Table S1. Rank correlation between trait importance (*TI*) and mean net effect size (|*ES*|) or phenotypic variation (*CV*) of the wild-type when only positive effects or negative effects are considered.

Effects considered	Variables correlated	Variables controlled	Spearman's ρ	*p*-value
positive	*TI*, *CV*		-0.712	<1e-300
positive	*TI*, mean net |*ES*|		-0.604	<1e-300
positive	*TI*, *CV*	mean net |*ES*|	-0.610	7.1e-22
positive	*TI*, mean net |*ES*|	*CV*	-0.434	1.2e-10
negative	*TI*, *CV*		-0.569	<1e-300
negative	*TI*, mean net |*ES*|		-0.485	<1e-300
negative	*TI*, *CV*	mean net |*ES*|	-0.392	7.9e-09
negative	*TI*, mean net |*ES*|	*CV*	-0.209	2.9e-03

Table S2. Spearman's rank correlation between the importance of a gene expression trait to fitness and the mean effect size of gene deletion ($|ES_G|$) or environmental perturbation ($|ES_E|$) after expression levels are controlled.

Variables correlated	Variables controlled	Spearman's ρ	p-value
Fitness effect[1], $|ES_E|$	Expression level[3]	-0.196	2.2e-16
Fitness effect[1], $|ES_G|$	Expression level[3]	-0.185	2.6e-25
Fitness effect[1], $|ES_E|$	Expression level[3] and $|ES_G|$	-0.145	3.5e-16
Fitness effect[1], $|ES_G|$	Expression level[3] and $|ES_E|$	-0.129	4.5e-13
Essentiality[2], $|ES_E|$	Expression level[3]	-0.117	5.7e-11
Essentiality[2], $|ES_G|$	Expression level[3]	-0.127	1.3e-12
Essentiality[2], $|ES_E|$	Expression level[3] and $|ES_G|$	-0.080	7.7e-06
Essentiality[2], $|ES_G|$	Expression level[3] and $|ES_E|$	-0.094	1.6e-07

[1] Fitness defect caused by deleting the gene.
[2] Essentiality = 0 for nonessential traits and 1 for essential traits.
[3] Expression level of the gene in the wild-type.

Table S3. Spearman's rank correlation between the importance of a gene expression trait to fitness and the mean effect size of gene deletion ($|ES_G|$) or environmental perturbation ($|ES_E|$) when $|ES_E|$ are measured in all environmental changes.

Variables correlated	Variables controlled	Spearman's ρ	p-value
Fitness effect[1], $|ES_E|$		-0.191	6.6e-27
Fitness effect[1], $|ES_G|$		-0.180	3.7e-24
Fitness effect[1], $|ES_E|$	$|ES_G|$	-0.138	9.4e-15
Fitness effect[1], $|ES_G|$	$|ES_E|$	-0.123	5.5e-12
Essentiality[2], $|ES_E|$		-0.117	6.4e-11
Essentiality[2], $|ES_G|$		-0.125	2.2e-12
Essentiality[2], $|ES_E|$	$|ES_G|$	-0.078	1.3e-05
Essentiality[2], $|ES_G|$	$|ES_E|$	-0.091	4.1e-07
Fitness effect[1], $|ES_E|$	Expression level[3]	-0.234	5.8e-40
Fitness effect[1], $|ES_G|$	Expression level[3]	-0.185	2.6e-25
Fitness effect[1], $|ES_E|$	Expression level[3] and $|ES_G|$	-0.183	7.8e-25
Fitness effect[1], $|ES_G|$	Expression level[3] and $|ES_E|$	-0.111	4.5e-10
Essentiality[2], $|ES_E|$	Expression level[3]	-0.141	2.4e-15
Essentiality[2], $|ES_G|$	Expression level[3]	-0.127	1.3e-12
Essentiality[2], $|ES_E|$	Expression level[3] and $|ES_G|$	-0.104	6.9e-09
Essentiality[2], $|ES_G|$	Expression level[3] and $|ES_E|$	-0.083	4.0e-06

[1] Fitness defect caused by deleting the gene.
[2] Essentiality = 0 for nonessential traits and 1 for essential traits.
[3] Expression level of the gene in the wild-type.

Table S4. Spearman's rank correlation between the importance of a gene expression trait to fitness and the mean effect size of gene deletion ($|ES_G|$) or environmental perturbation ($|ES_E|$) after the removal of highly correlated expressional traits.

