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State dependence and exchange rate regime choice: a new empirical explanation to the polarization phenomenon

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ABSTRACT

This paper, using the dynamic multinomial choice random effect panel Logit model, and focusing on the intermediate exchange rate regimes, tries to provide new empirical explanations to the special polarization phenomenon. The main findings are as follows: Firstly, the state dependence can influence the choice of exchange rate regimes greatly, and the state dependence can explain the phenomenon of the special polarization. Secondly, the non-state dependence factors influence exchange rate regimes choice of different development stage economies in different manner. The non-state dependence factors can also explain the special polarization. Thirdly, the policy makers will choose the less-flexible exchange rate regimes with the increasing of capital account openness. The intermediate exchange rate regimes can survive and stabilize the economy under certain conditions. Lastly, this paper draws a series of important conclusions and policy implications.

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Exchange rate regimes choice; special polarization; state dependence

1. Introduction

The main goal of the research is to explore the reason why the intermediate exchange rate regimes can survive for a long time and is adopted by most emerging market and developing economies? The exchange rate regime bipolar view holds that capital flow and less-credible macro-policies are the main reasons that the intermediate exchange rate regimes can't be maintained for a long time (Eichengreen & Razo-Garcia, 2006). Therefore, the policy maker should choose fixed or floating exchange rate regime. However, recent researches (Bird and Rowlands, 2009; Husain, Mody, & Rogoff, 2005; Ilzetzki, Reinhart, & Rogoff, 2019) have questioned the bipolar view, and argue that the bipolarization is exaggerated and the intermediate exchange rate regimes are not prone to crisis in all economies. This paper further finds that there are large differences in the phenomena of exchange rate regime bipolarization among

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different development economies. In 2016, the proportion of developed economies choosing the intermediate exchange rate regimes was 24.1%, while the proportion of emerging market and developing economies choosing the intermediate exchange rate regimes was 80.0% and 46.5% respectively. This means that most of emerging market and developing economies still widely choose the intermediate exchange rate regimes. However, the bipolarization phenomenon appears while an economy enters into high-income economies, and the intermediate exchange rate regimes are abandoned by most developed economies. This phenomenon is called special bipolarization phenomenon in this paper.

The hypothesis of the research is the state dependence has an important influence on the choice of exchange rate regimes. The state dependence means the exchange rate regime choice is correlating in time, which means that if the policy maker chose an exchange rate regime in the past, it is highly possible that the policy maker will continue to choose the same exchange rate regime in the future. The dynamic multinomial choice random effect panel Logit model can better identify and control the true state dependence and spurious state dependence. In addition, with good identification of the two kinds of state dependence, the estimation results have far fewer statistically significant parameters than those obtained through discrete choice model without state dependence. Therefore, existing empirical literatures on the choice of exchange rate regimes overestimate the true impact of the explanatory and control variables on the choice of exchange rate regimes.

Compared with the existing literatures, the main contributions of the research are as follows: Firstly, this paper, focusing on the intermediate exchange rate regimes, provides empirical explanations to the special bipolarization phenomenon. Secondly, in the selection of econometric model, this paper advances the binary choice model to the multinomial choice model and further considers the spurious state dependence and true state dependence. This paper also calculates the marginal effect and considers the endogeneity problems in parameter estimation. These are important to correctly identifying relevant parameters, explaining the real impact of relevant variables on the evolution of exchange rate regimes, and promoting the empirical studies on the choice of exchange rate regimes. Thirdly, this paper finds that capital account openness and foreign exchange reserve have inherent economic mechanisms, which can explain the special bipolarization phenomenon that the intermediate exchange rate regime exists widely in reality but contradicts to the classic theory of impossible trinity.

The rest of the paper is organized as follows. Section 2 reviews the related literatures, section 3 discusses the state dependence and its identification strategies. The data and its statistics features are also discussed in section 3. Section 4 discusses the estimation results of state dependence and their implications to the polarization phenomenon. Section 5 discusses the estimation results of non-state dependence factors and their implications to the polarization phenomenon. Section 6 is conclusion.

2. Literature review

Although the exchange rate regime choice is a classic topic in open economy macroeconomics, recent literatures still provide new insights on this topic. Some researches

argue the fixed exchange rate regime can stabilize the economy. Badarau and Sangaré (2019) uses a two-sector two-country DSGE model and shows that the currency union can outperform the independent floating regime in dealing with the duration and depth of a liquidity trap. Liu, Wei, Shi, and Chang (2018) empirically finds high-risk economies are more likely to choose a fixed regime with a low level of composite and political risk in the government. Nakatani (2018) shows that capital controls mitigate the effects of productivity shocks in pegged regimes. Some literatures believe the floating exchange rate regime is a good choice. Rohit and Dash (2019) finds that the flexible exchange rate regime in the advanced economies insulates them against the spillover to a relatively larger extent as compared to the managed float regime in the emerging market economies. Zeev (2019) finds output responds significantly more adversely to contractionary global credit supply shocks in the fixed ERR than in the non-fixed ERR. Deleveraging and the fall in imports are much more severe in the fixed ERR; and the lack of exchange rate depreciation in the fixed ERR is accompanied by a stronger fall in exports.

The intermediate exchange rate regimes are seldom discussed because the bipolar view believes the intermediate exchange rate regimes have the crisis tendency. The bipolar view argues that the capital flow and lacking policy credibility are the reasons why the intermediate exchange rate regimes cannot be maintained for a long time. Swoboda (1986) first proposed the bipolar view and argues the floating or the fixed exchange rate regime are superior to the intermediate exchange rate regimes. Obstfeld and Rogoff (1995) argues that the fixed adjustable exchange rate regime is vulnerable to speculative attacks under the condition that capital can freely flow. Therefore, an economy has to choose either a fixed or a floating exchange rate regime (Edwards, 2001; Eichengreen, 1994; Eichengreen & Hausmann, 1999; Fischer, 2001). Frankel, Schmukler, and Serven (2000) and Frankel (2003) argues that the intermediate exchange rate regimes make the public difficult to verify whether the monetary authority has fulfilled their policy commitments. Therefore, the problem of policy credibility arises. Eichengreen and Razo-Garcia (2006) argues the fixed adjustable exchange rate regime tends to be vulnerable and cause crisis under the condition that capital can freely flow.

As the International Monetary Fund (IMF) and some important macroeconomists (Reinhart & Rogoff, 2004) have provided the de facto exchange rate regimes classification data since the beginning of 21st century, economists have found that the bipolarization phenomenon only appears in developed economies, but not in emerging market and developing economies. For example, Fischer (2001) argues that exchange rate regime bipolarization is exaggerated. Exchange rate regime bipolarization is not obvious in the economies which capital flow is regulated strictly. Masson (2001) also questioned the bipolar view, holding that there is no evidence that many economies have abandoned the intermediate exchange rate regimes. Prasad, Rogoff, Wei, and Kose (2003) also finds that the de jure classification overestimates the proportion of floating and fixed exchange rate regimes, there is no empirical evidence supporting the bipolar view under the de facto classification, and the intermediate exchange rate regimes are highly sustainable. Husain et al. (2005) offers evidence that there is no bipolarization phenomenon, which is especially true in emerging economies.

Eichengreen (2008) uses the de facto classification data to prove that bipolarization only exists in developed economies and was not obvious in emerging market and developing economies. Klein and Shambaugh (2015) argues that controlling the exchange rate volatility can enable policy maker to obtain a certain degree of monetary policy autonomy, but partial capital control cannot. This finding is true especially in emerging market and developing economies.

Recent researches provide new evidences supporting to choose the intermediate exchange rate regimes. Bleaney, Saxena, and Yin (2018) shows that, contrary to the hard pegs exchange rate regimes, the intermediate regimes with recent devaluations are less likely to experience a growth collapse, which confirms the role of exchange rate adjustment in reducing the output effects of a negative shock. Santana-Gallego and Pérez-Rodríguez (2019) estimates a gravity equation for bilateral trade and finds that the intermediate exchange rate regimes can promote flows of goods between economies. Ilzetzki et al. (2019) also points out that the existing literatures overestimate the transition from fixed to floating exchange rate regime in the Post-Bretton Woods System period, and the limited flexibility exchange rate regimes still dominate.

The main difference of the research to the literature is the introduction of state dependence and the identification methods are further refined. This paper summarizes 21 important researches on the exchange rate regime choice using the discrete choice model from 1978 to 2016, and finds that only Hagen and Zhou (2007) and Berdiev, Kim, and Chang (2012) considered heterogeneity and identified spurious state dependence by respectively introducing random effects and fixed effects models. Hagen and Zhou (2007) further considered dynamic model and identified the true state dependence by using the dynamic multinomial choice random effect panel Logit model. Although Hagen and Zhou (2007) and Berdiev et al. (2012) greatly promoted the relevant empirical studies on the exchange rate regime choice, there are still the following shortcomings: firstly, the estimation method to solve the endogeneity of the lagged dependent variables in the dynamic model is not clearly given, and thus the consistency of the parameter estimation needs to be further investigated. Secondly, the marginal effect of parameter estimated is not given, so it is impossible to give an accurate economic explanation for the influence of different factors on the exchange rate regime choice.

3. Methodology and data

3.1. State dependence

There is an important finding in empirical researches on the choice of the exchange rate regime, the exchange rate regime choice has a high correlation in time, which means that if the policy maker chose an exchange rate regime in the past, it is highly possible that the policy maker will continue to choose the same exchange rate regime in the future. Hagen and Zhou (2007) argues that there are two reasons to explain this rule of thumb.

