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**Article**

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## BANKING & FINANCE | RESEARCH ARTICLE

# Threshold effects of fiscal decentralization on income inequality: Evidence from Vietnam

Nguyen Thanh Hung<sup>1\*</sup> and Su Dinh Thanh<sup>1</sup>

**Abstract:** This paper proposes a new approach to analyse the dynamic relationships between Fiscal decentralization and Income inequality of 63 provinces/cities of Vietnam in the period from 2000 to 2018, with the the Panel smooth transition regression (PSTR) model for estimating the threshold impact of fiscal decentralization on income equality through economic growth. The empirical results obtained from the analysis show strong and unequivocal evidence on the different effects of fiscal decentralization variables (ED1, ED2, RD1, RD2, TD) on income inequality, according to each stage of local growth. Additionally, in their relationship with inequality, the variables ED1, ED2, and FDI react quite sensitively to the change of income levels of the economy around the threshold value of VND78.33 million VN/person/year. Thus, our study contributes to the theory a new insight into the mixed results regarding the nonlinear relationship between fiscal decentralization and income inequality, based on which an effective strategy can be drawn up to reduce income inequality within the country.

**Subjects:** Economics; Political Economy; Public Finance

**Keywords:** Income inequality; threshold of fiscal decentralization; growth; PSTR

### 1. Introduction

Income inequality has risen internationally during the last two decades, garnering the attention of academics and politicians owing to its influence on growth and economic stability (Bastagli et al., 2012; Dabla-Norris et al., 2015). The fact that income inequality is connected with faster economic



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### PUBLIC INTEREST STATEMENT

The research has made a new contribution to the theory of fiscal decentralization, which is the existence of a nonlinear relationship between fiscal decentralization and income inequality. There is a transition from the low-income region to the high-income region of the locality with the slope of the transition function in the estimate being on average 2.6048. And the transitions of the fiscal decentralization policy variables will take place gradually according to the growth values of GDP, especially around the estimated value of the optimal threshold parameter  $\hat{C}=4.29495$ , (respectively GDP is 78.33 million VND/person/year). At this level of income, the magnitude and sign of the effects of fiscal decentralization variables on income inequality will change. From there, support policy makers and regional managers to make policies suitable for each stage of economic growth of each locality/province.

growth in high-income nations, but hampers economic progress in developing countries is a key point of contention in the argument (Barro, 2000, 2008). Furthermore, the growth rate of income inequality varies from country to country, suggesting that national and institutional contexts influence the trajectory of inequality (Alvaredo et al., 2018). As a result, it is possible to create suitable policies to minimize income inequality and slow growth by better understanding the variables that influence inequality. One of the potential strategies to minimize income inequality is to change the structure of political institutions and fiscal decentralization.

The most recent decentralization theories, such as Gemmell et al. (2013) and Filippetti and Sacchi (2016), on the provision of public goods and services primarily focus on the impact of fiscal decentralization on economic growth outcomes (Arze Del et al., 2016; Faguet & Sánchez 2014). The link between fiscal decentralization and income inequality is a tiny but rising subgroup of this theory, although the quantity of studies on this relationship is typically disproportionate and mainly underlines regional disparities (Christian Lessmann, 2012; Kyriacou et al., 2013; Lessmann, 2009; Rodríguez-Pose & Ezcurra, 2010). The most important takeaway from these investigations is that fiscal decentralization helps reduce regional differences in high-income nations, but has the reverse impact in low- and middle-income countries.

Both Neyapti (2006) and Bojanic (2018) look at revenue decentralization and find that it reduces income inequality, whereas others, such as Sacchi and Salotti (2014), who investigate tax decentralization and Bojanic (2018), who examines expenditure and revenue decentralization in low-income countries, find that it increases income inequality. Using interactive models, several studies have discovered a differential effect of fiscal decentralization on income inequality. This implies that prior research findings are contradictory.

According to CF Sepulveda and Martinez-Vazquez (2011), decentralizing expenditures raises income inequality, although the effect diminishes as the size of the government grows. Although various methodologies and samples lead to seemingly conflicting conclusions, Tselios et al. (2012) and Cavusoglu and Dincer (2015) both investigate interactions with income. Tselios et al. (2012), using data from the European Union, indicate that income and spending decentralization lowers income inequality in low-income areas while increasing income inequality in high-income regions. Exploring data from the United States, Cavusoglu and Dincer (2015) demonstrate that decentralizing expenditure and revenue increases income inequality for low-income states while reducing income inequality for high-income states. Despite these advancements, little research has been done on the influence of decentralization on income inequality.

Many countries are interested in fiscal decentralization because of its potential to increase government efficiency (Oates, 2005; Organisation for Economic Co-operation and Development (OECD) 2006, 2009a; Organisation for Economic Co-operation and Development (OECD), 2009b). In the design of redistributive policies, state and local governments have acquired a significant degree of autonomy, particularly in the case of state and municipal governments (Bahl et al., 2000). The question is how income inequality will be affected by this fiscal decentralization. The study's primary goal is to provide empirical evidence on this relationship at the country level, focusing on: (i) whether income inequality is systematically related to decentralization of government finance; and (ii) whether fiscal decentralization affects local income inequality, and thus can improve a country's income distribution.

Previous theories have long studied the relationship between redistributive fiscal policy and income distribution, concluding that differences in the progressiveness of tax and expenditure policies help explain the majority of variance in average disposable income inequality between nations (Bastagli et al., 2012). Several theories of fiscal decentralization and economic inequality argue that the two should be linked, particularly the redistribution of decentralized government and independent sub-national governments, which rely largely on transfers to fund their expenditures. More importantly,

1. The following table shows the number of students who took the SAT in each year from 1990 to 2010. The number of students is in millions.

Year	Number of Students (Millions)
1990	1.5
1991	1.5
1992	1.5
1993	1.5
1994	1.5
1995	1.5
1996	1.5
1997	1.5
1998	1.5
1999	1.5
2000	1.5
2001	1.5
2002	1.5
2003	1.5
2004	1.5
2005	1.5
2006	1.5
2007	1.5
2008	1.5
2009	1.5
2010	1.5

2. The following table shows the number of students who took the SAT in each year from 1990 to 2010. The number of students is in millions.

Year	Number of Students (Millions)
1990	1.5
1991	1.5
1992	1.5
1993	1.5
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1996	1.5
1997	1.5
1998	1.5
1999	1.5
2000	1.5
2001	1.5
2002	1.5
2003	1.5
2004	1.5
2005	1.5
2006	1.5
2007	1.5
2008	1.5
2009	1.5
2010	1.5

levels, even though these bodies may not be elected representatives. They might not have the power to allocate funds in a way that meets societal needs as a result.

Participation in local governance and the mechanism of collecting local resources are insufficient at the local level. As a result, it is critical to maintain an optimal mix of decentralization at any given time, such as increased fiscal decentralization, which goes hand in hand with sufficient expenditure/revenue autonomy to match local preferences (administrative decentralization), and a sufficient political infrastructure so that local preferences can be communicated appropriately to elected officials with a sufficient political infrastructure (political decentralization).

### **2.2. Equality and fiscal decentralization**

Assuming that jurisdictions and resources differ, income inequalities will emerge as a result of resource discrepancies. Decentralization will allow for more targeted efforts and therefore more success in decreasing inequality if local government units strive to promote social welfare within their jurisdiction and citizens demand a more equitable distribution of wealth (Tselios et al., 2012). Furthermore, greater political decentralization improves openness and accountability, possibly strengthening underprivileged people while also reducing corruption (Tselios et al., 2012).

However, decreasing income inequality is not the conventional objective of decentralization, and local governments frequently confront budgetary restrictions that prohibit them from reducing any effective inequality. As a result, some believe that central government should undertake redistributive measures (WE Oates, 1999; Prud'homme, 1995). Nonprofit taxes, for example, are frequently used for redistribution and are best handled by the federal government to minimize jurisdictional rivalry and inefficient tax rates (WE Oates, 1999). Furthermore, if fiscal and administrative decentralization are not coordinated with proper accountability systems, further decentralization might result in increased inequality (Bardhan & Mookherjee, 2006; Blanchard & Shleifer, 2001).

Although fiscal decentralization has the potential to reduce income inequality, the actual benefits of equality are contingent on: (i) the extent to which authorities are able to match local preferences for equality due to resource constraints; and (ii) the extent to which they are responsible for doing so. Because further decentralization may make monitoring more difficult and put more strain on the resource base, for example, due to implementation costs (Hindriks & Gareth, 2006), there is a threshold for attaining income equality if fiscal decentralization promotes income equality.

### **2.3. Efficiency and fiscal decentralization**

Fiscal decentralization is frequently promoted on the grounds that it improves resource allocation efficiency and/or efficiency in the delivery of public goods. Support for fiscal decentralization is based on the assumption that local government units are “closer” to public service consumers, policies are more adaptable, and preferences will be more appropriate. Fiscal decentralization, in particular, works better when preferences and costs differ across jurisdictions (WE Oates, 1999). As a result, the more diverse people’s choices are, the larger the potential welfare advantages of fiscal decentralization (Ezcurra & Pascual, 2008; WE Oates, 1999; Tiebout, 1956).