Variables correlated	Variables controlled	Spearman's ρ	p-value
Fitness effect[1], $|ES_E|$		-0.156	6.2e-10
Fitness effect[1], $|ES_G|$		-0.181	5.1e-13
Fitness effect[1], $|ES_E|$	$|ES_G|$	-0.099	8.9e-05
Fitness effect[1], $|ES_G|$	$|ES_E|$	-0.136	6.3e-08
Essentiality[2], $|ES_E|$		-0.104	4.0e-05
Essentiality[2], $|ES_G|$		-0.131	2.1e-07
Essentiality[2], $|ES_E|$	$|ES_G|$	-0.062	1.5e-02
Essentiality[2], $|ES_G|$	$|ES_E|$	-0.101	6.5e-05
Fitness effect[1], $|ES_E|$	Expression level[3]	-0.196	4.7e-15
Fitness effect[1], $|ES_G|$	Expression level[3]	-0.185	1.7e-13
Fitness effect[1], $|ES_E|$	Expression level[3] and $|ES_G|$	-0.141	2.1e-08
Fitness effect[1], $|ES_G|$	Expression level[3] and $|ES_E|$	-0.124	8.2e-07
Essentiality[2], $|ES_E|$	Expression level[3]	-0.126	5.3e-07
Essentiality[2], $|ES_G|$	Expression level[3]	-0.132	1.7e-07
Essentiality[2], $|ES_E|$	Expression level[3] and $|ES_G|$	-0.085	7.7e-04
Essentiality[2], $|ES_G|$	Expression level[3] and $|ES_E|$	-0.093	2.3e-04

[1] Fitness defect caused by deleting the gene.
[2] Essentiality = 0 for nonessential traits and 1 for essential traits.
[3] Expression level of the gene in the wild-type.

Table S5. Spearman's rank correlation between the importance of a gene expression trait to fitness and the mean effect size of gene deletion ($|ES_G|$) or environmental perturbation ($|ES_E|$) for genes with and without a canonical TATA box in the promoter, respectively.

Variables correlated	Variables controlled	TATA (n=563) Spearman's ρ	p-value	Non-TATA (n=2726) Spearman's ρ	p-value
Fitness effect[1], $|ES_E|$		-0.185	2.4E-04	-0.178	6.7E-21
Fitness effect[1], $|ES_G|$		-0.267	8.5E-08	-0.155	4.0E-16
Fitness effect[1], $|ES_E|$	$|ES_G|$	-0.062	2.2E-01	-0.139	3.4E-13
Fitness effect[1], $|ES_G|$	$|ES_E|$	-0.206	4.4E-05	-0.107	2.3E-08
Essentiality[2], $|ES_E|$		-0.168	8.4E-04	-0.105	3.7E-08
Essentiality[2], $|ES_G|$		-0.201	6.2E-05	-0.109	1.3E-08
Essentiality[2], $|ES_E|$	$|ES_G|$	-0.081	1.1E-01	-0.076	7.4E-05
Essentiality[2], $|ES_G|$	$|ES_E|$	-0.138	6.6E-03	-0.080	2.6E-05
Fitness effect[1], $|ES_E|$	Expression level[3]	-0.232	3.6E-06	-0.214	1.2E-29
Fitness effect[1], $|ES_G|$	Expression level[3]	-0.294	3.4E-09	-0.147	1.5E-14
Fitness effect[1], $|ES_E|$	Expression level[3] and $|ES_G|$	-0.112	2.8E-02	-0.179	5.6E-21
Fitness effect[1], $|ES_G|$	Expression level[3] and $|ES_E|$	-0.215	1.9E-05	-0.085	9.3E-06
Essentiality[2], $|ES_E|$	Expression level[3]	-0.205	4.6E-05	-0.124	7.9E-11
Essentiality[2], $|ES_G|$	Expression level[3]	-0.221	1.1E-05	-0.102	9.0E-08
Essentiality[2], $|ES_E|$	Expression level[3] and $|ES_G|$	-0.118	2.0E-02	-0.097	3.8E-07
Essentiality[2], $|ES_G|$	Expression level[3] and $|ES_E|$	-0.144	4.5E-03	-0.067	4.9E-04

[1] Fitness defect caused by deleting the gene.
[2] Essentiality = 0 for nonessential traits and 1 for essential traits.
[3] Expression level of the gene in the wild-type.