First, true state dependence. The macroeconomic conditions associated with the current exchange rate regime choice are influenced by the past choice of exchange

rate regimes. For example, the economies that used to choose a fixed exchange rate regime would promote their trade with anchoring economies or increase unhedged foreign currency liabilities, which would strengthen their incentives to choose a fixed exchange rate regime in the current period. Thus, the past choice of the exchange rate regime has a real structural impact on the current choice of the exchange rate regime, the dynamic link of exchange rate regime choices in time is called true state dependence.

Second, spurious state dependence. If the economic and political factors affecting the exchange rate regime choice are correlated in time. Specifically, if the country heterogeneities affecting the exchange rate regime choice are correlated in time, and these heterogeneities are not well controlled in econometric model, then the previous choice of the exchange rate regime will be a significant determinant of the current choice of the exchange rate regime. This is only because the previous choice of the exchange rate regime is a proxy variable of those persistent and unobservable factors which affect the current choice of the exchange rate regime. This dynamic link between the previous and current exchange rate regime choices is called spurious state dependence.

3.2. Dynamic multinomial choice random effect panel logit model

In this paper, Y_{ijt} indicates that economy i chooses the jth exchange rate regime in the tth year, where $i = 1, 2, \ldots, N$, $t = 0, 1, \ldots T_i$, and $j = 0, 1, 2$. Since the time length T_i of different economies i is different, the model is unbalanced panel data model[1], and $j = 0, 1, 2$ respectively represent the exchange rate regime chosen by country i in the tth year as the intermediate, fixed or floating exchange rate regime. Each economy chooses exchange rate regimes based on utility maximization criteria and has clear definitions of utility levels under different exchange rate regimes, i.e.,

$$P_{ijt} = \Pr(U_{ijt} > U_{ikt}), j, k = 0, 1, 2, k \neq j \tag{1}$$

U_{ijt} is the unobservable utility obtained by economy i which chooses the exchange rate regime j in the tth year, and P_{ijt} is the probability that country i chooses the exchange rate regime j in the tth year. This paper assumes that the unobservable random utility U_{ijt} includes the predetermined part V_{ijt} and the random error item u_{ijt}. The predetermined part V_{ijt} is a linear function of the explanatory variable and the control variable vector X_{it}, and the random error term u_{ijt} has a specific structure as follows,

$$U_{ijt} = V_{ijt} + u_{ijt} = \beta_j' X_{it} + \gamma_j' Z_{it} + \alpha_{ij} + \varepsilon_{ijt} \tag{2}$$

Z_{it}, which is composed of lagged values of explained variables, is a vector composed of dummy variables. Model (2) is similar to the first-order markov model proposed by Heckman (1981a), which introduces the lagged state dummies (i.e. Z_{it}) to identify the true state dependence. Meanwhile, Model (2) introduces α_{ij} reflecting the latent, unobservable and time-invariant heterogeneity of economy i, and the above heterogeneity can be used to identify the spurious state dependence. Therefore,

Model (2) can identify and distinguish between true state dependence and spurious state dependence. It is assumed in this paper that the random error term ε_{ijt} in Equation (2) follows the extreme value Type-1 distribution (Gumbel distribution), and the J random error terms are independent. Therefore, the specific form of conditional selection probability of the dynamic multinomial choice random effect panel Logit model set above is,

$$P_{ijt}|\alpha_{i1},\ldots,\alpha_{iJ}=\frac{\exp\left(\beta_j'X_{it}+\gamma_j'Z_{it}+\alpha_{ij}\right)}{\sum_j^J\ \exp\left(\beta_j'X_{it}+\gamma_j'Z_{it}+\alpha_{ij}\right)},\ \ t=1,\ldots,\ \ T_i,j=0,1,2,J=2,\forall_i \tag{3}$$

3.3. Identification method

The true state dependence part of model (3), that is γ_j', is estimated according to the methods of Gong, Soest, and Villagomez (2004) and Heckman (1981a). Since Z_{it} is lagged dependent variable and endogenous variable in model (3), parameter estimations are inconsistent when such a model is estimated with traditional maximum likelihood estimation method. Gong et al. (2004) pointed out that consistent estimators can be obtained with Heckman's (1981a) method. Heckman (1981a) regards the first period of the model as equilibrium and estimate the following multinomial choice Logit model without lagged dependent variables.

$$P_{ij0}/\theta_{i1},\ldots,\theta_{iJ}=\frac{\exp\left(\delta_j'x_{i0}+\theta_{ij}\right)}{\sum_j^J\exp\left(\delta_j'x_{i0}+\theta_{ij}\right)},\mathrm{t}=0,\mathrm{j}=0,1,2,\forall_i \tag{4}$$

Model (4) can be regarded as a linear approximation of the reduced form model (3). Although this approximation is not accurate enough for the nonlinear model, the Monte Carlo results reported by Heckman (1981b) show that the above process is a good approximation to the dynamic panel binary choice model, which only causes a small asymptotic bias.

The spurious state dependence part of model (3), that is α_{ij}, is estimated based on the simulated maximum likelihood method. The conditional probability with $Y_{it}=j$ based on the observable V_{ijt} is represented by P_{ijt}, which can be obtained by integrating the α_i via the formula (3) $P_{ijt}|\alpha_i$, i.e.,

$$P_{ijt}=\int_{\alpha_i}(P_{ijt}|\alpha_i)f(\alpha_i)d\alpha_i \tag{5}$$

f is a density function of α_i and P_{ijt} is the expectation of $P_{ijt}|\alpha_i$ with respect to α_i, which is known from the formula (5). In the later estimation, P_{ijt} is obtained by the approximation of the mean value of numerical simulation of $P_{ijt}|\alpha_i$, and the numerical simulation is obtained by the mixed logit simulator. The basic method is to randomly extract α_j^r from the heterogeneity α_{ij} with the mean value of 0 and the covariance matrix of $\sum$, calculate $P_{ijt}|\alpha_j^r$ for each extraction via formula (5), repeat this process for R times, and ultimately, calculate the approximate value of P_{ijt}, i.e.,

$$P_{ijt}^{*} = \frac{1}{R}\sum_{r=1}^{R}(P_{ijt}|\alpha_j^r) \tag{6}$$

The simulated likelihood function is given by,

$$logL^{*} = \sum_i \sum_k \sum_t d_{ikt} \log P_{ijt}^{*} \tag{7}$$

The above estimator is a simulated maximum likelihood estimator. When the increase of the number of extractions R is faster than $\sqrt{N}$ (N is the number of cross-section economies in the sample), and the random extractions are completely independent, the estimator is consistent, asymptotically normal and efficiency, asymptotically equivalent to the maximum likelihood estimator (Train, 2001), and the maximum simulated likelihood estimator converges faster. In this paper the number of extractions $R = 50$. The extraction is carried out for 20 and 25 times in this paper, and it is found that the estimation results are robust to the number of extractions.[2]

3.4. Data

This paper uses the panel data from 155 economies from 1980 to 2014.[3] The data is from Ilzetzki et al. (2019), Habermeier, Kokenyne, Veyrune, and Anderson (2009), Chinn and Ito (2006), Lane and Milesi-Ferretti (2007), and the IMF World Economy Outlook Database (WEO), IMF International Financial Statistics Database (IFS), IMF World Trade Direction Database (DOTS), World Bank World Development Indicators Database (WDI) and Global Economic Database.

3.4.1. Explained variables

In this paper, the latest classification data of exchange rate regimes provided by Ilzetzki et al. (2019) are used as explained variables. Based on Reinhart and Rogoff (2004), Ilzetzki et al. (2019) used monthly nominal exchange rate data of 194 economies (regions) from 1940 to 2016, to make a detailed analysis on exchange rate regime arrangement, currency anchor and measurement of foreign exchange market intervention under de facto classification. Ilzetzki et al. (2019) respectively classified exchange rate regimes into 6 sub-categories roughly and 15 sub-categories finely. This paper further adds these exchange rate regimes up to fixed exchange rate regime, intermediate exchange rate regime and floating exchange rate regime.

3.4.2. Explanatory variables and control variables

This paper takes capital account openness (ka_open), foreign exchange reserve adequacy (reserve), and currency mismatch (nfa_gdp) as the core explanatory variables. Classical exchange rate regime choice theories, such as Mundell-Fleming and Impossible Trinity theory and the Bipolar View argue that capital flow has an important impact on the choice of exchange rate regime. Fear of Floating theories hold that liability dollarization and currency mismatch are the important reasons for the intervention of monetary authorities in foreign exchange market. The choice of exchange rate regime is highly related to the ability of a country to borrow in its own currency internationally (Hausmann et al., 2001). The heavily liability-dollarized economies

prefer to choose the exchange rate regime that lacks flexibility in order to avoid the Balance Sheet Effect (Calvo & Reinhart, 2002). Ganapolsky (2003) also finds that there is a negative correlation between currency mismatch and the flexibility of exchange rate regime. Ilzetzki et al. (2019) finds that monetary authorities have accumulated foreign exchange reserves to intervene in foreign exchange market while global capital flows growing greatly.