Assuming that the central government would choose to offer public goods and services uniformly given a variety of incentives, some degree of decentralization is deemed desirable (Hindriks & Gareth, 2006). However, due to coordination issues and unnecessary overlapping tasks across levels of government, the greater the degree of decentralization, the less successful it is likely to be. Citizens may find it increasingly difficult to hold government institutions responsible as decentralization progresses, since the duties of particular local units become less apparent. The ability of public goods to spread benefits and costs across jurisdictions (WE Oates, 1999; Tiebout, 1956), as well as the extent to which economies of scale and/or scope associated with a given function (Rodríguez-Pose & Bwire, 2004) determine the degree to which decentralization will occur and the

functions that must be decentralized. These considerations, taken together, imply that there is likely to be a point at which greater decentralization becomes undesirable and inefficient.

Previous empirical research on the influence of fiscal decentralization on regional income inequality might be categorized as developed country studies, studies of both developed and developing nations, studies of a developing country, or studies of a single country. Case studies show that fiscal decentralization increases income inequality across regions in China (Kanbur & Zhang, 2004; Qiao et al., 2008), the Philippines, and Colombia (Bonet, 2006), but it reduces inequality in the United States (Akai and Hosio, 2009) and Italy (Calamai, 2009). Furthermore, in the European Union (Ezcurra & Pascual, 2008) and OECD nations, fiscal decentralization has been identified as a factor in reducing income gaps (Gil et al., 2004; Lessmann, 2009). As a result, in comparing one country with another, there are several differences. In particular, fiscal decentralization has been found to raise regional income inequalities in poor nations, whereas it is either neutral or tends to reduce income disparities in wealthy countries (Christian Lessmann, 2012; Rodríguez-Pose & Ezcurra, 2010).

Tselios et al. (2012) used a dataset of 102 European Union regions from 1995 to 2000 to investigate the impact of fiscal decentralization on income inequality across regions. According to the findings of this study, the greater the degree of fiscal decentralization as measured by the proportion of local government spending to total central government spending, the smaller the regional inequality. However, if the region's per capita GDP rises, the benefits of fiscal decentralization would decline. From 1980 to 2009, Christian Lessmann (2012) investigates the influence of fiscal decentralization on regional inequality using a sample of 54 industrialized and developing nations. The findings are generally consistent with those of Tselios and others, implying that fiscal decentralization, as measured by the degree of "vertical imbalance" (Aldasoro and Seiferling 2014; Eyraud & Lusinyan, 2013), or fiscal decentralization (as measured the greater the degree of fiscal decentralization in terms of expenditure, income decentralization, or taxation decentralization, the greater the propensity to minimize regional inequality, depending on the region's growth. As a result, fiscal decentralization raises income inequality in developing nations while decreasing it in industrialized economies.

In the context of fiscal decentralization and full factor transfer, individuals can freely choose all of their preferred public goods, as well as tax incentives, according to Tiebout (1956). Fiscal decentralization can thus lead to more efficient supply of public goods at the local level. Janos Kornai (1980) identifies a number of pro-devolution ideas, but cautions against fiscal flexibility. In a totally centralized economy, the central government controls the bulk of public resources and may transfer them to local governments based on their financial requirements. However, because local governments do not have to worry about failure or bankruptcy because they would be bailed out by the state, this may reduce their desire to build local economies. Central government transfers will function as flexible fiscal restrictions in this instance. As a consequence, fiscal decentralization, which empowers local governments, will aid in the resolution of this tough problem and the avoidance of minor budgetary limitations.

Fiscal decentralization and adequate capital mobility across regions, according to Qian and Roland (1998), can help relieve local government budget restrictions while also supporting economic growth. In conclusion, fiscal decentralization improves government efficiency and empowers local governments to support economic growth (Oates, 1972; WE Oates, 1999). In the framework of inter-jurisdictional rivalry, Qian and Weingast (1997) examine fiscal decentralization and advocate its development. According to Qian and Roland (1998), fiscal decentralization and adequate capital mobility across regions can help relieve local government budget restrictions as well as support economic growth. In conclusion, fiscal decentralisation improves government efficiency and empowers local governments to support economic growth (Oates, 1972; WE Oates, 1999).

McKinnon (1995, 1997) and Qian and Weingast (1997) suggest that decentralization of compliance, which includes various degrees of welfare assistance, can be more successful than centralized redistribution in decreasing regional income inequality. To encourage investment and growth, poorer local governments might take advantage of less generous social systems and lower taxation (McKinnon, 1997). As a result, the ensuing migratory drivers may diminish regional income differences, lowering annualized income inequalities. The second generation hypothesis emphasizes the shift from central to local government, which is seen as a potential cause of differences in government spending objectives. Dependence on transfers across levels of government can hinder adjustment and convergence, whereas reliance on distinct income streams maintains a balance.

#### **2.4. Inefficiency and fiscal decentralization**

Several studies, on the other hand, show that budgetary decentralization has a detrimental influence on regional income inequality. Prud'homme (1995) conducted a comprehensive assessment of the negative consequences. He claims that the central government should be responsible for redistributive programs and should hold a substantial portion of taxes and public expenditure, based on his theoretical perspective and actual findings. While centralization is not a necessary condition for reducing regional disparities, it is a necessary prerequisite. He also states that implementing redistribution plans on a local level is challenging for a country. As a result, fiscal decentralization makes it more difficult to achieve redistribution goals. The impacts of fiscal decentralization on income inequality have been studied empirically, and there is a negative connection between income inequality and fiscal decentralization. CF Sepulveda and Martinez-Vazquez (2011) use a five-year average for a sample of 56 nations to look at the link between fiscal decentralization and inequality. The ratio of local spending to government operating expenses is used to measure fiscal decentralization. The effect of fiscal decentralization on conditional income inequality is calculated in this study based on the size of the economic government. The findings demonstrate that fiscal decentralization decreases income inequality in government sectors, at least 20% of the GDP.

According to income inequality theories, the government's redistribution function plays a key role in explaining income disparities between regions and nations (Gustafsson & Johansson, 1999; Li et al., 2000; Chu et al., 2000; Galli & Rolph, 2001; Dollar & Kraay, 2002; Lundberg & Squire, 2003). At the same time, fiscal decentralization, according to fiscal federalism theory, may reduce the efficacy of redistribution in the economy. There is a link between fiscal decentralization and income inequality, according to existing empirical data. The hypothesis of the link between fiscal decentralisation and income inequality, on the other hand, solely takes into account the worldwide degree of fiscal decentralization. The connection is also confined to a linear one.

Furthermore, state and local governments should not be involved in income redistribution under the theory of fiscal federalism (Oates, 2008). According to this idea, decentralized redistribution would encourage "poor" households to relocate to regions with more generous redistribution schemes, while "rich" households might relocate to places with minimal taxes and transfers (Musgrave, 1959; Oates, 1972; Stigler, 1957). Redistribution at lower levels of the central government, or in economic unions with complete labor mobility, would be self-defeating and unsustainable due to this "foot vote" phenomena (Prud'homme, 1995; Tiebout, 1956). As the poor relocate and the rich move, income inequality in each region will be decreased, but national income inequality will not be changed. Because local governments would be severely limited in their capacity to change the existing distribution of national revenue, broad redistribution would be unlikely (Oates, 1972). A decentralized redistribution system, according to this collection of ideas, would result in less redistribution than is socially acceptable (Prud'homme, 1995; Tiebout, 1956). Hence, according to this hypothesis, local governments' efforts to redistribute through decentralization would be too weak and ineffectual to change the national income distribution. As a result, when redistributed policies are decentralized, fewer redistributions and higher disparities are predicted.



Padovano (2007) proposed an economic model in which local governments make redistribution more effective. In this concept, regions use their resources to support dispersed initiatives in a decentralized fiscal system. Concentrated redistribution, on the other hand, permits areas to receive profits from other regions, causing a distortion that obstructs the movement of means of production, which typically leads to long-term income convergence. Padovano (2007) also suggests that because these resources cannot compensate for the initial direction of redistribution, an emphasis on income redistribution is required to alleviate income inequality in less developed countries. His study, based on Italian and American data, shows that decentralized systems produce greater efficiency rates and redistributive flow stability. In summary, the authors of the second generation contend that extensive tax decentralization, including redistribution, is more likely to produce greater income equality when funded largely from personal income sources.

