The initial control polygon is $b_0, \ldots, b_m$, we want to find a new set of points $b'_0, \ldots, b'_{m+1}$ so that they describe the same Bezier curve.

To do that, let's express $B_i^m(t)$ via B_i^{m+1}:

$$B_i^m(t) = (1-t)B_i^m(t) + tB_i^m(t) = \frac{m+1-i}{m+1}B_i^{m+1}(t) + \frac{i+1}{m+1}B_{i+1}^{m+1}(t). \quad (1)$$

Then we can rewrite the equation of our curve using the Bernstein polynomials of higher order:

$$F(t) = \sum_{i=0}^{m} B_i^m(t) \cdot \mathbf{b_i} = \sum_{i=0}^{m} \frac{m+1-i}{m+1}B_i^{m+1}(t) \cdot \mathbf{b_i} + \sum_{i=0}^{m} \frac{i+1}{m+1}B_{i+1}^{m+1}(t) \cdot \mathbf{b_i} = \quad (2)$$

$$= \sum_{i=0}^{m+1} (\frac{i}{m+1}\mathbf{b_{i-1}} + (1 - \frac{i}{m+1})\mathbf{b_i})B_i^{m+1}(t) = \sum_{i=0}^{m+1} \mathbf{b'_i}B_i^{m+1}(t) \quad (3)$$

Thus we have found an expression of the same curve via $m+1$ control points, so we have elevated the degree.