This paper introduces the following 5 groups, 12 variables as control variables. (1) Mundell-Fleming theory. This paper introduces inflation rate (cpinf), broad money growth rate (nomshk_t), and real GDP per capita growth rate (gdppcg) to identify different economic shocks. (2) Optimal Currency Area theory. This paper uses the proportion of total import and export trade volume to GDP (tradeope) to measure the trade openness of an economy. This paper constructs the proportion of the top ten trading partners' trade volume to total trade volume (zhougon) of sample economies to measure the trade geographic concentration of an economy, uses the logarithm of GDP in dollars (lsize) to measure the scale of an economy, and uses the logarithm of GDP per capita in dollars (lnlevel) to measure the economic development stage of an economy. (3) New Political Economy theory of exchange rate regime choice. The Central Banks' aims of stabilizing inflation are controlled by the variables of inflation rate (cpinf) and broad money growth rate (nomshk_t). Referring to the study of Liu and Zhang (2015), this paper uses the polity2 index and the ACTOTAL index to measure the democracy of a political system and the political instability respectively. (4) Impossible Trinity theory. This paper uses the proportion of domestic private sector credit to GDP (ldcpsgdp) as the proxy variable of financial development degree. (5) Currency Crisis Theory. Similar to Hagen and Zhou (2007), this paper identifies the risk of currency speculation by variables of foreign exchange reserve (reserve) and current account status (ca).

3.4.3. Sample grouping, statistical description, and coefficients correlation test

Referring to the classification method of Husain et al. (2005), Liu and Zhang (2015), this paper classifies 155 economies into developed economies (29), emerging market economies (25) and developing economies (101). Table 1 gives the statistical description of 15 core explanatory and control variables in 155 sample economies. Specifically, this paper gives the mean value and standard deviation of 15 relevant variables under the 155 sample economies and three exchange rate regimes (fixed, intermediate and floating). Because this paper focuses on the intermediate exchange rate regime, Table 1 also gives the mean values comparison test of the variables of the intermediate exchange rate regime relative to the fixed exchange rate regime and the intermediate exchange rate regime relative to the floating exchange rate regime, i.e. Z statistics, to test whether the mean value of each variable is significant difference under different exchange rate regimes. Through the correlation test, this paper finds that there is a high correlation between the economic development level (lnlevel) and the size of economy (lsize), and there is also a high correlation between the degree of financial development (ldcpsgdp) and trade concentration (zhougon). Therefore, the subsequent estimations exclude two variables, namely, the degree of economic development (lnlevel) and the size of economy (lsize).[4]

Table 1. Statistical description of sample in 155 economies.

	155 Economies		Fixed Exchange Rate		Intermediate Exchange Rate		Floating Exchange Rate		Z-statistics[5]	
Variable	Mean Value	Standard Deviation	Mean Value	Standard Deviation	Mean Value	Standard Deviation	Mean Value	Standard Deviation	Intermediate-fixed	Intermediate-floating
ka_open	0.462	0.367	0.525	0.369	0.432	0.356	0.398	0.387	−3.020***	0.706
reserve	0.700	5.450	0.786	6.443	0.721	5.127	0.288	2.513	−2.044***	8.641***
nfa_gdp	−0.412	1.608	−0.270	1.347	−0.415	1.712	−0.813	1.745	−4.485***	8.313***
cpinf	0.096	0.142	0.047	0.067	0.082	0.076	0.326	0.286	1.151	−5.193***
nomshk_t	0.143	0.151	0.102	0.117	0.137	0.105	0.317	0.279	1.110	−3.691***
gdppcg	0.018	0.062	0.021	0.069	0.024	0.050	−0.012	0.076	0.091	0.772
rgdpg	0.036	0.064	0.040	0.069	0.041	0.056	0.003	0.073	0.029	0.798
tradeope	0.831	0.553	1.001	0.609	0.774	0.507	0.553	0.368	−7.410***	4.761***
zhougon	0.767	0.098	0.778	0.096	0.761	0.097	0.761	0.105	−0.552	0.012
lsize	2.831	2.371	2.289	2.324	3.056	2.223	3.500	2.816	25.259***	−9.650***
lnlevel	7.853	1.584	8.115	1.662	7.743	1.464	7.521	1.740	−12.238***	4.767***
polity2	2.405	7.025	1.559	7.466	2.911	6.715	2.430	6.943	41.830***	10.384***
actotal	0.733	1.772	0.286	1.089	0.940	2.003	1.030	1.940	20.387***	−1.950*
ldcpsgdp	0.429	0.399	0.456	0.402	0.401	0.349	0.478	0.575	−1.771*	−1.587
ca	−0.033	0.106	−0.036	0.121	−0.029	0.097	−0.045	0.091	0.226	0.352

Note: (1) Z statistics in columns 10 and 11 of the table give the main result of mean-comparison tests. In the original hypothesis, the mean value of the variable is equal under the two groups of exchange rate regimes. *, ***, and *** indicate that the significance level is high at the significant level of 10%, 5% and 1%, respectively; (2) Because this paper focuses on the intermediate exchange rate regime, Z statistics give the mean value comparison test of corresponding variables such as the intermediate exchange rate regime relative to the fixed exchange rate regime and the intermediate exchange rate regime relative to the floating exchange rate regime. For example, the mean values of the capital account openness (ka_open) variable under the fixed exchange rate system, the intermediate exchange rate regime and the floating exchange rate regime are 0.525, 0.432, and 0.398, respectively. The mean value comparison test shows that the capital account openness under the intermediate exchange rate regime is less than that under the fixed exchange rate regime and is statistically significant; the capital account openness under the intermediate exchange rate regime is greater than that under the floating exchange rate regime and is statistically significant.

4. The estimation results of state dependence

4.1. The estimation results of spurious state dependence

Table 2 gives the main estimation results of the multinomial choice random effect panel Logit model. Comparison of the log-likelihood function values shows that the likelihood function values of each group estimation result under the random effect model are significantly higher than the corresponding results in the pool estimation (see Appendix 4). Thus, the introduction of random effect greatly improves the fitting of the model to the data. Random effects (RE) estimation results also have new features compared with the pool estimation (PE), i.e., the mean of random effects α_1 and α_2 (spurious state dependence) are statistically significant in different samples, and have important impact on the parameter estimation results. The specific demonstrations are as follows. First, the capital account openness (ka_open) only affects the choice of exchange rate regimes in developed economies in the PE estimation, and the capital account openness (ka_open) affects the choice of exchange rate regimes in developing economies and emerging market economies in RE estimation. Second, currency mismatch (nfa_gdp) has a significant impact on the choice of exchange rate regimes at different stages of development in RE estimation, but this feature does not exist in PE estimation. Third, the introduction of random effects has important impact on the estimation of important explanatory variables in this paper. Therefore, the estimation results of PE are not reliable because the spurious state dependence is not considered.

4.2. The estimation results of true state dependence

Table 3 is the main estimation results of the dynamic multinomial choice random effect panel Logit model. Comparison of the log-likelihood function values shows that the likelihood function values of each group estimation result under the dynamic multinomial choice random effect panel Logit model are significantly higher than the corresponding results in the multinomial choice random effect panel Logit model, and it is even higher than the likelihood function value in the multinomial choice logit model with pool estimation. Therefore, the introduction of the dynamic model and random effect further improves the fitting of the model to the data. Accordingly, compared with RE and PE, the dynamic multinomial choice random effect panel Logit model (DRE) also has many new and important features, which are specifically.

First, random effects (spurious state dependence) are not statistically significant in 155 economies samples, and this leads to the reason of temporal correlation of exchange rate regimes choice are different in different samples. The random effects (α_2) are statistically significant in the estimation results of the 155 economies sample and emerging market economies sample, but not significant in the developing and developed economies samples. The above results indicate that the temporal correlation of exchange rate regime choices in developing and developed economies is mainly caused by the dynamic part of the model, that is, the true state dependence. In emerging market economies, the mean value of random effect (α_2) and covariance matrices of random effects (σ_{11} and σ_{22}) are statistically significant. The temporal

Table 2. Estimation results of the multinomial choice random effect panel logit model.

	155 Economies		Developing Economies		Emerging Market Economies		Developed Economies	
Variable	Fixed	Floating	Fixed	Floating	Fixed	Floating	Fixed	Floating
ka_open	1.271***	−0.866**	−1.144***	−2.279***	1.238*	−0.030	−2.242	23.071
	(0.170)	(0.391)	(0.412)	(0.611)	(0.646)	(1-123)	(2.168)	(51.761)
reserve	0.057***	−2.869***	0491***	−3.792***	−0.633	−3.851	0.321***	−3.270
	(0.009)	(0.398)	(0.069)	(0.488)	(1.458)	(2.895)	(0.055)	(47.170)
nfa_gdp	−0.813***	−0.189**	−0.462***	0.012	2.247*	−0.826	−3.981***	9.755
	(0.093)	(0.076)	(0.161)	(0.103)	(1.275)	(1-621)	(1.334)	(16.920)
cpinf	−2.624**	7.802***	−0.881	5.680***	−6.385	8.311*	−33.616	0.815
	(1.189)	(0.774)	(1-519)	(1.097)	(7.981)	(4.603)	(34.437)	(329.228)
nomshk_t	0.673	1.610*	−0.572	1.991	0.372	3.926	−6.612	−52.629
	(1.325)	(0.900)	(2.039)	(1.311)	(6.745)	(5.227)	(8.182)	(87.240)
gdppcg	5.034**	−4.656**	2.499	−4.385*	6.097	−1.323	4.478	−52.046
	(2.153)	(2.163)	(3.548)	(2.498)	(8.121)	(14.053)	(17.572)	(202.764)
tradeope	0.809***	−1.726***	0.151	−0.199	−0.782	−3.444*	7.078***	−128.202***
	(0.183)	(0.306)	(0.304)	(0.377)	(0.715)	(1.952)	(1.613)	(47.182)
zhougon	0.257	5.554***	−6.802***	3.008*	13.502***	10.130***	−47.589***	−66.831
	(0.711)	(1.252)	(1.372)	(1.551)	(2.269)	(3.300)	(8.260)	(183.233)
phlity2	−0.135***	−0.037***	−0.003	−0.093***	−0.248***	0.097*	Null[6]	Null
	(0.010)	(0.013)	(0.018)	(0.018)	(0.045)	(0.057)	Null	Null
actotal	−0.014	−0.047	−0.248***	−0.033	0.351***	−0.254	−27.091	−10.040
	(0.038)	(0.059)	(0.065)	(0.083)	(0.100)	(0.217)	(0.505)	(9.999)
ldcpsgdp	1.819***	2.926***	−1.274*	−0.950	2.838***	1.100	12.128***	23.230**
	(0.195)	(0.325)	(0.713)	(0.865)	(0.873)	(1-542)	(2.615)	(10.356)
ca	2.392***	−2 994***	2.198	−1.534	3.432	−24.246**	14.670	−15.841
	(0.906)	(1.068)	(1.817)	(0.983)	(4-275)	(11.258)	(10.405)	(222.492)
α_1	−2.589***(0.617)		3.984***(1.231)		−14.083***(2.134)		18.441***(5_636)	
α_2	−8.034***(1.116)		−3.922***(1.345)		−11.364***(2.615)		67.292(152.211)	
σ_{11}	69.720***(0.000)		79.100***(0.000)		11.130***(0.000)		417.2_(0.000)	
σ_{22}	6.063***(0.000)		4.992***(0.000)		1.323***(0.001)		84.39**(0.017)	
σ_{12}	−7.598***(0.000)		6.561***(0.001)		1.373(0.230)		112.4(0.172)	
Log-likelihood	−1162.739		−664.863		−251.605		−93.960	
Observations	3192		1954		665		573	