Additionally, the political systems, legal frameworks, and levels of fiscal decentralization in many industrialized countries are rapidly changing. In industrialized countries, decentralization initiatives have recently been introduced with the aim of enhancing subordinate governments' autonomy and reducing the inefficiencies of centralized fiscal policy. By moving policy authority and empowerment to the local level, fiscal decentralization is driven by the goal to more efficiently employ public resources. This has the added benefit of promoting a nation's economic development (Bahl and Linn, 1992; Musgrave, 1959; Oates, 1972; Stigler, 1957). Kanbur and Zhang (2004) focus on the backdrop of growing decentralization of expenditure in China, which promotes regional income inequality. According to Akai and Sakata (2005), increasing revenue fiscal decentralization decreases regional income inequality, reduces local government financial dependency, and supports economic growth in poor areas.

According to Oates (1972), preferential policies that are uneven throughout regions may stimulate fiscal decentralization in an effort to improve the performance or well-being of local government. Oates (1997) asserts that the acceptance of a range of government products is required given the local environment. As a result, the following ways in which regional economic inequalities can significantly influence fiscal decentralization: (1) Extreme regional economic inequalities may lead to a greater need for fiscal autonomy and decentralization (Bolton and Roland, 1997); (2) if certain provinces or regions are unable to provide basic public services, resources may be diverted from other provinces or regions to address the issue (Buchanan, 1950, Rodríguez-Pose & Ezcurra, 2010). On the other hand, wealthy locals are often more against it than for it. Redistributive decentralization is unworkable due to the conflict that results between local governments over taxation and public utilities (Musgrave, 1959; Oates, 1972; Stigler, 1957), and fair redistribution must be carried out at the federal level.

Furthermore, according to Hung et al. (2020), there may be a connection between regional economic inequalities, fiscal decentralization, and corruption. When compared to the nation's overall revenue, fiscal decentralization produces 100% of local revenue from local taxes and other non-tax sources, which has a positive effect on income disparity. Population increase in a community is inversely correlated with income inequality. Contrarily, income disparity has a positive impact on the decentralization of the independent revenue sources in the provinces.

In consequence, fiscal decentralization has the potential to decrease or increase regional income disparities. Because fiscal decentralization includes more precise policies and greater reporting, it can help minimize income inequality in the region (Oates, 1972, p. 1993). Fiscal decentralization allows local governments to have more detailed knowledge about people's needs, allowing them to adjust and develop unique policies for each locality (Oates, 1972).

In summary, most studies on the relationship between fiscal decentralization and income inequality only stop at a linear relationship. And make general statements about whether fiscal decentralization has a positive or negative impact on income inequality. Previous empirical studies

have largely relied on the linear relationship between fiscal decentralization and income inequality, but there has been no research on the nonlinear relationship between fiscal decentralization and inequality in the world income. As well as determining the threshold for the impact of fiscal decentralization on income inequality by stages of economic growth has not been done in a developing country like Vietnam.

In addition, in Vietnam, the inequality of per capita income of the province compared to the per capita income of the country, there is a huge disparity between provinces and this disparity affects as follows: How about fiscal decentralization. Especially the ability to be autonomous in spending, direct spending, autonomous in revenue as well as decentralized in tax collection. Thus, in order to assess the variability of income inequality when there is an impact of fiscal decentralization, a question arises whether the impact of anti-dumping on income inequality has the form of a Kuznet curve (EKC) or not? As well as examining the potential nonlinear relationship between fiscal decentralization and inequality in average income among provinces in Vietnam, the study uses the smooth transition table regression model PSTR as proposed by Gonzalez et al. (2005) performed in two steps: first, removing the individual fixed effects by averaging the variables; The next step is to use nonlinear least squares (NLLS) estimates to estimate the parameters. With the PSTR model approach that the topic used, it brought two advantages in the research. Firstly, on the basis of PSTR, the study obtained the estimated coefficients of the fiscal decentralization variables as well as economic growth and foreign direct investment that varied between provinces as well as between years in the period survey section. Therefore, the approach of the topic will add to the academic treasure a practical demonstration of how to apply the PSTR method—which is still relatively new in research in Vietnam to recognize heterogeneity. provinces and time instability when considering the nonlinear relationship between fiscal decentralization and inequality across provinces in Vietnam. Second, the PSTR modeling approach also allows the estimated coefficients of the fiscal decentralization variables in each province to vary smoothly as a function of economic growth. Therefore, the study can perform tests on (i) the existence of threshold effects; (ii) it is possible to extend the assessment of the impact of threshold variables other than economic growth on the coefficients of fiscal decentralization by comparing the estimated parameters in each period.

### 3. Data and methodology

#### 3.1. PSTR model

The panel smooth transition regression (PSTR) model established by Gonzalez et al. (2005, 2017) is used to investigate the potential non-linear link between fiscal decentralization and inequality in the average income of Vietnam's provinces. Accordingly, a basic PSTR model has the following form:

$$y_{it} = \mu_i + \beta_0' x_{it} + \beta_1' x_{it} g(q_{it}, \gamma, c) + u_{it} \quad (1)$$

where:

- $y_{it}$  is income inequality;
- $\mu_i$  are fixed factors that do not change over time for each province;
- $x_{it}$  is the lagged vector of the decentralization variable, the logarithm of per capita income and foreign investment, with coefficients varying according to the transition function;
- $q_{it}$  is per capita income, acting as a transition variable;
- $c = (c_1, c_2, \dots, c_m)'$  is an  $m$ -dimensional vector of location parameters and the slope parameter  $\gamma$  determines the smoothness of the transitions;
- $u_{it}$  are the errors;
- $g()$  is a continuous and bounded function.

The function  $q_{it}$  value is determined by:

$$g(q_{it}, \gamma, c) = \left( 1 + \exp(-\gamma \prod_{j=1}^m (q_{it} - c_j)) \right)^{-1} \quad (2)$$

with  $\gamma > 0$  and  $c_1 \leq c_2 \leq \dots \leq c_m$

where:

- $m$  is the number of thresholds of the model;
- $c_1 \leq c_2 \leq \dots \leq c_m$  are the values of the positional parameter;
- $\gamma > 0$  is the slope of the transition function, which determines the smoothness of the transition function  $g(q_{it}, \gamma, c)$ .

Equation (1) also allows  $r$  transition functions based on different transition variables with corresponding positional parameters. In addition, equation (1) can also add explanatory variables such as  $z$  such as trade openness, investment expenditure, recurrent expenditure, time dummy variables ... These  $Z$  variables have coefficients does not change with time nor does it change with the value of the transition function. Then, equation (1) will have the following general form:

$$y_{it} = \mu_i + \delta'_0 z_{it} + \beta'_0 x_{it} + \sum_{j=1}^r \beta'_j x_{it} g_j(q_{it}^{(j)}, \gamma_j, c_j) + u_{it} \quad (3)$$

where  $r$  denotes the number of transition functions (which is the same as the number of transition variables), and:

$$g_j(q_{it}^{(j)}, \gamma_j, c_j) = \left( 1 + \exp(-\gamma_j \prod_{k=1}^{m_j} (q_{it}^{(j)} - c_{j,k})) \right)^{-1} \quad (4)$$

According to Gonzalez et al. (2005, 2017), just one transition function is used in Equation (2), and this transition function only has one or two thresholds:

- When  $m = 1$ , the model will have two distinct regions, with coefficients transitioning from  $\beta_0$  to  $(\beta_0 + \beta_1)$  as  $q_{it}$  increases.
- The transition becomes rougher as  $\gamma$  rises, and the transition function  $g(q_{it}, \gamma, c)$  transforms into the indicator function  $g(q_{it}, c)$ . The indicator function will assume the form as  $\gamma$  approaches infinity.

$$\begin{cases} g(q_{it}, c) = 1 & \text{if } q_{it} > c \\ g(q_{it}, c) = 0 & \text{if } q_{it} \leq c \end{cases}$$

The transition function  $g(q_{it}, \gamma, c)$  will be constant when  $\gamma$  reaches infinity. The PSTR model converges to Hansen's two-regime panel threshold regression (PTR) in this situation (Hansen, 1999). When  $g(q_{it}, \gamma, c)$  approaches 0, the transition function  $g(q_{it}, \gamma, c)$  becomes a constant function, and the model of Equation (3) becomes a linear panel regression model with fixed effects in the general case of  $m$  thresholds.

The PSTR model has an advantage over the PTR model in that the coefficients of the fit variables can change between panel units and time points. Consequently, the PSTR model permits table items to migrate between groups and over time as the threshold variable changes. In cases when there is heterogeneity across table items as well as coefficient instability over time, the PSTR model allows for model estimation (since these parameters change smoothly as a function of the threshold variable).

The PSTR model is estimated in two steps: first, the individual fixed effects are removed by averaging the variables; next, the parameters are estimated using nonlinear least squares (NLLS) estimates. The following is the process for using NLLS to estimate model parameters: Find the

relevant parameters  $\alpha, \beta$  in Equation (3) using Fixed Effect estimation for each slope of the transition function,  $\gamma_j$  and position parameter  $c_j$ . We shall determine the values of  $\gamma_j$  and  $c_j$  that meet the BFGS algorithm's criterion of minimal squares of residuals (RSS) (Broyden-Fletcher-Goldfarb-Shanno). The procedure is continued until all parameters in the model have reached convergence. The difficulty of convergence, on the other hand, is largely determined by the choice of  $\alpha, \beta$ 's beginning value.

