Proof. Denote $S_x = \{(t, t + x) \mid t \in M_x\}$ for a given x and

$$S = \bigcup_x S_x = \bigcup_x \{(t, t + x) \mid t \in M_x\} .$$

Since $(t, x) \in S$ if and only if $t \in M_{x-t}$ and M_r, $0 \leqq r \leqq 1$ are disjoint sets, it is evident that to a given t there is at most one x such that $(t, x) \in S$.

Denote by $P : R^2 \to R$ the projection $P(t, x) = x$. Since $P(S_x) = M_x + x$ and the sets $M_r + r$ are disjoint, we conclude again that to a given x there is at most one t such that $(t, x) \in S$.

Finally, $\{t \mid (t, t + x) \in S\} = \{t \mid t \in M_x\}$ for a given x, $0 \leqq x \leqq 1$. Hence $m^*\{t \mid (t, t + x) \in S\} = m^*(M_x) = 1$ and $m_*\{t \mid (t, t + x) \in S\} = m_*(M_x) = 0$.

Let $F(t, x)$ be defined by

$$F(t, x) = \{0\} \quad \text{for} \quad (t, x) \notin S ,$$
$$F(t, x) = [0, 1] \quad \text{for} \quad (t, x) \in S .$$

Then (4.6) to (4.8) imply (0.13) to (0.15).

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