Note: (1) The number in the bracket is the robust standard error[7]; (2) ***, **, and * indicate that the significance level is high at 1%, 5%, and 10%, respectively; (3) Estimation is made by simulation based maximum simulation likelihood in the multinomial choice random effect panel Logit model, i.e., numerical simulations are obtained by the mixed logit simulator. Specifically, the above estimation process is implemented with the Halton Draws method, and the number of extractions R is set to 50. Extraction is also conducted for 20 times and 25 times in this paper, and it is found that the estimation results are robust to the number of extractions; (4) α_1 and α_2 are the estimated values of the random effect mean value, and σ_{11}, σ_{22}, and σ_{12} are the estimated values in the random effect variance - covariance matrix. Since the multinomial choice random effect panel Logit model setting in this paper allows the correlation of random effects, there are parameters in the estimation results. (5) The numbers in the brackets in the σ_{11}, σ_{22}, and σ_{12} parameter estimation results are the p values.

Table 3. Estimation results of the dynamic multinomial choice random effect panel logit model.

	155 Economies		Developing Economies		Emerging Market Economies		Developed Economies	
Variable	Fixed	Floating	Fixed	Floating	Fixed	Floating	Fixed	Floating
ka_open	1.716***	−0.735	0.840	−1.202*	0.557	−0.245	4.757***	4.005
	(0.330)	(0.457)	(0.641)	(0.680)	(0.805)	(1.509)	(1.575)	(10.610)
reserve	0.037***	−3.128***	0.054	−3.359***	0.209	−2.339	0.069***	0.130
	(0.013)	(0.491)	(0.088)	(0-577)	(3.051)	(3.356)	(0.022)	(1.343)
nfa_gdp	−0.379***	0.005	−0.471**	−0.056 (0.140)	1.566	0.770	0.425	−0.552
	(0.140)	(0.115)	(0.191)		(1.869)	(2.767)	(1.115)	(6.130)
cpinf	−3.836**	3.591***	−3.614*	2.646**	−8.770	4.117	−74.706***	49.559
	(1.654)	(1.101)	(2.133)	(1.246)	(9.514)	(5.621)	(19.060)	(60.011)
nomshk_t	−0.299	0.864	−1.239	0.452	1.857	4.499	Null	Null
	(1.553)	(0.937)	(2.054)	(1.198)	(9.372)	(5.526)		
gdppcg	6.994**	−1.189	6.240	−1.692	4.366	1.779	2.489	18.515
	(2.732)	(2.470)	(4.616)	(2.619)	(7.645)	(15.929)	(10.391)	(62.091)
tradeope	0.405	−1.208***	0.516	−0.146	0.986	−2.080	−0.028	−22.630**
	(0.272)	(0.323)	(0.448)	(0.396)	(1.153)	(2.320)	(0.606)	(9.368)
zhougon	−0.442	4.647***	−2.274	2.390	2.085	7.895**	2.619	−16.970
	(1.260)	(1.338)	(1.957)	(1.796)	(3.241)	(3.823)	(5.559)	(22.802)
phlity2	−0.044**	−0.024	0.021	−0.049**	−0.131**	0.079	Null	Null
	(0.017)	(0.016)	(0.027)	(0.023)	(0.052)	(0.067)		
actotal	−0.038	−0.091	−0.125	−0.082	0.085	−0.258	Null	Null
	(0.062)	(0.069)	(0.098)	(0.087)	(0.116)	(0.233)		
ldcpsgdp	0.205	1.526***	−0.752	−0.176	−0.467	−0.101	−0.325	6.545*
	(0.333)	(0.346)	(1.233)	(0.787)	(1.442)	(1.755)	(1.301)	(3.402)
ca	1.277	−4.793***	0.804	−1.778	−0.482	−25.226	−7.405	26.616
	(1.459)	(1.174)	(2.466)	(1.226)	(8.552)	(16.867)	(10.704)	(69.862)
ditLAG[8]	−5.493***	−3.386***	−5.297***	−3.370***	4.874***	−2.567*	8.637***	0.921
	(0.284)	(0.234)	(0.386)	(0.301)	(1.034)	(1.422)	(1.607)	(5.924)
α_1	0.592(1.061)		2.098(1.697)		−0.413(2.388)		−7.127 (4.438)	
α_2	−3.730*** (1.168)		−1.164(1.502)		−6.941** (3.209)		5.573(13.074)	
σ_{11}	13.250***(0.000)		26.860***(0.000)		1.028***(0.001)		6.934***(0.001)	
σ_{22}	2_533***(0.000)		0.891 ***(0.007)		0.439**(0.031)		5.354(0.977)	
σ_{12}	4.890*** (0.000)		3.445(0.001)		−0.100(0.749)		6.093(0.181)	
Log-likelihood	−815.108		−495.789		−177.661		−91.766	
Observations	3119		1954		665		629	

Note: (1) The number in bracket is the robust standard error; (2) ***, **, and * indicate that the significance level is high at 1%, 5%, and 10% respectively; (3) The dynamic multinomial choice random effect panel Logit model is also estimated with the Halton Draws method, and the number of extractions R is set to 50. Extraction is also conducted for 20 times and 25 times in this paper, and it is found that the estimation results are robust to the number of extractions; (4) α_1 and α_2 are the estimated values of the random effect mean value, and σ_{11}, σ_{22}, and σ_{12} are the estimated values in the random effect variance - covariance matrix. Since the multinomial choice random effect panel Logit model setting in this paper allows the correlation of random effects, there are σ_{11}, σ_{22}, and σ_{12} in the estimation results; (5) The numbers in the brackets in the σ_{11}, σ_{22}, and σ_{12} parameter estimation results are the p values. Theoretical econometricians believe that there is no need to report the significance level of the covariance matrix, so Nlogit 6.0 does not report its significance level when estimating the covariance matrix of random effects. To be consistent with the literature (e.g., Hagen & Zhou, 2007), the significance level of the Cholesky matrix (denoted as L, $L^*L' = \Sigma$) is reported here as a reference; (6) The reason why the estimation results for variables of nomshk_t, polity2, and actotal for the developed economies are null is that the data characteristics of these variables lead the covariance matrix obtained by maximum likelihood estimation to be the singular matrix. Therefore, these variables are eliminated when this group of samples is estimated.

correlation of exchange rate regime choices in emerging market economies is determined by both true state dependence and spurious state dependence.

Second, the introduction of dynamic models (true state dependence) will reduce the number of statistically significant parameter, but it has differently impact on the parameter estimation at different development stage economies. See Appendix 5 for details. (1) The introduction of dynamic models has generally reduced the number of statistically significant parameter estimation of developing economies. In the dynamic model (DRE), ka_open and reserve are only statistically significant in the estimation of the floating exchange rate regime relative to the intermediate exchange rate regime. However, in the random effect (RE) model, ka_open and reserve are statistically significant both in the estimation of the floating exchange rate regime relative to the intermediate exchange rate regime and the fixed exchange rate regime relative to the intermediate exchange rate; the estimation of nfa_gdp in the the DRE model is consistent with that in the RE models, which is statistically significant in the estimation of the fixed exchange rate regime relative to the intermediate exchange rate regime. It can be seen that the three core explanatory variables (ka_open, reserve, nfa_gdp) are important factors influencing the choice of exchange rate regimes in developing economies. The parameter estimations of actotal and ldcpsgdp in developing economies are not statistically significant since the introduction of dynamic model (DRE). (2) The introduction of dynamic models has led to a great decline in the number of significant parameter estimation in emerging market economies. In the estimation results of random effect (RE) model, the parameter estimations of ka_open, nfa_gdp, cpinf, tradeope, zhougon, polity2, actotal, ldcpsgdp, and ca are all statistically significant, while in the dynamic model (DRE), only the zhougon and polity2 parameter estimations are statistically significant. It can be seen that the high temporal correlation of the choice of exchange rate regime (true state dependence and spurious state dependence) is the main factor affecting the evolution of the exchange rate regime in emerging market economies. (3) The introduction of dynamic model has also partially reduced the number of statistically significant parameter estimation in developed economies. For example, whether in the random effect (RE) or the dynamic model (DRE), the estimation results of floating exchange rate regime relative to the intermediate exchange rate regime in developed economies are the same, and only tradeope and ldcpsgdp are statistically significant. However, in the dynamic model (DRE), nfa_gdp, tradeope, zhougon, and ldcpsgdp are not significant in the estimation result of the fixed exchange rate regime relative to intermediate exchange rate regime in developed economies.