We calculate the standard errors in the robust standard error model (Gonzalez et al., 2017) since the process of estimating the PSTR model in the event of heterogeneous effects across the cross-units may skew the findings if the standard estimate approach is used.

### 3.2. Model evaluation

It is important to validate the presence of a non-linear component in the model before estimating any non-linear form. If the data collected is homogenous, the PSTR model will not be determined statistically, and homogeneity checks will be required to avoid the estimate of undetermined models. To do so, we must first create a null model (NULL) that we may regulate, using Lagrange multiplier tests (LM-test) or F-test groups.

After model estimation, the findings must meet the estimated coefficients' stability and uniformity before being utilized for statistical inference. In panel data models, parameter stability testing does not receive nearly as much attention as it does in temporal data models (Gonzalez et al., 2005, 2017). This is due to the fact that the T of the panel data is lower than that of the temporal data. The stability of the parameters in the panel data becomes increasingly essential as T rises. The TV-PSTR (Time-Varying Panel Smooth Transition Regression) model of Luukkonen, Saikkonen, and Terasvirta was used by Gonzalez et al. (2005, 2017) to propose a parameter constancy test (2003).

However, as T grows larger, it becomes increasingly necessary to evaluate the parameters' stability in the panel data. Gonzalez et al. (2005, 2017) developed a parameter constancy test based on Lundberg and Squire (2003)'s TV-PSTR (Time-Varying Panel Smooth Transition Regression) model.

As a result, we must combine the hypothesis  $H_0: r = 1$  with the hypothesis that there exist at least two more transition functions to test the hypothesis. The procedure of testing residual heterogeneity with the  $r^*$  transition function model goes like this (Thanh, 2015). We will compare the null  $H_0: r = r$  to  $H_1: r = r + 1$ , given a PSTR model with  $r = r$ . The process terminates if  $H_0$  is not rejected.  $H_0: r = r + 1$  is tested against  $H_0: r = r + 2$  if the null hypothesis  $H_0: r = r + 1$  is true. The method is repeated until  $H_0$  is accepted for the first time.

A generic PSTR model with  $r = 2$  or 3 stages can be considered in the PSTR framework as follows:

$$y_{it} = \mu_i + \beta_0' x_{it} + \beta_1' x_{it} g_1(q_{it}^{(1)}, \gamma_1, c_1) + \beta_2' x_{it} g_2(q_{it}^{(2)}, \gamma_2, c_2) + u_{it} \quad (5)$$

where  $q_{it}^{(1)}$  and  $q_{it}^{(2)}$  might be distinct transition factors. In the two-stage PSTR model estimate,  $H_0: \gamma_2 = 0$  is the null hypothesis of non-remaining heterogeneity.

### 3.3. Variables and data

The study's research dataset spans the years from 2000 to 2018, and includes data for the entire nation, the central government, and 63 provinces/cities directly under the central government of Vietnam. The data are gathered from the General Statistics Office, assuring testing consistency and reliability. In the data processing process, economic indicators from 2000 to 2003 for provinces separated in 2003, such as Dien Bien separated from Phu Tho, Dak Nong separated from Dak Lak, and Hau Giang separated from Can Tho City, are calculated based on the proportion of the population corresponding to each province at the time being considered. In addition, in the case of the 2008 merger of Ha Tay province and Hanoi City, the economic data for Hanoi will be computed

using the weighted average total (population) of these two provinces for the 2000–2007 period. The information for the model's variables came from the sources indicated in Table A1. The descriptive statistical findings for the model's variables are shown in Table A1.

Table A1 indicates that the panel's data is entirely balanced, with 1197 observations for 63 provinces/cities gathered during a 19-year period from 2000 to 2018. According to preliminary descriptive statistics, per capita income in Vietnam during the survey period was 16.7 million VND/person/year, with the lowest per capita income of 1.73 million VND/person/year in Ha Giang province (in 2000) and the highest per capita income of 386.3 million VND per year in Baria—Vung Tau province (in 2018). During the IP, the ratio of import-export turnover to average province GDP was about 69.3%.

About the variables in the model: with the aim of assessing the nonlinear relationship between fiscal decentralization and income inequality. Income inequality in this study measures the inequality of per capita income of province  $i$  compared to the per capita income of the whole country. And evaluate the level of comprehensive decentralization on the basis of revenue decentralization, expenditure decentralization and tax decentralization, specifically:

- Indices below  $i$  represent provinces/cities,  $t$  is time.
- $FD_{it}$ , which is a group of variables representing the fiscal decentralization of province  $i$  at time  $t$ , was developed by Stegarescu (2005) and Norman Gemmill (2013). The topic considers the separate relationship between 5 hierarchical variables including: ED1, ED2, RD1, RD2 and TD on inequality represented by  $PW\_CV$ ;
- $PW\_CV_{it}$  is the variable representing the inequality of income per capita of province  $i$  compared with the per capita income of the whole country at time  $t$  (Cowell, 1995, Lessmann, 2012; Kyriacou, 2012, 2014);
- $C_{it}$  is a set of control variables included in the model based on economic growth theories such as trade openness ( $Open_{it}$ ), investment spending rate ( $ISR_{it}$ ), current spending rate ( $CST_{it}$ ), foreign direct investment ( $FDI_{it}$ ), economic growth ( $LnGDP_{it}$ ).

## 4. Results and discussion

### 4.1. Research results

When economic growth reaches a particular level, fiscal decentralization and the attraction of FDI to localities will be determined, impacting the inequality in local average income. As a result, the impact of decentralization and FDI on inequality will vary, depending on the stage of economic development. Macroeconomic factors typically lag behind the results of mean income inequality among provinces. The study uses a one-year lagged variable to examine the impact of decentralization factors, as well as economic growth and foreign investment, on income inequality in the connection between change and change with average income. The study utilizes a one-year policy lag since the research data collection time was limited. During the investigation, the most comprehensive data collection from the General Statistics Office is made full use of for 63 provinces/cities across the country from 2000 to 2018. It is tough to find the perfect combination of lengthier delays with just 19 periods to choose from. Each year, capital (FDI, Investment spending, and recurrent spending) is pooled from decentralized sources and partially reflected in per capita income for the previous year (inequalities computation).

A homogeneous panel data model for  $PW-CV$  with one-year lagged variables of ED1, ED2, RD1, RD2, TD, LGDP, and FDI as explanatory factors will be used to estimate the income inequality of each province. The one-year lagged variables of OPEN, ISR, and CST, as well as the dummy year  $YR_i$  (with  $I = 2001-2018$ ), are considered as proxies for improvement opportunities in the province's quality of life as well as external macro shocks.

The RATS (Regression Analysis of Time Series) software from Estima is used to estimate the nonlinear model of transition between income inequality and fiscal decentralization hierarchical factors.

At the 1% significance level, the assumption  $H_0^* : \beta_3^* = \beta_2^* = \beta_1^* = 0$  is rejected with the statistical value  $F(21, 775) = 65,939$ . The PSTR model, in other words, has a non-linear shape. After verifying that the PSTR model has at least one threshold, the authors evaluate the other assumptions  $H_{03}^* : \beta_3^* = 0$ ,  $H_{02}^* : \beta_2^* = 0 | \beta_3^* = 0$ , and  $H_{01}^* : \beta_1^* = 0 | \beta_3^* = \beta_2^* = 0$ , to find the threshold number  $m$  for the transitional function. As a result, if the rejection of  $H_{02}^*$  is the strongest of the three hypotheses, the decision will be to pick  $m = 2$ ; otherwise,  $m = 1$  will be chosen (Gilbert Colletazy and Christophe Hurlinz 2008, 2013).

Table 1 shows that when the lagged variable LGDP is utilized as the transition variable, the greatest rejection does not occur for  $H_{02}^*$  at  $m = 1$ .

As a consequence, in the PSTR model, we use LGDP as the transition variable as follows:

$$PWCV_{it} = \mu_i + \sum_{i=1}^{13} \delta_i YR_i + \delta_{14} DM_{it} + \delta_{15} CDT_{it} + \delta_{16} CTX_{it} + \beta_{01} ED1_{it-1} + \beta_{02} ED2_{it-1} + \beta_{03} RD1_{it-1} + \beta_{04} RD2_{it-1} + \beta_{05} TD_{it-1} + \beta_{06} LGDP_{it-1} + \beta_{07} FDI_{it-1} + (\beta_{01} ED1_{it-1} + \beta_{02} ED2_{it-1} + \beta_{03} RD1_{it-1} + \beta_{04} RD2_{it-1} + \beta_{05} TD_{it-1} + \beta_{06} LGDP_{it-1} + \beta_{07} FDI_{it-1})g(Q_{it-1}, \gamma, c) + u_{it}$$

with  $g(LGDP_{it-1}, \gamma, c) = (1 + \exp(-\gamma(LGDP_{it-1} - c)))^{-1}$  with  $\gamma > 0$

We examine the appropriateness of the single-threshold PSTR model for parameter stability and residual heterogeneity before interpreting the estimation findings. The results in Table 2 demonstrate that there is no evidence for the presence of a residual heterogeneity problem, and the hypothesis of parameter stability is likewise based on the robust test. As a results, we may infer that the single-threshold PSTR model is adequate based on the robust test.

