PROOF. $p_i(t)$ is the ith coordinate of $\pi \cdot P^{(t)}$, so equals $\sum_{j=1}^{n} p_{j,i}^{(t)} \pi_j$. Recalling that $\sum_{j=1}^{n} \pi_j = 1$, we have

$$\begin{aligned}
|p_i(t) - p_i^*| &= \left| \sum_{j=1}^{n} p_{j,i}^{(t)} \pi_j - p_i^* \right| \\
&= \left| \sum_{j=1}^{n} p_{j,i}^{(t)} \pi_j - \sum_{j=1}^{n} \pi_j p_i^* \right| \\
&= \left| \sum_{j=1}^{n} \pi_j (p_{j,i}^{(t)} - p_i^*) \right| \\
&\leq \sum_{j=1}^{n} \pi_j (M_0 - m_0)(1 - 2\epsilon)^t \\
&\leq (M_0 - m_0)(1 - 2\epsilon)^t.
\end{aligned}$$