Third, the reason why the introduction of true state dependence (dynamic multinomial choice random effect panel Logit model) can greatly reduce the number of statistical significance parameter estimation. In reality, the high temporal correlation of the evolution of the exchange rate regime is caused by both the true state dependence and spurious state dependence. However, the multinomial choice random effect panel Logit model only identifies and controls the temporal correlation of unobserved variables, i.e., the spurious state dependency. In this situation, the explanatory variables and control variables with high continuity in time will indirectly absorb the actual influence of the dynamic part of the econometric model (true state

dependence) on the choice of the exchange rate regime. Therefore, the true state dependence and spurious state dependence are identified and controlled by the dynamic multinomial choice random effect panel Logit model, the estimation results of explanatory variables and control variables with high continuity in time only reflect the true influence of the variable changes on the exchange rate regime. Accordingly, the introduction of the dynamic multinomial choice random effect panel Logit model will greatly reduce the statistical significance of estimation results.

4.3. The true state dependence and the special polarization phenomenon

The introduction of dynamic models (true state dependence) is important and statistically significant. More importantly, the main estimation results of the dynamic part of the model are consistent with the Special Polarization Phenomenon proposed in this paper, which is reflected in the following aspects:

First, the parameter estimation results reflecting the dynamics of the model are statistically significant except the floating exchange rate regime relative to the intermediate exchange rate regime in the developed economies sample, which indicates that the true state dependence is an important determinant factor of the exchange rate regime choice.

Second, in the estimation results of 155 economies sample, developing and emerging market economies sample, the parameter estimation reflecting the dynamics model (dit1LAG) are negative and statistically significant, which implicates that the economies chose the intermediate exchange rate regime in the previous period do not choose a fixed exchange rate regime or a floating exchange rate regime in the current period, i.e., the probability of holding on to the intermediate exchange rate regime is increasing.[9] This estimation result is consistent with the fact that there is no significant polarization phenomenon in 155 economies sample, including developing and emerging market economies.

Third, in the estimation results of the fixed exchange rate regime relative to the intermediate exchange rate regime in developed economies, the parameter estimation of the dynamic part (dit2LAG) is 8.637, and this positive number implicates that the probability of choosing the fixed exchange rate regime in the current period increases if the fixed exchange rate regime is chosen in the previous period. Since the observations are only 4 that the developed economies transform between the floating exchange rate regime and the intermediate exchange rate regime.[10] This is an important reason that the dynamic part of the floating exchange rate regime relative to the intermediate exchange rate regime in the sample of developed economies is not statistically significant. Therefore, the estimation results of developed economies also prove that developed economies tend to choose and continue to hold on to fixed or floating exchange rate regimes. Thus, polarization of exchange rate regime exists in developed economies.

5. The estimation results of non-state dependence factors

5.1. Robustness test

To test the robustness of the estimation results of dynamic multinomial choice random effect panel Logit model, the following three robustness tests are estimated.

First, this paper sets different dynamic econometric model to estimate. In the estimation of the dynamic multinomial choice random effect panel Logit model, the Nlogit 6.0 software requires the generation of dummy variables of the one-period lagged explained variable. The explained variables in this paper are the latest classification of exchange rate regimes provided by Ilzetzki et al. (2019). The exchange rate regimes are divided into intermediate exchange rate regime (value: 0), fixed exchange rate regime (value: 1), and floating exchange rate regime (value: 2). In detail, dit1LAG, dit2LAG, and dit3LAG are dummy variables of the intermediate exchange rate regime, the fixed exchange rate regime, and the floating exchange rate regime which are one-period lagged. In the robustness test, in order to avoid complete multicollinearity, the two lagged explained variables of dit1LAG and dit2LAG are reserved on the right side of Model (3) in the 155 economies sample and the developing economies sample. For the developed economies, only dit2LAG and dit3LAG on the right side of Model (3) are reserved. Since in most of the periods, emerging market economies mainly adopts the intermediate exchange rate regime, therefore, in the estimation of the sample of this group, only dit1LAG is retained in Model (3).

Second, this paper drops out the outliers of the dataset. In detail, the foreign exchange reserves have outliers in Slovenia from 1991 to 2006, at [6.303, 136.190]. The currency mismatches (nfa_gdp) have outliers in Liberia in 1980–2014 and in Mauritius in 2005–2011, at [−1.480, −32.970] and [7.381, 17.207] respectively. 7 observed values less than −0.2 are excluded in inflation rate (cpinf), namely Laos (1990),[11] Equatorial Guinea (1986), Zimbabwe (1998, 2001, 2002, 2005), Samoa (1985). 11 observed values less than −0.5 are excluded in broad monetary growth rate (nomshk_t), namely Ecuador (1999), Democratic Republic of Congo (1984), Equatorial Guinea (1990), Guinea-Bissau (1991, 2003), Liberia (1997), Zimbabwe (1990, 2003, 2004), Belarus (2004). 6 observed values greater than 0.5 are excluded in actual per capital GDP growth rate (gdppcg), such as Equatorial Guinea (1997).

Thirdly, the dummy variables reflecting the Asian financial crises and global financial crises are introduced into model (3). In detail, the variable dumyasia, introduced in this paper to reflect the Asian financial crisis, was assigned the value of 1 in 1997 and 1998, and a value of 0 in other years. The variable dumyglobal, introduced to reflect the global financial crisis, was assigned the value of 1 in 2007 and 2008, and the value of 0 in other years.

The estimation results show that the different setting of dynamic models, the elimination of outliers, and the introduction of dummy variables reflecting the two financial crises have no significant impact on the estimation results in this paper.[12]

5.2. Parameter estimation and partial effects

The dynamic multinomial choice random effect panel Logit model estimated above is a non-linear econometric model. The above parameter estimation results are different to the partial effect,[13] and the partial effect really shows the partial impact of the partial change of the explanatory variable on the explained variable. Theoretically, two kinds of partial effects can be calculated, namely, the Partial Effects at the Mean (PEA for short) and the Average Partial Effects (APE for short). In the literature, the Average Partial Effects (APE) are considered to be of more referential significance,

and this result is usually reported. Based on this, the average partial effects (APE) corresponding to the parameter estimation results of all explanatory variables and control variables of the dynamic multinomial choice random effect panel Logit model will be re-calculated in this paper.[14]

Table 4 shows the average partial effects (APE) corresponding to the parameter estimation of the dynamic multinomial choice random effect panel Logit model. Compared with the parameter estimation results of the model, the average partial effects have the following characteristics: Firstly, most values of the average partial effect are smaller than the parameter estimation values; secondly, the symbol of the value of average partial effect changes in some groups compared with that of the parameter estimation result, such as nfa_gdp and ldcpsgdp of the developing economies, ca of the emerging market economies, and tradeope of the developed economies; thirdly, not only the symbol, but also the significance level of the value of average partial effect changes in some groups. For example, in the 155 economies sample, the estimation result of the average partial effect of ka_open of the floating exchange rate relative to the intermediate exchange rate is -0.073^{***} (0.021), and its parameter estimation result is -0.735 (0.457). There are 8 other similar cases. Therefore, in order to accurately explain the real impact of each explanatory variable and control variable in the dynamic multinomial choice random effect panel Logit model, it is necessary to calculate the partial effect corresponding to the parameter estimation results of each variable.

5.3. Capital control, foreign exchange reserve and the special polarization phenomenon

In the dynamic multinomial choice random effect panel Logit model, random effect and dynamic model are used to identify the impact of state dependence on the choice of the exchange rate regimes. At the same time, the non-state dependence factors such as capital control, foreign exchange reserve, currency mismatch and so on introduced in this paper also have important influences on the exchange rate regime choice. The estimation results in Table 4 implicate that the core explanatory variables in this paper, namely the capital account openness (ka_open), the foreign exchange reserve adequacy (reserve) and the level of currency mismatch (nfa_gdp), have a significant impact on the exchange rate regimes choice. However, their effects on different developing stages economies, especially the impacts on special polarization phenomenon, are different. Details are as follows.

First, the estimation result of the capital account openness (ka_open) is inconsistent with the theoretical prediction, but it is an important factor leading to the special polarization phenomenon. Among the estimation results of the 155 economies and the developing economies samples, the value of average partial effect of ka_open is positive (fixed relative to the intermediate) and negative (floating relative to the intermediate), which indicates that, with the improvement of the openness of capital account, the economies are inclined to choose the fixed exchange rate regime (relative to the intermediate exchange rate regime) or intermediate exchange rate regime (relative to the floating exchange rate regime). That is to say, economies are more inclined

Table 4. Average partial effects corresponding to parameter estimation for the of the dynamic multinomial choice random effect panel logit model.

