Table 1: Results of PRUC with different base models on XMRec with cluster number $K = 1$. The best results are marked with **bold face**.

Data	Method	Recall@20	F1@20	MAP@20	NDCG@20	Precision@20
France, Italy, India →Japan, Mexico	CDL (Base Model)	0.0143	0.0016	0.0028	0.0009	0.0009
	PRUC w/o Causality	0.1149	0.0138	0.0335	0.0093	0.0073
	PRUC (Full)	**0.1193**	**0.0143**	**0.0369**	**0.0101**	**0.0076**
	DLRM (Base Model)	0.0044	0.0004	0.0004	0.0002	0.0002
	PRUC w/o Causality	0.0165	0.0020	0.0019	0.0009	0.0010
	PRUC (Full)	**0.0178**	**0.0021**	**0.0020**	**0.0010**	**0.0011**
	PerK (Base Model)	0.1098	0.0128	0.0512	0.0112	0.0068
	PRUC w/o Causality	0.1345	0.0160	0.0562	0.0131	0.0085
	PRUC (Full)	**0.1600**	**0.0189**	**0.0621**	**0.0148**	**0.0100**
	NCF (Base Model)	0.0131	0.0015	0.0026	0.0008	0.0008
	PRUC w/o Causality	0.1099	0.0132	0.0233	0.0077	0.0070
	PRUC (Full)	**0.1204**	**0.0146**	**0.0285**	**0.0090**	**0.0077**
	LightGCN (Base Model)	0.0182	0.0021	0.0050	0.0014	0.0011
	PRUC w/o Causality	0.0836	0.0101	0.0255	0.0069	0.0054
	PRUC (Full)	**0.0875**	**0.0106**	**0.0285**	**0.0074**	**0.0056**

Table 2: Results of PRUC with different base models on XMRec with cluster number $K = 2$. The best results are marked with **bold face**.

Data	Method	Recall@20	F1@20	MAP@20	NDCG@20	Precision@20
France, Italy, India →Japan, Mexico	CDL (Base Model)	0.0143	0.0016	0.0028	0.0009	0.0009
	PRUC w/o Causality	0.0918	0.0110	0.0332	0.0083	0.0059
	PRUC (Full)	**0.1032**	**0.0120**	**0.0476**	**0.0104**	**0.0063**
	DLRM (Base Model)	0.0044	0.0004	0.0004	0.0002	0.0002
	PRUC w/o Causality	0.0194	0.0023	0.0031	0.0012	0.0012
	PRUC (Full)	**0.0273**	**0.0031**	**0.0063**	**0.0018**	**0.0016**
	PerK (Base Model)	0.1098	0.0128	0.0512	0.0112	0.0068
	PRUC w/o Causality	0.1198	0.0139	0.0539	0.0120	0.0074
	PRUC (Full)	**0.1345**	**0.0153**	**0.0456**	**0.0113**	**0.0081**
	NCF (Base Model)	0.0131	0.0015	0.0026	0.0008	0.0008
	PRUC w/o Causality	0.0960	0.0115	0.0234	0.0071	0.0061
	PRUC (Full)	**0.1269**	**0.0151**	**0.0324**	**0.0096**	**0.0080**
	LightGCN (Base Model)	0.0182	0.0021	0.0050	0.0014	0.0011
	PRUC w/o Causality	0.0723	0.0086	0.0205	0.0056	0.0046
	PRUC (Full)	**0.0947**	**0.0111**	**0.0348**	**0.0085**	**0.0059**

Table 3: Results of PRUC with different base models on XMRec with cluster number $K = 4$. The best results are marked with **bold face**.

Data	Method	Recall@20	F1@20	MAP@20	NDCG@20	Precision@20
France, Italy, India →Japan, Mexico	CDL (Base Model)	0.0143	0.0016	0.0028	0.0009	0.0009
	PRUC w/o Causality	0.1046	0.0123	0.0339	0.0087	0.0065
	PRUC (Full)	**0.1350**	**0.0160**	**0.0571**	**0.0133**	**0.0085**
	DLRM (Base Model)	0.0044	0.0004	0.0004	0.0002	0.0002
	PRUC w/o Causality	0.0270	0.0030	**0.0057**	0.0018	0.0016
	PRUC (Full)	**0.0299**	**0.0035**	0.0047	**0.0018**	**0.0019**
	PerK (Base Model)	0.1098	0.0128	0.0512	0.0112	0.0068
	PRUC w/o Causality	0.1390	0.0162	0.0558	0.0130	0.0086
	PRUC (Full)	**0.1757**	**0.0203**	**0.0666**	**0.0158**	**0.0108**
	NCF (Base Model)	0.0131	0.0015	0.0026	0.0008	0.0008
	PRUC w/o Causality	0.1090	0.0130	0.0241	0.0077	0.0069
	PRUC (Full)	**0.1254**	**0.0149**	**0.0342**	**0.0099**	**0.0079**
	LightGCN (Base Model)	0.0182	0.0021	0.0050	0.0014	0.0011
	PRUC w/o Causality	0.0975	0.0115	0.0298	0.0078	0.0061
	PRUC (Full)	**0.1065**	**0.0127**	**0.0429**	**0.0102**	**0.0068**