Table 3 summarizes the results of estimating the single-threshold PSTR model with robust standard error. The coefficients  $\delta_{0j}$  are estimated with  $I = 18-20$  for simplicity of comprehension (part of the coefficients). Table A2 shows estimates of time dummy variables, as well as estimates of coefficients  $\beta_{0j}$  and  $\beta_{0j} + \beta_{1j}$  with  $j = 1-9$  for regression coefficients in two periods with  $g(LGDP_{it-1}, \gamma, c)$  equal to 0 and equal to 1.

Estimates of  $\gamma$  and  $c$  as transitions from a low period corresponding to small values of per capita income to a higher period corresponding to large values of per capita income. This transition is quite smooth and quite gradual.

Table 1. Summary of test results to select the optimal number of thresholds		
$H_{03}^* : \beta_3^* = 0$	$H_{02}^* : \beta_2^* = 0   \beta_3^* = 0$	$H_{01}^* : \beta_1^* = 0   \beta_3^* = \beta_2^* = 0$
F (7, 775) = 33.544	F (7, 782) = 37.451	F (7, 789) = 67.827
P-value = 0.000	P-value = 0.000	P-value = 0.000

Source: Author calculated from RATS software

Table 2. Results of evaluating the suitability of the one-threshold PSTR model		
Residual heterogeneity test, H0: $\gamma_2 = 0$		
Additional	F- Statistics	p-value
G (G2, C1, C2, LGDP 1)	0.004	1.000
G (G2, C1, LGDP 1)	0.003	1.000
Testing the stability of the parameter, H0: $\gamma_2 = 0$		
G (G2, C1, C2, t)	0.005	1.000
G (G2, C1, t)	0.007	1.000

Source: author calculated from RATS software

Table 3 shows more closely the distribution of provincial per capita income within the high LGDP group. Therefore, province  $i$  is aggregated in the low-income region in year  $t$  when  $g(LGDP_{it-1}, \gamma, c) < 0.5$ , and conversely, province  $i$  is aggregated in the high-income region if  $g(LGDP_{it-1}, \gamma, c) > 0.5$ . In all years, most provinces are categorized as low-income provinces. Compounded with the point estimate  $\hat{c} = 4.29495$ , it is shown that the model shows provinces with high-income growth opportunities (with higher GDP values) as a separate group compared to provinces with high-income growth opportunities medium or low entry. Table A4 also indicates the movement of two provinces (Binh Duong province and HoChiMinh City) from low GDP to high GDP in 2016, as well as the movement of Bac Ninh province from low LGDP group to high LGDP group in 2017. This clearly illustrates the relevance of provinces that are not bound to maintain existence in the group over time.

Table 3 depicts the distribution of province per capita income within the high LGDP category in further detail. As a result, when  $g(LGDP_{it-1}, \gamma, c) < 0.5$  occurs in year  $t$ , province  $i$  is aggregated in the low-income area, and conversely, when  $g(LGDP_{it-1}, \gamma, c) > 0.5$  occurs in year  $t$ , province  $i$  is aggregated in the high-income region. Most provinces are classified as low-income provinces in all years. When the model is combined with the point estimate  $\hat{c} = 4.29495$ , it is clear that provinces with high-income

**Table 3. Synthesized results of one-threshold PSTR model estimation**

	Variable	Estimated coefficient	Standard Deviation (robust)
$\delta_{0i}$			
	OPEN <sub>it-1</sub>	-0,002 (*)	0,001
	ISR <sub>it-1</sub>	-0,011	0,015
	CST <sub>it-1</sub>	0,012	0,021
0 $\beta_{0j}$			
	ED1 <sub>it-1</sub>	-0,009	0,026
	ED2 <sub>it-1</sub>	0,043 (*)	0,023
	RD1 <sub>it-1</sub>	-0,006	0,018
	RD2 <sub>it-1</sub>	-0,033 (***)	0,010
	TD <sub>it-1</sub>	0,002	0,013
	LGDP <sub>it-1</sub>	-0,037 (***)	0,005
	FDI <sub>it-1</sub>	-0,068 (***)	0,011
$\beta_{0j} + \beta_{1j}$			
	ED1 <sub>it-1</sub>	0,418 (***)	0,080
	ED2 <sub>it-1</sub>	-0,453 (***)	0,072
	RD1 <sub>it-1</sub>	0,258 (***)	0,065
	RD2 <sub>it-1</sub>	-0,182 (***)	0,046
	TD <sub>it-1</sub>	0,236 (***)	0,036
	LGDP <sub>it-1</sub>	0,018 (*)	0,010
	FDI <sub>it-1</sub>	0,657 (***)	0,136
$\gamma$	2.6084		
$c$	4.2950		
$R^2$	0.9820		

Source: Author's estimation using RATS software

Note:  $\delta_{0i}$ : With the threshold value, the estimated coefficient of the explanatory variable does not change.

$\beta_{0j}$ : The estimated coefficient of the explanatory variable varies with the threshold value at the low stage

$\beta_{0j} + \beta_{1j}$ : The estimated coefficient of the explanatory variable changes with the threshold value of the high stage; this is also the elasticity of income inequality according to the values of the hierarchical lagged variable.

(\*), (\*\*), and (\*\*\*) denote the 10%, 5%, and 1% significance levels, respectively.

growth possibilities (higher GDP values) are treated as a different group from provinces with high-income growth prospects medium or low entry. Table A4 in Appendix also shows the transition in 2016 of two provinces (Binh Duong province and Ho Chi Minh City) from low to high GDP, as well as the transition in 2017 of Bac Ninh province from low to high LGDP. This demonstrates the importance of provinces that are not obligated to remain in the organization over time.

#### **4.2. Explanation of the estimated coefficients**

First, in the group of provinces with low GDP, the estimate of the lagged coefficient ED1 is negative and not statistically significant, but in the group of provinces with high GDP, it is positive and statistically significant. That is, the market does not perceive the impact of decreasing PW-CV in provinces with low LGDP in the ED1 group. This may also be true in RD1's lagged variable.

Second, in the group of provinces with low GDP, the estimated value of the lagged variable ED2 is positive and statistically significant (at 10% level). However, the estimate of ED2 in the group of provinces with high GDP is negative (at 1% level). This means that an increase in ED2 will progressively raise inequality in average income in provinces with low GDP; conversely, an increase in ED2 will reduce inequality in provinces with high GDP more than the low LGDP group (Appendix 2). As a result, if a province transitions from a time of low GDP to a period of high GDP, a rise in ED2 will significantly reduce inequality in the province's per capita income.

Thirdly, in both groups of low and high GDP provinces, the coefficient of the lagged variable RD2 is negative and statistically significant. In the broader LGDP group, however, it is far more negative. This supports the previous finding that the relationship between RD2 and inequality is more reactive among those with high LGDP. Furthermore, because RD2 has a negative effect on both categories of LGDP, it is clear that raising ED2 in the provinces with low GDP will progressively reduce inequality. When the province's GDP rises, its economy improves. If we move to the upper LGDP group, and RD2 continues to rise, the province's per capita income inequality will be reduced even further.

Fourth, the estimated coefficient of the variable TD is positive in both groups of GDP; however, the influence of TD on inequality is not detected in the group of states with low GDP. As a result, among the group of provinces with a high GDP, a rise in credit will raise the province's per capita income inequality.

Additionally, the impact of growth on income inequality varies by GDP category. As a result, economic progress will reduce inequality in the low LGDP group at a young stage (at 1% level). The higher the amount of economic development in a group with a higher LGDP, however, the stronger the trend toward inequality in that group (statistical significance of 10%). Transitioning from low to high LGDP provinces is rather gradual as per capita income rises.