	155 Economies Sample		Developing Economies		Emerging Market Economies		Developed Economies	
Variable	Fixed	Floating	Fixed	Floating	Fixed	Floating	Fixed	Floating
ka_open	0.154***	−0.073***	0.118**	−0.113**	0.025	−0.012	0.154**	0.025
	(0.027)	(0.021)	(0.057)	(0.045)	(0.035)	(0.051)	(0.065)	(0.055)
reserve	0.074***	−0.143***	0.114***	−0.240***	0.022	−0.083	0.002***	0.001
	(0.014)	(0.024)	(0.023)	(0.040)	(0.129)	(0-117)	(0.001)	(0.009)
nfa_gdp	−0.030***	0.009**	−0.042***	0.011	0.063	0.018	0.014	−0.004
	(0.009)	(0.003)	(0.015)	(0.007)	(0.083)	(0.096)	(0.037)	(0.040)
cpinf	−0.388***	0.251***	−0.426**	0.305***	−0.400	0.194	−2.452***	0.343
	(0.127)	(0.056)	(0.204)	(0.104)	(0.358)	(0.185)	(0.689)	(0.244)
nomshk_t	−0.044	0.046	−0.131	0.072	0.055	0.148	Null	Null
	(0.124)	(0.054)	(0.190)	(0.100)	(0.386)	(0.174)	Null	Null
gdppcg	0.585***	−0.213*	0.642	−0.323	0.178	0.038	0.077	0.121
	(0.207)	(0.114)	(0.406)	(0.197)	(0.309)	(0.548)	(0.348)	(0.393)
tradeope	0.060***	−0.064***	0.053	−0.027	0.054	−0.079	0.005	−0.148*
	(0.022)	(0.016)	(0.040)	(0.028)	(0.044)	(0.083)	(0.018)	(0.086)
zhougon	−0.141	0.222***	−0.292*	0.243**	0.046	0.266**	0.090	−0.112
	(0.097)	(0.056)	(0.171)	(0.114)	(0.141)	(0.133)	(0.175)	(0.132)
phlity2	−0.003**	−0.000	0.004	−0.004***	−0.006***	0.004	Null	Null
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	Null	Null
actotal	−0.001	−0.003	−0.009	−0.002	0.005	−0.010	Null	Null
	(0.005)	(0.003)	(0.009)	(0.006)	(0.005)	(0.008)	Null	Null
ldcpsgdp	−0.018	0.065***	−0.065	0.012	−0.020	−0.001	−0.012	0.043
	(0.026)	(0.016)	(0.117)	(0.065)	(0.060)	(0.062)	(0.042)	(0.034)
ca	0.211*	−0.247***	0.134	−0.152	0.120	−0.884	−0.248	0.176
	(0.110)	(0.058)	(0.221)	(0.097)	(0.388)	(0.578)	(0.357)	(0.438)

Note: (1) The figure in the brackets is robust standard error; (2) ***, ** and * indicate that the significance level is high at 1%, 5%, and 10%. (3) The reason why the estimation results for variables of nomshk_t, polity2, and actotal for the developed economies are null is that the data characteristics of these variables lead the covariance matrix obtained by maximum likelihood estimation to be the singular matrix. Therefore, these variables are eliminated when this group of samples is estimated.

to choose the less-flexible exchange rate regime. The classical exchange rate regime choice theories, such as Impossible Trinity, argue that with the improvement of the capital account openness, the economies should choose the floating exchange rate regime if the policy maker want to obtain monetary policy independence. The above estimation results are inconsistent with the classical theory, but they are consistent with the empirical observation result that most developing economies choose non-flexible exchange rate regimes such as the fixed and the intermediate exchange rate regimes. Among the estimation results of developed economies, the value of average partial effect of ka_open is also positive (fixed relative to the intermediate), which indicates that with the improvement of the capital account openness, the developed economies are more inclined to choose the fixed exchange rate regime (relative to the intermediate exchange rate regime). This result is also inconsistent with the classical theory, but it is consistent with the stylized fact that the fixed exchange rate regime and floating exchange rate regime are chosen by most developed economies, while the developed economies seldom choose the intermediate exchange rate regime. Among the estimation results for emerging market economies, the average partial effect of ka_open are not statistically significant.

Second, the estimation result of the foreign exchange reserve adequacy (reserve) is basically consistent with the theoretical prediction, and the estimation result is also

internally consistent with the special polarization phenomenon. Among the estimation results of the 155 economies and developing economies samples, the value of average partial effect of reserve is positive (fixed relative to the intermediate) and negative (floating relative to the intermediate), which indicates that, with the improvement of foreign-exchange reserve adequacy, economies are more inclined to choose either fixed exchange rate regime (relative to the intermediate exchange rate regime) or intermediate exchange rate regime (relative to the floating exchange rate regime). That is, the higher the economy foreign-exchange reserves are, the more willing the monetary authorities are to intervene in the foreign exchange market and reduce the volatility of the nominal exchange rate. Accordingly, the non-flexible exchange rate regime will be chosen. This result is consistent with the findings of Klein and Shambaugh (2015), Ilzetzki et al. (2019). Among the estimation results of developed economies, the average partial effect of reserve is 0.002 (fixed relative to the intermediate), which indicates that, with the increase of foreign exchange reserves, the developed economies also tend to choose fixed exchange rate regime (relative to the intermediate exchange rate regime). Among the estimation results of emerging market economies, the value of average partial effect of reserve are not statistically significant.

Third, the estimation results of the currency mismatch (nfa_gdp) are consistent with the theoretical prediction. Among the estimation results of 155 economies sample, the average partial effect for nfa_gdp is negative (fixed relative to the intermediate) and positive (floating relative to the intermediate), which indicates that, with the weakening of the level of currency mismatch (the value of nfa_gdp increases), the economies tend to choose the intermediate exchange rate regime (relative to the fixed exchange rate regime) and floating exchange rate regime (relative to the intermediate exchange rate regime); that is, economies are more inclined to choose the flexible exchange rate regime, and this result is consistent with the theoretical predictions. The estimation results of the developing economies also have similar results. The value of average partial effect of nfa_gdp is negative and statistically significant in developing economies (fixed relative to the intermediate); that is, with the weakening of the level of currency mismatch in developing economies (the value of nfa_gdp increases), the economies tends to choose the intermediate exchange rate regime (relative to the fixed exchange rate regime). The nfa_gdp is not statistically significant in the estimation results of the emerging market economies and developed economies.

6. Conclusions and implications

6.1. Important conclusions

The bipolar view argues the intermediate exchange rate regimes have crisis tendency and the policy maker should not choose these regimes. Although recent empirical literatures find the bipolar view overestimates the vulnerability of the intermediate exchange rate regimes, the special polarization phenomenon and state dependence are seldom discussed in recent researches. This paper, identifying spurious and true state dependence and focusing on the intermediate exchange rate regimes, provides new empirical explanations to the special polarization phenomenon. The main conclusions are as follows.

The state dependence has important influence on the choice of exchange rate regimes, and there is internal consistency between the state dependence and the special polarization phenomenon. Specifically, (1) with the simultaneous introduction of heterogeneity and dynamics in the econometric model, the dynamic multinomial choice random effect panel Logit model can better identify and control the spurious and true state dependence. In addition, with the good control of the two kinds of state dependence, the estimation results have far fewer statistically significant parameters than those obtained through discrete choice model without considering heterogeneity and dynamics. Therefore, existing empirical studies on the choice of exchange rate regimes overestimate the true impact of the explanatory and control variables on the choice of exchange rate regimes. (2) The choice of exchange rate regimes in emerging market economies is mainly determined by state dependence. The influence of non-state dependence factors on the choice of exchange rate regime of this group is not statistically significant. In emerging market economies sample, both true state dependence and spurious state dependence are statistically significant, and for the non-state dependence factors, only trade concentration (zhougon) and democracy level (polity2) are statistically significant. (3) True state dependence is the main cause for the special polarization phenomenon. In the estimation results of 155 economies sample, developing economies sample and emerging market economies sample, the parameter estimation reflecting the model dynamics (dit1LAG) are all negative and statistically significant, indicating that the economies that select the intermediate exchange rate regime in the previous period do not choose the fixed exchange rate regime or floating exchange rate regime in the current period, that is, the probability of maintaining the intermediate exchange rate regime is increasing. This estimation result is consistent with the fact that there is no significant exchange rate regime polarization in the 155 economies sample, developing economies sample and emerging market economies sample. In the estimation results of the fixed exchange rate regime relative to the intermediate exchange rate regime in developed economies, the parameter estimation of the dynamic part (dit2LAG, i.e. fixed exchange rate regime) is positive, which means that if the fixed exchange rate regime is selected in the previous period, the probability of continuing to use the fixed exchange rate regime in the current period will increase. The estimation results of developed economies also prove that developed economies tend to choose and maintain the fixed or floating exchange rate regime. Therefore, exchange rate regime polarization appears in developed economies.

Non-state dependence factors have important different impacts on the choice of exchange rate regime. Although the main estimation results are contrary to the classical theory, they are still intrinsically consistent with the special polarization phenomenon. In detail, (1) the impact mechanism of capital account openness is contrary to classical theoretical predictions. In 155 economies sample, developing economies sample and developed economies sample, the economy is more inclined to choose the less-flexible exchange rate regime with the increasing of capital account openness. The classical theory of exchange rate regime choice (such as the Impossible Trinity) argues that as the openness of the capital account increases, the economy should choose the floating exchange rate regime if the policy maker wants to gain

monetary policy independence. The finding of this paper is inconsistent with the classical theory but it is consistent with the empirical observation result that developing economies prefer less-flexible exchange rate regimes such as fixed exchange rate regime and intermediate exchange rate regime in reality. (2) The estimation results of foreign exchange reserves adequacy and the level of currency mismatch are consistent with theoretical predictions. In 155 economies sample, developing economies sample and developed economies sample, this paper finds that with the increase in the adequacy of foreign exchange reserves, the economy is more inclined to intervene in the foreign exchange market and choose the less-flexible exchange rate regime, which are consistent with the theoretical prediction. In 155 economies sample, developing economies sample, this paper finds that with the improvement of currency mismatch, the economy prefers to choose the flexible exchange rate regime, which is also consistent with the theoretical prediction.

