### Supplementary Table 1. Antibodies used in western blotting and IHC.

| Primary antibodies | Dilution in WB | Source species | Company  | Catalog No. |
|--------------------|----------------|---------------|----------|-------------|
| PSMC2              | 1:1000         | Mouse         | Santa Cruz | SC-166972   |
| GAPDH              | 1:3000         | Rabbit        | Bioworld  | AP0063      |
| E-cadherin         | 1:1000         | Rabbit        | CST       | 3195        |
| N-cadherin         | 1:1000         | Rabbit        | abcam     | ab18203     |
| Vimentin           | 1:1000         | Rabbit        | abcam     | ab92547     |
| CCND1              | 1:2000         | Rabbit        | CST       | 2978        |
| CDK1               | 1:2000         | Rabbit        | abcam     | ab133327    |
| E2F1               | 1:1500         | Rabbit        | abcam     | ab179445    |
| HDAC2              | 1:1000         | Rabbit        | abcam     | ab322117    |
| Cyclin B1          | 1:3000         | Rabbit        | abcam     | ab32053     |

| Primary antibodies | Dilution in IHC | Source species | Company  | Catalog No. |
|--------------------|-----------------|---------------|----------|-------------|
| PSMC2              | 1:50            | Mouse         | Santa Cruz | SC-166972   |
| Ki67               | 1:200           | Rabbit        | abcam     | ab16667     |
| CDK1               | 1:100           | Rabbit        | abcam     | ab133327    |

| Secondary antibody | Dilution | Company  | Catalog No. |
|--------------------|----------|----------|-------------|
| HRP Goat Anti-Rabbit IgG (WB) | 1:3000 | Beyotime | A0208       |
| HRP Goat Anti-Mouse IgG (WB) | 1:3000 | Beyotime | A0216       |
| HRP Goat Anti-Mouse IgG (IHC) | 1:2000 | abcam    | ab205719    |
| HRP Goat Anti-Rabbit IgG (IHC) | 1:400  | abcam    | Ab6721      |

### Supplementary Table 2. The target sequences and shRNA sequences.

| Gene     | No.  | Target sequence (5'-3') | shRNA sequences (5'-3') |
|----------|------|-------------------------|-------------------------|
| PSMC2    | Human-PSMC2-1 | GCCAGGGAGATTGG             | cggGCCAGGGAGATTGGATAGAAAttcgaaga |
|          |       | ATAGAAA                  | TTTCTATCCAAATCTCCCTGGCttttg |
|          |       |                         | aattcaaaaGCCAGGGAGATTGGATAGAAAttcgaaga |
| CDK1     | Human-CDK1-1 | TTCCATGGATCTGAA          | CggTTCCATGGATCTGAAGAAATActcgagTATTTCTTCGAG |
|          |       | GAAATA                   | TCCATGGAATTTTTtg         |
|          |       |                         | aattcaaaaTTCCATGGATCTGAAGAAATActcgagTATTTCTTCGAGATCCATGGAA |
| CDK1     | Human-CDK1-2 | AGACTAGAAAGTGAGAGAGGAA   | CggAGACTAGAAAGTGGAAGAGGAActcgagTTTCTTCTCCTCATTTCAGAGAGGAAActcgagTTTCTTCTCCTCTTTTAGAGAGGAAActcgagTTTCTTCTCCTTTG |
|          |       | AGAGGAA                  | aattcaaaaaaaaAGACTAGAAAGTGGAAGAGGAActcgagTTTCTTCTCCTCCTCTTTCAGAGAGGAAActcgagTTTCTTCTCCTTTTG |
|          |       |                         | aattcaaaaaaaaAGACTAGAAAGTGGAAGAGGAActcgagTTTCTTCTCCTCCTCTTTCAGAGAGGAAActcgagTTTCTTCTCCTTTG |
| CDK1     | Human-CDK1-3 | ATGGAGTTGGTTGATA         | CggATGGAGTTGGTTGATATAAGGGGATACCTTATACCAACTCCATTTTTTG |
|          |       | AGGGTA                   | aattcaaaaaaaaATGGAGTTGGTTGATATAAGGGGATACCTTATACCAACTCCATTTTTTG |
|          |       |                         | aattcaaaaaaaaATGGAGTTGGTTGATATAAGGGGATACCTTATACCAACTCCATTTTTTG |

www.aging-us.com
### Supplementary Table 3. Primers used in qPCR.

| Gene     | Forward primer sequence (5'-3')          | Reverse primer sequence (5'-3')          |
|----------|-----------------------------------------|------------------------------------------|
| GAPDH    | TGACTTCAACACGCAACCA                      | CACCCGTGTGCTGTAGCCAAA                    |
| PSMC2    | CACGCACTCTGGATTTGCT                     | TTTCATCCACGCCACTCTC                     |
| HDAC2    | TCTATTGAGCATAGCAACAAG                   | GCCACATTCTCAGCATCCTC                    |
| ALDH1A1  | CAGGTGGGCACATTGCCTAT                    | TGGGTAGAGGAGTTGGAAT                     |
| HDAC9    | GCTGTTGAGTTCCTCTACAT                    | AAGGTGCACTGAGGGGTTCG                    |
| ALDH1A1  | GTGACACCAGCAAGCAAACT                    | TTGACTACTCAAGAGGAAAC                   |
| MAP3K5   | GTGGGAGCTGAGCAACCA                      | TCCGAGAAGGCAGACTACTCT                   |
| ALDH1A3  | GTTTAACAGAGCTGCGCTCC                    | GGTGAGAAGACACTCCCTGAG                   |
| MCM7     | ATCAGGCTGTGGATGAAAGG                    | CGCAGAAGTCGCTGCAG                       |
| BIRC5    | TCTCAAGGACCCACAGCATCT                   | TTTCATGAGGTGTCATC                      |
| NFIB     | CTTATCCAATACCGCGACA                     | GACTAGATCCAGACGCGAG                    |
| BRCA1    | TGGCAACATACCATCTCTCAAC                  | TTGTCAATTCTGGCTTCTCC                   |
| CCNA2    | AGCTCTCGATTCACGATTCA                    | GGCTCATTCTCAGGCTTATT                   |
| CCNB2    | AAGTTCCAGCTAGCAACCA                     | GCAGAGCAAGGCATGAG                      |
| SMC1A    | TCTTGCCCTGTGACTAATG                     | TGGCTCACTAGCAATGACAT                   |
| CCND1    | AGCTGTGACATCTACAGCCAC                   | GAAATCTGAGGGGATTTG                     |
| STAT3    | GATTGACACCGACATGACGT                   | GCACTGTAGAAGAGGGGATGT                 |
| CDC25A   | TGGAAGTACAAAGAGGAAGAGAGGAGGAAGAG       | GCCAGAAATACAGAATGATGAAAG              |
| UBE2C    | AAGTTCCAGCTAGCAACCA                     | TGGCTGATGAGCTTCTGAG                   |
| CCNB1    | AAACCTTTGCTGCGTGTGAGG                   | TGCTGCAATTGAGAAGGAGG                  |
| E2F1     | CACTTTGGGCTTTCCTGTCT                    | GTGCTCATTCCGCTATAC                    |
| FOS      | CAGACTACGAGGCGTCATCC                    | TCTGCGGAGTGAGTAGTA                    |

### Supplementary Table 4. Relationship between PSMC2 expression and tumor characteristics in patients with cholangiocarcinoma analyzed by spearman rank correlation analysis.

| Tumor characteristics | Index       |
|-----------------------|-------------|
| Grade                 | Pearson correlation 0.624 |
|                       | Significance (two tailed) <0.001 |
|                       | n 70         |