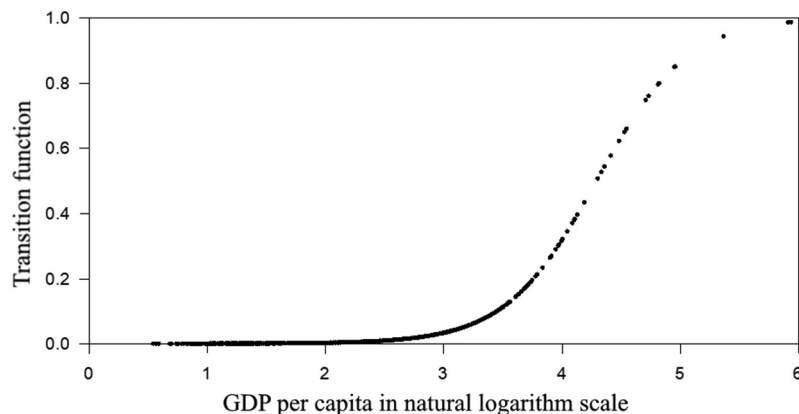
The influence of the lagged FDI variable on inequality in average income between provinces is likewise different in the two groups of low and high LGDP, similar to the economic growth factor (statistically significant at 1%). FDI, in particular, lowers income inequality in the province of the low LGDP group (with a one-year lag). FDI, on the other hand, increases income inequality in provinces within the high LGDP category. It is worth noting that, in tandem with average income increase, the transfer of FDI from provinces with low LGDP to provinces with high LGDP is rather quick.

The graph in Figure 1 below shows the transition as GDP rises from a low to a high level, with the average slope of the transition function in the estimate being 2.6048. It demonstrates that policy variable transitions will occur gradually in response to GDP growth rates, particularly around the projected value of the optimal threshold parameter (corresponding to GDP per person annually which is 83.33 million VND).

The transition rate from the low to the high stage when the GDP increases, according to the formula (\*), is also the elasticity of income inequality according to fiscal decentralization variables



**Figure 1. Logarithmic transition chart of average GDP per capita.**



for the province at the time when the fiscal decentralization variable is not the threshold determining variable.

$$\frac{\partial y_{it}}{\partial x_k} = \beta_{0(k)} + \beta_{1(k)} * g(q_{it}, \gamma, c) \quad (*)$$

The lagged variables of ED1, ED2, and FDI, combined with FDI, are the variables with the highest transition speed between the two eras in terms of magnitude. RD2's delayed variable, on the other hand, has the slowest transition speed (the transition speed of the lagged GDP variable is not statistically significant). It indicates that the variables ED1, ED2, and FDI react fairly sensitively to changes in the economy's income levels around the threshold value of 78.33 million VND/person/year in the connection with income inequality. And the transition function under LGDP is shown in [Figure 1](#).

The presence of statistically significant time dummy coefficients shows that some of the changes over time are still not explained by the model's explanatory factors (excluding the time dummy). Table 4 demonstrates how macroeconomic policies like province per capita income inequality are intertwined with other macroeconomic policies. In comparison to 2018, income inequality fell gradually between 2001 and 2010 (base year in the regression equation).

#### 4.3. Discussion

From the above research results, it shows that there exists a non-linear relationship between fiscal decentralization and income inequality, there are different effects of variables representing fiscal decentralization on inequality, as follows:

**Expenditure Decentralization:** Self-financed spending (ED1) before the threshold has a negative impact on inequality (No statistical significance), after the threshold has a positive impact on inequality; Direct spending (ED2) before the threshold has a positive effect, but after the threshold has a negative effect. The results of our study partly coincide with the results of Sepulveda und Martinez-Vazquez (2011) and Tselos et la (2012). The results of CF Sepulveda and Martinez-Vazquez (2011) analysis of developed and developing countries from 1971 to 2000 show that spending decentralization increases income inequality for countries of the main size. Although the government is small, it has the effect of reducing inequality when government size is 20% or more of GDP. In addition, they found that spending decentralization exacerbates poverty in developing countries. More specifically, the results of the study by Tselos et la (2012), with data for 13 countries of Western Europe, the results show that both income and expenditure decentralization have a negative impact on income inequality, and implies that increasing decentralization reduces regional income inequality.

**Revenue Decentralization:** For Autonomous own revenue (RD1) before the threshold has a negative effect (Not statistically significant) but after the threshold has a positive effect on income

inequality, this result is consistent with the study. previous work by Savitri (2012), and the results of this study show that in Indonesia, a greater degree of fiscal decentralization tends to lead to a greater degree of income inequality over the observed period, implies that income redistribution tends to exacerbate post-decentralization. For Autonomous and Shared own revenue (RD2), there is a negative impact on income inequality at both stages. However, the negative impact value after the threshold has a higher value than before the threshold. This result is consistent with previous work of Neyapti (2006), Tselos et la (2012). Research results by Neyapti (2006) suggest that revenue decentralization can reduce income inequality when it is interacted with good governance.

**Tax decentralization:** Tax decentralization (TD) has a positive effect on income inequality at both the pre-threshold (not statistically significant) and post-threshold periods. This all means that the greater the degree of local tax autonomy, the greater the degree of local income inequality. This result is consistent with the previous study of Sacchi and Salotti (2014). Their results suggest that: support a positive relationship between fiscal decentralization and income inequality. Although results vary depending on the measures of fiscal decentralization used in the analysis, evidence suggests that a higher degree of tax decentralization is indeed associated with a greater degree of income inequality. Our results on the consequences of tax decentralization are in line with some of the earlier research. According to CF Sepulveda and Martinez-Vazquez (2011), decentralized tax policies are likely to have a direct impact on how much disposable income is distributed among citizens of a nation. Promoting fiscal decentralization on the revenue side may reduce the tax system's progressiveness, which may change how disposable income is distributed nationally. This is because, in contrast to the tax mix used by the central government, indirect taxes, which have a tendency to be more regressive, and property taxes, which are typically less progressive, are the main sources of funding for sub-national governments. According to the accepted wisdom regarding the incidence of local taxes, both types of taxes reduce the progressivity of the national tax system.

In summary, the research results have strong evidence for the existence of a non-linear relationship between fiscal decentralization and income inequality, and sign the impact of fiscal decentralization on inequality. Income depends on the method of decentralization (Decentralization of revenue, Decentralization of expenditures, or decentralization of taxes), and depending on the level of income in each stage of development of each region of the country. From there, there are policy implications for appropriate decentralization measures according to each growth stage of each locality in the country.

#### **4.4. Implications**

In the context of Vietnam's economy and society, there is an unequal income distribution within states, with the majority of provinces falling into the low-income category, despite provinces' revenue increase over time. Policies on fiscal decentralization must be tailored in harmony with each stage of local development, such as:

#### **4.5. For provinces with per capita income below the threshold of 78.33 million VND/person/year**

First, local governments' ability to spend directly raises income inequality in areas with annual per capita incomes of less than 78.33 million VND, implying that four provinces in the low-income group had annual per capita incomes of less than 78.33 million VND. The process of improving a province's direct spending capability widens the income inequality across provinces, albeit in a good way, since the increased capacity of local direct spending would reduce income inequality when local income per capita surpasses 78.33 million VND/person/year.

Second, local governments must aggressively enhance their autonomy in terms of non-tax income, 100% local tax collections, and proportionately divided taxes between the locals and central government. It is necessary to improve commercial openness and draw foreign investments to specific locations and also to encourage local economic growth in order to narrow the gap between prosperous and poor areas.

#### **4.6. For provinces with income exceeding the threshold of 78.33 million VND/person/year**

First, when the average yearly income per person exceeds VND 78.33 million, income inequality widens. As a result, it is critical to reduce local expenditure's autonomous competence while increasing central government-funded expenditure.

Furthermore, direct local expenditure aids in the reduction of economic inequalities. And the impact of income below the threshold deteriorates at a quicker rate. For this reason, more resources are needed to ensure expenditures and reduce rate control from the local to the national levels.

Thirdly, the ability to be self-sufficient in terms of local revenue (including non-tax revenues, 100 percent local taxes and local taxes, according to the ratio between the locality and the central government) reduces per capita income inequality in the province when compared to the rest of the country, although at a quicker rate than income levels below the poverty line. There is a need to improve non-tax revenue self-restraint as well as overall tax revenue self-restraint.

Fourth, tax revenue decentralization is determined using the local tax revenue to 100 percent ratio and the tax revenue that the locality is entitled to, based on the ratio of the locality to the country's total tax revenue calculated on average. Increases in the number of troops per capita will widen wealth disparities across localities.

Hence, when local income surpasses the average income level of 78.33 million VND/person/year, the locality's strategy of decentralizing tax revenue grows, widening the gap between local and national per capita income. To decrease income inequalities, it is imperative to cut the tax rate that the locality is entitled to, based on the division ratio between the locality and the central government.

Fiscal decentralization can help achieve a more equal distribution of income. However, certain conditions must be satisfied. First, the public sector must be significant enough. Secondly, fiscal decentralization must be comprehensive, including redistribution of public expenditure. Given the lower gradient of decentralization of expenditure, this may be a good objective for the first step toward further decentralization. Decentralization of expenditures must be complemented by adequate decentralization of income so that local governments rely largely on their own revenues rather than on inter-administration transfers. Finally, there should be a suitable regulatory policy that is reliant on the degree of economic growth of each area in each era. Evidence and qualitative research will be important to clarify policy findings in order to create a more equitable distribution of income, given the little empirical research in this field and the rising interest in attaining inclusive growth.