The intermediate exchange rate regimes have been widely adopted by non-developed economies for a long time. The possible economic mechanism is that, when there are a large number of market imperfections in the economy, stabilizing the nominal exchange rate is an important condition for ensuring the effectiveness of other macroeconomic policy instruments and maintaining macroeconomic stability. An important economic feature of non-developed economies lies in the large number of market imperfections, such as the underdeveloped financial market and long-term currency mismatch. Under the above economic and financial conditions, only policy instruments such as adjusting the money supply and nominal interest rates are not enough to ensure macroeconomic stability. As foreign trade is an important economic growth channel and policy transmission channel for most non-developed economies, stabilizing the nominal exchange rate has become an important condition for non-developed economies to ensure the effectiveness of other macroeconomic policy instruments and the stability of macro economy. The estimation results of developing economies further prove that, as these economies loosen capital control, they stabilize the nominal exchange rate through accumulating foreign exchange reserves with stronger incentives. In summary, the market imperfections and export-oriented economy are the motivations for most non-developed economies to choose intermediate exchange rate regime for a long term to stabilize the nominal exchange rate.

6.2. Policy implications

The policy implication in this paper refers to the following contents.

The intermediate exchange rate regimes do not necessarily lead to a crisis, under certain condition, it has high sustainability and it can play a role in stabilizing economy. This paper has similar findings with Klein and Shambaugh (2015). Part of the capital control does not enable the policy makers to obtain a great degree of monetary policy autonomy. For developing economies and emerging market economies, controlling exchange rate fluctuations (intermediate exchange rate regimes) can give policy makers a certain degree of monetary policy autonomy. The above theoretical mechanism can explain the motivations of some economies to intervene the

fluctuation of nominal exchange rate by accumulating foreign exchange reserves while the capital account is open.

The choice of optimal exchange rate regime does not necessarily follow the only path from the fixed ones to the intermediate ones and then to the floating ones. The policy makers of an economy should choose an optimal exchange rate regime based on the fundamentals of economic operations (such as capital flow, foreign exchange reserve, currency mismatch, and development level of financial market), the nature and continuity of economic shocks (spurious state dependence) and the maturity of the macroeconomic policy framework (true state dependence). At the same time, the classical choice theory of exchange rate regime is mainly based on empirical observations and theoretical studies in developed economies. These classical theories cannot properly explain the choice of exchange rate regime in all economies at different development stages.

The reason why few developed economies choose intermediate exchange rate regime and the polarization phenomenon occurs in these economies is that developed economies have mature financial markets, regulatory frameworks and macro-control capabilities. Therefore, only when the above conditions are met, could an economy choose a floating exchange rate regime or a fixed exchange rate regime with the capital account open.

Notes

1. Special gratitude would be expressed to Professor Aman Ullah of the Department of Economics of the University of California Riverside for his correction and help on this issue.
2. The above estimation process is implemented in this paper through the Halton Draws method. See Train (2001) for specific ideas and implementation methods of Halton Draws.
3. The special bipolarization phenomenon is a new stylized fact during the Post-Bretton Woods System period, and the problem of missing data is serious before 1980 and after 2014 in this paper. Thus, this paper uses the panel data from 155 economies from 1980 to 2014.
4. Due to length limitations, this paper does not elaborate the specific results, and the details are available on request.
5. According to the mean value comparison results presented in Z statistics, there are significance differences between explanatory variables and control variables in fixed, intermediate and floating exchange rate regimes. Thus, this paper extends the binary discrete choice model to the multinomial discrete choice model, which is of great value and makes great contribution to this field.
6. Through the introduction of explanatory variables and control variables in the model step by step, it is found that the data characteristics of the democracy degree (polity2) variable could lead the variance covariance matrix obtained from the maximum likelihood estimation to be the singular matrix. Therefore, the polity 2 variable is eliminated in the estimation of the developed economies. Hereby, special acknowledgment is given to Professor William Greene from NYU Stern School of Business for his selfless help on this problem.
7. Since the introduction of random effect a_{ij} in the multinomial choice random effect panel Logit model results in serial correlation in the random error term u_{ijt}, the random effect model cannot be corrected through the introduction of clustered standard error. Therefore, the robust standard error is adopted here.

8. To estimate the dynamic multinomial choice random effect panel Logit model, as required by the Nlogit 6.0 software, the one-period lagged explained variable shall be generated by command. The explained variables in this paper are the latest exchange rate regime classifications provided by Ilzetzki, Reinhart, and Rogoff (2019), and the exchange rate regimes are classified into the intermediate exchange rate regime (value: 0), the fixed exchange rate regime (value: 1), and the floating exchange rate regime (value: 2). dit1LAG, dit2LAG, and dit3LAG are respectively the one-period lagged intermediate exchange rate regime, fixed exchange rate regime, and floating exchange rate regime. Since the core issue studied in this paper is closely related to the intermediate exchange rate regime, the one-period lagged intermediate exchange rate regime (dit1LAG) is introduced in the dynamic random effect model to reflect the dynamics of the model. The bipolarization phenomenon occurs in developed economies, that is to say, there are few developed economies choosing the intermediate exchange rate regimes in some years. Therefore, the one-period lagged intermediate exchange rate regime (dit1LAG) is introduced in the estimation of the developed economies, and the variable, along with other variables, will give rise to the multicollinearity problem. Thus, the one-period lagged fixed exchange rate regime (dit2LAG) is introduced in the estimation of the developed economies to reflect the dynamics of the model.
9. Relative to the reference status (the intermediate exchange rate regime), the variable has a positive impact on the probability of holding on to the reference status. For instance, the first group of estimation results among the 155 economies sample, namely the parameter estimation value of the dynamic part in the estimation results of the fixed exchange rate regime relative to the intermediate exchange rate regime, is - 5.493, which means that the probability of not selecting the fixed exchange rate regime at current period and continuing to hold on to the intermediate exchange rate regime will rise if the intermediate exchange rate regime is selected in the previous period.
10. For instance, the United Kingdom shifted from the intermediate exchange rate regime to the floating exchange rate regime in 2009; Iceland shifted from the floating exchange rate regime to the intermediate exchange rate regime in 1984; Australia shifted from the intermediate exchange rate regime to the floating exchange rate regime in 1984; Slovenia shifted from the floating exchange rate regime to the intermediate exchange rate regime in 1993.
11. The figure in brackets is the year when the outlier occurs.
12. Due to the pages limitation, the estimation results of robustness test is not provided, the details are available on request.
13. In the discrete choice model, the partial effect refers to the influence of the changes in one unit of the explanatory variable on the probability by which the explained variable will be selected when other conditions remain unchanged. For details, please refer to Hensher, Rose, and Greene (2015).
14. In the discrete choice model, the average partial effect (APE) refers to the average influence of changes in one unit of the explanatory variable on the probability by which the explained variable will be selected when other conditions remain unchanged.

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Appendix

Appendix 1. The related empirical researches from 1978 to 2016.

Number	Sample	(quantity, grouping)	Sample period	Econometric model, exchange rate regimes classification	Estimation method
1	88	Developing	1976	Ordered Choice, Trichotomy	Cross-section
2	64	Developed, Developing	1979	Ordered Choice, Trichotomy	Cross-section
3	39	Developing	1976-1984	Binary Choice, Dichotomy	Pool Estimation of Panel Data Model
4	43	Developing	1979-1986	Ordered Choice, Trichotomy	Pool Estimation of Panel Data Model
5	125	Developed, Developing	1991	Multinomial Choice, Trichotomy	Cross-section
6	63	Developed, Developing	1980-1992	Binary Choice, Dichotomy	Pool Estimation of Panel Data Model
7	70	Developed, Developing	1979-1992	Binary Choice, Dichotomy	Cross-section
8	125	Developing	1977-1995	Ordered Choice, Trichotomy	Cross-section
9	20	Developed	1974-1995	Binary Choice, Dichotomy	Pool Estimation of Panel Data Model
10	65	Developing	1980-1994	Binary Choice, Dichotomy	Panel Random Effect Model
11	93	Developing	1999	Ordered Choice, Trichotomy	Cross-section
12	125	Developed, Developing	1980-1994	Binary Choice, Dichotomy	Pool Estimation of Panel Data Model
13	130	Developed, Developing	1990-2000	Multinomial Choice, Trichotomy	Cross-section
14	25	Transition Economy	1990-1999	Ordered Choice, Trichotomy	Pool Estimation of Panel Data Model
15	128	Developing	1981-1999	Multinomial Choice, Trichotomy	Dynamic Multinomial Choice Random Effect Panel Logit Model
16	34	Multi-area	1973-1996	Ordered Choice, Trichotomy	Panel Fixed Effect Model
17	183	Industrialization, Non-industrialization	1974-2003	Multinomial Choice, Trichotomy	Pool Estimation of Panel Data Model
18	180	Developed, Developing	1974-2004	Multinomial Choice, Trichotomy	Panel Fixed Effect Model
19	182	Developed, Emerging, Developing	1971-2011	Binary Choice, Dichotomy	Pool Estimation of Panel Data Model
20	150	Emerging, Developing	1974-2007	Binary Choice, Dichotomy	Pool Estimation of Panel Data Model
21	31	Emerging	1990-2010	Multinomial Choice, Trichotomy	Pool Estimation of Panel Data Model

Note: The above literatures are not listed in the reference, and are available on request.

