Equation $(**)$ and then replace the occurrence of A^j in $-\theta A^j$ by the right hand side of Equation $(*)$ to obtain

$$\begin{aligned} b &= \sum_{k\in K} u_k A^k - \theta A^j + \theta A^j \\ &= \sum_{k\in K} u_k A^k - \theta\biggl(\sum_{k\in K} \gamma^j_k A^k\biggr) + \theta A^j \\ &= \sum_{k\in K}\Bigl(u_k - \theta\gamma^j_k\Bigr)A^k + \theta A^j. \end{aligned}$$

Consequently, the vector $u(\theta)$ appearing on the right-hand side of the above equation given by

$$u(\theta)_i = \begin{cases} u_i - \theta\gamma^j_i & \text{if } i \in K \\ \theta & \text{if } i = j \\ 0 & \text{if } i \notin K \cup \{j\} \end{cases}$$

automatically satisfies the constraints $Au(\theta) = b$, and this vector is a feasible solution iff

$$\theta \geq 0 \quad \text{and} \quad u_k \geq \theta\gamma^j_k \quad \text{for all } k \in K.$$

Obviously $\theta = 0$ is a solution, and if

$$\theta^j = \min\biggl\{\frac{u_k}{\gamma^j_k} \;\bigg|\; \gamma^j_k > 0,\; k \in K\biggr\} > 0,$$

then we have a range of feasible solutions for $0 \leq \theta \leq \theta^j$. The value of the objective function for $u(\theta)$ is

$$cu(\theta) = \sum_{k\in K} c_k(u_k - \theta\gamma^j_k) + \theta c_j = cu + \theta\biggl(c_j - \sum_{k\in K}\gamma^j_k c_k\biggr).$$

Since the potential change in the objective function is

$$\theta\biggl(c_j - \sum_{k\in K}\gamma^j_k c_k\biggr)$$

and $\theta \geq 0$, if $c_j - \sum_{k\in K}\gamma^j_k c_k \leq 0$, then the objective function can't be increased.

However, if $c_{j^+} - \sum_{k\in K}\gamma^{j^+}_k c_k > 0$ for some $j^+ \notin K$, and if $\theta^{j^+} > 0$, then the objective function can be strictly increased by choosing any $\theta > 0$ such that $\theta \leq \theta^{j^+}$, so it is natural to zero at least one coefficient of $u(\theta)$ by picking $\theta = \theta^{j^+}$, which also maximizes the increase of the objective function. In this case (Case below (B2)), we obtain a new feasible solution $u^+ = u(\theta^{j^+})$.

Now, if $\theta^{j^+} > 0$, then there is some index $k \in K$ such $u_k > 0$, $\gamma^{j^+}_k > 0$, and $\theta^{j^+} = u_k/\gamma^{j^+}_k$, so we can pick such an index k^- for the vector A^{k^-} leaving the basis K. We claim that