#### **5. Conclusion**

In this study, we provide a new approach to the relationship between fiscal decentralization and income inequality of 63 provinces/cities in Vietnam in the period 2000–2018. The results show that there exists a non-linear relationship between fiscal decentralization and income inequality. Specifically, there exists a threshold value with per capita income of 78.33 million VND/person/year. Then the impact sign and impact value of the fiscal decentralization variables on income inequality will change around a specific threshold value: Decentralization of expenditure autonomy before the negative impact threshold, after the positive impact threshold. to income inequality; Direct expenditure decentralization before the threshold of positive impact, after the threshold of negative impact on income inequality; Decentralization of revenue autonomy before the negative impact threshold, after the positive impact threshold on income inequality; Autonomous and Shared own revenue both have a negative effect on income inequality, but the negative impact value after the threshold is larger than the negative value before the threshold. Thus, the sign of the impact of fiscal decentralization on income inequality depends on the type of fiscal decentralization (Revenue Decentralization, Expenditure Decentralization, or Tax Decentralization). And

the impact of fiscal decentralization on this income inequality depends on the size of income in each stage of development of each province/city.

Overall, this study makes an important, new contribution on the link between fiscal decentralization and income inequality to the theory of fiscal decentralization. The study is not without limitations. First, the empirical findings are limited to countries with developing economies such as Vietnam. Moreover, from an endogenous point of view, most of the country-level financial development variables are defined in a network of relationships. Future research that expands the sample of countries, adds economic factors, and controls for endogenous issues could make a valuable contribution to the field.

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#### References

- Akai, N., & Hosio, M. (2009). Fiscal Decentralization, Commitment and Regional Inequality: Evidence from State-level Cross-sectional Data for the United States. *Journal of Income Distribution*, 18(1), 113. <https://doi.org/10.25071/1874-6322.22708>
- Akai, N., & Sakata, M. (2005). Fiscal Decentralization, Commitment and Regional Inequality: Evidence from State-level Cross-sectional Data for the United States. CIRJE Discussion Paper Series. <http://www.cirje.e.u-tokyo.ac.jp/research/dp/2005/2005cf315.pdf>
- Aldasoro, I., & Seiferling, M. (2014). Vertical fiscal imbalances and the accumulation of government debt. In *IMF working paper no. 14/209* 39. International Monetary Fund, Washington.
- Alvaredo, F., Chancel, L., Piketty, T., Saez, E., & Zucman, G. (2018). *World inequality report: Executive summary*. World Inequality Lab.
- Arze Del, G. F. J., Martinez-Vazquez, J., & McNab, R. M. (2016). Decentralized governance, expenditure composition and preferences for public goods. *Public Finance Rev*, 44(3), 291–310. <https://doi.org/10.1177/1091142116639127>
- Bahl, R. W., & Linn, J. F. (1992). *Urban public finance in developing countries*, Oxford [England]. New York, NY: Oxford University Press.
- Bahl, R., Martinez-Vazquez, J., & Wallace, S. (2000). State and local government choices in fiscal redistribution. Program Report No. 49 *Fiscal research*. Georgia State University, Atlanta, Georgia.
- Bardhan, P., & Mookherjee, D. (2006). Decentralization and accountability in infrastructure delivery in developing countries. *Econ J*, 116(508), 101–127. <https://doi.org/10.1111/j.1468-0297.2006.01049.x>
- Barro, R. (2000). Inequality and growth in a panel of countries. *Journal of Economic Growth*, 5(1), 5–32. <https://doi.org/10.1023/A:1009850119329>
- Barro, R. 2008. *Inequality and growth revisited* Working Paper on Regional Economic Integration No. 11. Asian Development Bank.
- Bastagli, F., Coady, D., & Gupta, S. 2012. *Income inequality and fiscal policy* IMF Staff Discussion Note No. 12/08 (Revised). International Monetary Fund.
- Beramendi, P. (2007). Inequality and the territorial fragmentation of solidarity. *International Organization*, 61(October), 783–820. <https://doi.org/10.1017/S0020818307070270>
- Blanchard, O., & Shleifer, A. (2001). Federalism with and without political centralization: China versus Russia. *IMF Staff Pap*, 48 (Suppl 1), 171–179. <https://doi.org/10.2307/4621694>.
- Bojanic, A. N. (2018). The impact of fiscal decentralization on growth, inflation, and inequality in the Americas. *CEPAL Review*, 124(124), 57–77. <https://doi.org/10.18356/31c71be8-en>
- Bolton, P., & Roland, G. (1997). The Breakup of Nations: A Political Economy Analysis. *The Quarterly Journal of Economics*, 112(4), 1057–1090. <http://www.jstor.org/stable/2951266>
- Bonet, J. (2006). Fiscal decentralization and regional income disparities : Evidence from the Colombian experience the Annals of Regional Science. 40, 661–676. <https://doi.org/10.1007/s00168-006-0060-z>
- Brambor, T., Clark, W. R., & Golder, M. (2006). Understanding interaction models: Improving empirical analyses. *Political Analysis: an Annual Publication of the Methodology Section of the American Political Science Association*, 14(1), 63–82. <https://doi.org/10.1093/pan/mpi014>
- Calamai, L. (2009). The link between devolution and regional disparities: Evidence from the Italian regions. *Environment & Planning A*, 41(5), 1129–1151. <https://doi.org/10.1068/a40282>
- Cavusoglu, T., & Dincer, O. (2015). Does decentralization reduce income inequality? Only in rich states. *Southern Economic Journal*, 82(1), 285–306. <https://doi.org/10.1002/soej.12047>
- Chu, K.-Y., Davoodi, H., & Gupta, S. 2000. *Income distribution and tax and government social spending policies in developing countries* IMF Working Paper No. 00/62. International Monetary Fund.
- Cowell, F. (1995). *Measuring Inequality* (Harvester Wheatsheaf, Hemel Hempstead, Herts).
- Dabla-Norris, E., Kochhar, K., Suphaphiphat, N., Ricka, F., & Tsounta, E. 2015. *Causes and consequences of income inequality: A global perspective* IMF Staff