Appendix 2. The exchange rate regimes classification of Ilzetzki et al. (2019).

	Coarse Classification	Fine Classification	Exchange Rate Regimes
Hard Pegs	1	1	1. No separate legal tender or currency union
	1	2	2. Pre announced peg or currency board arrangement
	1	3	3. Pre announced horizontal band that is narrower than or equal to +/−2%
	1	4	4. De facto peg
Soft Pegs	2	5	5. Pre announced crawling peg; de facto moving band narrower than or equal to+/−1%
	2	6	6. Pre announced crawling band that is narrower than or equal to +/−2% or de facto horizontal band that is narrower than or equal to +/−2%
	2	7	7. De facto crawling peg
	2	8	8. De facto crawling band that is narrower than or equal to +/−2%
	3	9	9. Pre announced crawling band that is wider than or equal to +/−2%
	3	10	10. De facto crawling band that is narrower than or equal to +/−5%
	3	11	11. Moving band that is narrower than or equal to +/−2% (i.e., allows for both appreciation anddepreciation over time)
	3	12	12. De facto moving band +/−5%/ Managed floating
	6	15	15. Dual market in which parallel market data is missing
Floating	4	13	13. Freely floating
	5	14	14. Freely falling

Appendix 3. The names and meanings of explanatory variables and control variables.

Number	Name	Meaning	Measuring Methods and Data Source	Theoretical Foundation
1	ka_open	Openness of Capital Account	Chinn&Ito (2008)	Core Explain Variable
2	reserve	Adequacy of Foreign Exchange Reserves	Non-gold Foreign Exchange Reserves/ Broand Money, IMF IFS	Core Explain Variable
3	nfa_gdp	Currency Mismatch	Lane&Milesi-Ferretti (2007)	Core Explain Variable
4	cpinf	Nominal Shock(Inflation)	CPI Growth Rate, IMF WEO	Mundell-Fleming Model
5	nomshk_t	Nominal Shock(Broad Money Expasion)	Broad Money Growth Rate, IMF WEO	Mundell-Fleming Model
6	gdppcg	Real shock(Growth Rate of Real GDP per Capita)	Growth Rate of Real GDP per Capita, World Bank WDI	Mundell-Fleming Model
7	rgdpg	Real shock(Real GDP Growth Rate)	Real GDP Growth Rate, World Bank WDI	Mundell-Fleming Model
8	tradeope	Trade Openness	Volumn of Import and Export /GDP, IMF WEO	Optimal Currency Area Theory
9	zhougon	Trade Concentration	Trading Volumn of Top 10 Trading Partners/ Total Trading Volumn (Hagen and Zhou, 2007) IMF Direction of Trade Statistics	Optimal Currency Area Theory

(*continued*)

Appendix 3. Continued.

Number	Name	Meaning	Measuring Methods and Data Source	Theoretical Foundation
10	lsize	Economy Scale	Log of GDP in Dollar, IMF WEO	Optimal Currency Area Theory
11	lnlevel	Economy Development Level	Log of GDP per Capita in Dollar, IMF WEO	Optimal Currency Area Theory
12	polity2	Degree of Democracy	Center for Systemic Peace	New Political Economy Theory of Exchange Rate Regimes Choice
13	actotal	Degree of Political Instability	Center for Systemic Peace	New Political Economy Theory of Exchange Rate Regimes Choice
14	ldcpsgdp	Financial Market Development Level	Loan of Domestic Private Sectors /GDP, World Bank WDI	Impossible Triangle Theory
15	ca	Current Account	Balance of Current Account/GDP, IMF WEO	Monetary Crisis Theory

Appendix 4. Estimation results of multinomial choice panel logit model with pool estimation.

	155 Economies Sample		Developing Economies		Emerging Economies		Developed Economies	
Variable Name	Fixed	Floating	Fixed	Floating	Fixed	Floating	Fixed	Floating
ka_open	0.341**	0.095	0.147	−0.617	0.529	0.400	1.306**	5.975***
	(0.133)	(0.243)	(0.165)	(0.408)	(0.343)	(0.760)	(0.588)	(2.307)
reserve	0.014***	−2.832***	0.003	−2.724***	0.774	−3.270**	0.022***	−0.402
	(0.005)	(0.602)	(0.042)	(0.614)	(0.935)	(1.410)	(0.005)	(2.337)
nfa_gdp	−0.153***	−0.331*	−0.057	−0.202	0.899	0.738	−0.218	2.701
	(0.054)	(0.197)	(0.050)	(0.197)	(0.563)	(1.264)	(0.305)	(3.714)
cpinf	−5.542***	6.806***	−5.497***	5.182***	−1.942	9.021***	−13.620**	11.778
	(1.151)	(1.108)	(1.263)	(1.262)	(1.982)	(2.567)	(5.644)	(22.325)
nomshk_t	−1.722***	1.273	−2.651***	1.361	1.501	3.934*	0.970	−12.283
	(0.491)	(0.967)	(0.618)	(1.163)	(1.480)	(2.201)	(1.579)	(12.701)
gdppcg	−0.918	−3.726**	−1.118	−5.956***	−2.439	−3.163	−1.457	34.869
	(0.802)	(1.648)	(0.835)	(1.868)	(3.482)	(4.932)	(3.296)	(30.984)
tradeope	0.115	−2.697***	0.815***	−0.037	0.642*	−2.259	−0.608***	−61.570***
	(0.087)	(0.377)	(0.150)	(0.336)	(0.385)	(1.642)	(0.183)	(12.579)
zhougon	0.898*	2.684***	0.183	2.817***	−0.147	4.818**	−10.479***	−6.012
	(0.509)	(0.741)	(0.656)	(1.046)	(1.677)	(2.093)	(1.569)	(6.326)
polity2	−0.066***	−0.029**	−0.051***	−0.049***	−0.142***	0.084*	−0.118***	22.715
	(0.007)	(0.012)	(0.008)	(0.014)	(0.022)	(0.047)	(0.044)	(145568.1)
actotal	−0.224***	−0.222***	−0.171***	−0.152***	−0.115	−0.214*	−31.877***	−4.999***
	(0.039)	(0.046)	(0.044)	(0.056)	(0.090)	(0.120)	(0.885)	(1.675)
ldcpsgdp	0.082	1.880***	−0.951***	−0.939	0.753	−0.118	0.994***	10.235***
	(0.144)	(0.205)	(0.344)	(0.808)	(0.464)	(1.211)	(0.333)	(2.463)
ca	−0.575	−1.739	0.994	0.449	0.615	−21.354***	−3.613	−35.752
	(0.523)	(1.235)	(0.605)	(1.191)	(2.673)	(6.659)	(2.517)	(32.304)
Cons	−0.758*	−3.426***	−0.005	−3.889***	−2.141*	−6.869***	7.132***	−210.496
	(0.419)	(0.599)	(0.549)	(0.906)	(1.221)	(1.982)	(1.389)	(0.181)
Chi squared	1189.973***		701.949***		343.855***		608.997***	
Log-likelihood	−2376.937		−1476.416		−312.796		−273.185	
Pseudo R2	0.200		0.192		0.355		0.527	
Observations	3192		1954		665		573	

Note: (1) The numbers in parentheses are clustered standard error; (2) ***, **, and * represent significant levels of significance. at 1%, 5%, and 10%, respectively.

Appendix 5. Comparison of the effects of state dependence on estimation results.

	155 Economies Sample						Developing Economies					
Variable Name	Fixed			Floating			Fixed			Floating		
ka_open	P	RE	DRE		RE			RE			RE	DRE
reserve	P	RE	DRE	P	RE	DRE		RE		P	RE	DRE
nfa_gdp	P	RE	DRE	P	RE			RE	DRE			
cpinf	P	RE	DRE	P	RE	DRE	P		DRE	P	RE	DRE
nomshk_t	P				RE		P			P		
gdppcg		RE	DRE	P	RE						RE	
tradeope		RE		P	RE	DRE	P			P		
zhougon	P			P	RE	DRE		RE			RE	
polity2	P	RE	DRE	P	RE		P			P	RE	DRE
actotal	p			P			P	RE		P		
ldcpsgdp		RE		P	RE	DRE	P	RE			RE	
ca		RE			RE	DRE						

	Emerging Economies						Developed Economies					
Variable Name	Fixed			Floating			Fixed			Floating		
ka_open		RE					P		DRE	P		
reserve				P			P	RE	DRE			
nfa_gdp		RE						RE				
cpinf				P	RE		P		DRE			
nomshk_t				P								
gdppcg												
tradeope	P				RE		P	RE		P	RE	DRE
zhougon		RE		P	RE	DRE	P	RE				
polity2	P	RE	DRE	P	RE		P					
actotal		RE		P			P			P		
ldcpsgdp		RE					P	RE		P	RE	DRE
ca				P	RE							

Note: (1) P, RE, and DRE respectively represent the estimation results of multinomial choice panel logit model with pool estimation, multinomial choice random effect panel logit model and dynamic multinomial choice random effect panel logit model; (2) P, RE, DRE appearing in one grid indicates that the explanatory variable or control variable corresponding to the model is significant in the estimation result; (3) The shaded part in the table represents the dynamic multinomial choice random effect panel logit model, the relevant variable parameter estimation result is significant, the number of shaded parts (DRE) To be less than the number of P and RE, the introduction of a dynamic model (true state dependent) will reduce the number of significant estimates of the parameters.