, CKS1
16	Possible regulation of HSF-1/ chaperone pathway in Huntington's disease	2.87E-05	PLA2, HSP70, PLK1, SUMO-2, Calmodulin, p23 co-chaperone
17	Microsatellite instability in gastric cancer	3.85E-05	PCNA, MutSalpha complex, MSH6, PMS1, EXO1, MSH2
18	CFTR folding and maturation (normal and CF)	6.59E-05	Csp, HSP70, Aha1, HSP105, Hdj-2, p23 co-chaperone
19	Release of pro-inflammatory mediators and elastolytic enzymes by alveolar macrophages in COPD	1.66E-04	MMP-12, Cathepsin L, MMP-1, IL-8, IP10, HDAC2
20	Reproduction_Progesterone-mediated oocyte maturation	1.83E-04	BUB1, MEK1(MAP2K1), Cyclin B1, Aurora-A, PLK1, PKA-reg (cAMP-dependent), G-protein alpha-i family
21	Cell cycle_Role of SCF complex in cell cycle regulation	2.04E-04	Emi1, Chk1, PLK1, RING-box protein 1, NEDD8, CKS1
22	Apoptosis and survival_Granzyme A signaling	2.49E-04	Ku70/80, NDPK A, Ku80, HMGB2, Ku70, Histone H3
23	DNA damage_Mismatch repair	3.61E-04	PCNA, MutSalpha complex, MSH6, EXO1, MSH2, Histone H3
24	Signal transduction_MIF signaling pathway	5.04E-04	MEK1/2, PRDX1, SFK, IL-8, GCL reg, G-protein alpha-i family, CXCR4, SPPL2a
25	Microsatellite instability in colorectal cancer	5.09E-04	PCNA, MutSalpha complex, Beta-2-microglobulin, MSH6, EXO1, MSH2