- Discussion Note 15/13. International Monetary Fund.
- Dollar, D., & Kraay, A. (2002). Growth is good for the poor. *Journal of Economic Growth*, 7(3), 195–225. <https://doi.org/10.1023/A:1020139631000>
- Ebel, R. D., & Yilmaz, S. (2002) On the measurement and impact of fiscal decentralization. World bank policy research working paper no. 2809. <https://ssrn.com/abstract=636092>
- Eyraud, L., & Lusinyan, L. (2013). Vertical fiscal imbalances and fiscal performance in advanced economies. *Journal of Monetary Economics*, 60(July), 571–587. <https://doi.org/10.1016/j.jmoneco.2013.04.012>
- Ezcurra, R., & Pascual, P. (2008). Fiscal decentralization and regional disparities: Evidence from several European Union countries. *Environment & Planning A*, 40(5), 1185–1201. <https://doi.org/10.1068/a39195>
- Faguet, J., & Sánchez, F. (2014). Decentralization and access to social services in Colombia. *Public Choice*, 160(1–2), 227–249. <https://doi.org/10.1007/s1127-013-0077-7>
- Filippetti, A., & Sacchi, A. (2016). Decentralization and economic growth reconsidered: The role of regional authority. *Environ Plan C: Gov Policy*, 34(8), 1793–1824. <https://doi.org/10.1177/0263774X16642230>
- Galli, R., & Rolph, V. D. H. (2001). Is inflation bad for income inequality: the importance of the initial rate of inflation. *Employment Paper No. 2001/29*. Geneva: International Labour Organization.
- Gemmell, N., Kneller, R., & Sanz, I. (2013). Fiscal decentralization and economic growth: Spending versus revenue decentralization. *Economic Inquiry*, 51(4), 1915–1931. <https://doi.org/10.1111/j.1465-7295.2012.00508.x>
- Gemmell, N., Kneller, R., & Sanz, I. (2013, October). Fiscal Decentralization and Economic Growth: Spending versus Revenue Decentralization. *Economic Inquiry, Western Economic Association International*, 51(4), 1915–1931.
- Gil, C., Pascual, P., & Rapún, M. (2004). Regional economic disparities and decentralization. *Urban Studies*, 41, 71–94. <https://doi.org/10.1080/0042098032000155696>
- Gonzalez, A., Terasvirta, T., & Van Dijk, D. (2005). Panel smooth transition regression model. *SEE/EFI Working Paper Series in Economics and Finance*, No 604.
- Gonzalez, A., Terasvirta, T., & Van Dijk, D. (2017). Panel smooth transition regression model. <https://www.diva-portal.org/smash/get/diva2:1152759/FULLTEXT01.pdf>
- Gustafsson, B., & Johansson, M. (1999). In search of smoking guns: What makes income inequality vary over time in different countries? *American Sociological Review*, 64(4), 585–608. <https://doi.org/10.2307/2657258>
- Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing and inference. *Journal of Econometrics*, 93(2), 345–368. [https://doi.org/10.1016/S0304-4076\(99\)00025-1](https://doi.org/10.1016/S0304-4076(99)00025-1)
- Hindriks, J., & Gareth, M. D. (2006). *Intermediate public economics*. The MIT Press.
- Hongyi, L., Colin, X., & Zou, H.-F. (2000). Corruption, Income Distribution, and Growth. *Economics & Politics*, 12(2), 155–182.
- Hung, et al. (2020). Fiscal decentralization, corruption, and income inequality: Evidence from Vietnam. *Journal of Asian Finance, Economics and Business*, 7 (2020), 529–540. <https://doi.org/10.13106/jafeb.2020.vol7.no11.529>
- International Monetary Fund (IMF). (2014). *Government finance statistics manual: Pre-publication draft*.
- International Monetary Fund (IMF). (various years). *Government finance statistics yearbook*.
- Kanbur, R., & Zhang, X. (2004) Fifty years of regional inequality in China: A journey through central planning, reform, and openness. Research Paper No. 2004/50.
- Kornai, J., 1980. The Dilemmas of a Socialist Economy: The Hungarian Experience. *Cambridge Journal of Economics*, 4(2), 147–157. <https://doi.org/10.1093/oxfordjournals.cje.a035445>
- Kuznets, S. (1955). Economic growth and income inequality. *American Economic Review*, 45(March), 1–28. <http://www.jstor.org/stable/1811581>.
- Kyriacou, A. P., Muínelo-Gallo, L., & Roca-Sagalés, O. (2013). Fiscal decentralization and regional disparities: The importance of good governance. *Papers in Regional Science: the Journal of the Regional Science Association International*, 94(1), 89–107. <https://doi.org/10.1111/pirs.12061>.
- Kyriacou, A., Muínelo, L., & Roca-Sagalés, O. 2014. Fiscal decentralization and regional disparities: The importance of good governance. *Papers in Regional Science*. <https://doi.org/10.1111/pirs.12061>
- Kyriacou, A., & Roca-Sagalés, O. (2012). The impact of Structural Funds on regional disparities within Member States. *Environment and Planning, C, Government & Policy*, 30, 267–281.
- Lessmann, C. (2009). Fiscal decentralization and regional inequality: Evidence from cross-section and panel data. *Environment & Planning A*, 41(10), 2455–2473. <https://doi.org/10.1068/a41296>
- Lessmann, C. (2012). Regional inequality and decentralization: An empirical analysis. *Environment & Planning A*, 44(6), 1363–1388. <https://doi.org/10.1068/a44267>
- Lim, G. C., & McNelis, P. D. (2014). Income inequality, trade and financial openness, IMF macroeconomic challenges facing low-income countries. *New Perspectives, January*, 30–31, 32. <http://dx.doi.org/10.2139/ssrn.2425068>.
- Lundberg, M., & Squire, L. (2003). The simultaneous evolution of growth and inequality. *Economic Journal*, 113(April), 326–344. <https://doi.org/10.1111/1468-0297.00127>
- Lundbergh, S., Terasvirta, T., & van Dijk, D. (2003). Time-varying smooth transition autoregressive models. *Journal of Business and Economic Statistics*, 21(1), 104–121. <https://doi.org/10.1198/073500102288618810>
- Luukkonen, R., Saikkonen, P., & Terasvirta, T. (1988). Testing linearity against smooth transition autoregressive models. *Biometrika*, 75(3), 491–499. <https://doi.org/10.1093/biomet/75.3.491>
- Mahesh, M. (2016). The effects of trade openness on income inequality—evidence from BRIC countries. *Econ Bull*, 36(3), 1751–1761.
- Martinez-Vazquez, J., Lago-Peñas, S., & Sacchi, A. (2017). The impact of fiscal decentralization: A survey. *Journal of Economic Surveys*, 31(4), 1095–1129. <https://doi.org/10.1111/joes.12182>
- McKinnon, R. I. (1995). Intergovernmental competition in Europe with and without a common currency. *Journal of Policy Modeling*, 17(5), 463–478. [https://doi.org/10.1016/0161-8938\(95\)00052-U](https://doi.org/10.1016/0161-8938(95)00052-U)
- McKinnon, R. I. (1997). Market-preserving fiscal federalism in the American Monetary Union. In M. I. Blejer & T. Ter-Minassian (Eds.), *Macroeconomic dimensions of public finance: Essays in honour of Vito Tanzi* 526. Routledge.

- Musgrave, R. A. (1959). *The theory of public finance: A study in public economy*. McGraw-Hill.
- Neyapti, B. (2006). Revenue decentralization and income distribution. *Economics Letters*, 92(3), 409–416. <https://doi.org/10.1016/j.econlet.2006.03.026>
- Oates, W. E. (1972). *Fiscal Federalism*. Harcourt Brace Jovanovich.
- Oates, W. E. (1999). An essay on fiscal federalism. *Journal of Economic Literature*, 37(3), 1120–1149. <https://doi.org/10.1257/jel.37.3.1120>
- Oates, W. E. (2005). Toward a second-generation theory of fiscal federalism. *International Tax and Public Finance*, 12(4), 349–373. <https://doi.org/10.1007/s10797-005-1619-9>
- Oates, W. E. (2008). On the evolution of fiscal federalism: Theory and institutions. *National Tax Journal*, 61(June), 313–334. <https://doi.org/10.17310/ntj.2008.2.08>
- Organisation for Economic Co-operation and Development (OECD). (2006). Intergovernmental transfers and decentralised public spending. In *Working paper no. 3*. Paris.
- Organisation for Economic Co-operation and Development (OECD). (2009b). Taxes and grants: On the revenue mix of sub-central governments. In *Working paper no. 7*. Paris.
- Organisation for Economic Co-operation and Development (OECD) 2006. (2009a). The fiscal autonomy of sub-central governments: An Update. In *Working paper no. 9*. Paris.
- Padovano, F. (2007). *The politics and economics of regional transfers: Decentralization, interregional redistribution and income convergence*. Edward Elgar.
- Persson, T., & Tabellini, G. (1994). Is inequality harmful for growth? Theory and evidence. *American Economic Review*, 84(3), 600–621.
- Prud'homme, R. (1995). The dangers of decentralization. *The World Bank Research Observer*, 10(2), 201–220. <https://doi.org/10.1093/wbro/10.2.201>
- Qian, Y., & Roland, G. (1998). Federalism and the Soft Budget Constraint. *The American Economic Review*, 88(5), 1143–1162. <http://www.jstor.org/stable/116864>
- Qian, Y., & Weingast, B. R. (1997). Federalism as a commitment to preserving market incentives. *Journal of Economic Perspectives*, 11(4), 83–92. <https://doi.org/10.1257/jep.11.4.83>
- Qiao, B., Martinez-Vazquez, J., & Xu, Y. (2008). The trade-off between growth and equity in decentralization policy: China's experience. *Journal of Development Economics*, 86(1), 112–128. <https://doi.org/10.1016/j.jdeveco.2007.05.002>
- Reuveny, R., & Li, Q. (2003). Economic openness. *Democracy, and Income Inequality: an Empirical Analysis. Comp Polit Stud*, 36(5), 575–601. <https://doi.org/10.1177/0010414003036005004>
- Rodríguez-Pose, A., & Bwire, A. (2004). The economic (in) efficiency of devolution. *Environment & Planning A*, 36(11), 1907–1928. <https://doi.org/10.1068/a36228>
- Rodríguez-Pose, A., & Ezcurra, R. (2010). Does decentralization matter for regional disparities? A cross-country analysis. *J Econ Geogr*, 10(5), 619–644. <https://doi.org/10.1093/jeg/lbp049>
- Sacchi, A., & Salotti, S. (2014). The effects of fiscal decentralization on household income inequality: Some empirical evidence. *Spat Econ Anal*, 9(2), 202–222. <https://doi.org/10.1080/17421772.2013.833343>
- Savitri, M. D. (2012). The impacts of fiscal decentralization on income inequality in Indonesia, Tokyo, The Okuma School of Public Management, Waseda University.
- Schneider, A. (2003). Decentralization: Conceptualization and measurement. *Studies in Comparative International Development*, 38(3), 32–56. <https://doi.org/10.1007/BF02686198>
- Sepulveda, C. F., & Martinez-Vazquez, J. (2011). The consequences of fiscal decentralization on poverty and income equality. *Environment and Planning. C, Government & Policy*, 29(2), 321–343. <https://doi.org/10.1068/c1033r>
- Sepulveda, C. F., & Martinez-Vazquez, J. (2011). The consequences of fiscal decentralization on poverty and income equality. *Environment and Planning. C, Government & Policy*, 29(2), 321–343. <https://doi.org/10.1068/c1033r>
- Sinding, S. W. (2009). Population, poverty and economic development. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 364(1532), 3023–3030. <https://doi.org/10.1098/rstb.2009.0145>
- Stegarescu, D. (2005). Public sector DECENTRALISATION: Measurement concepts and recent international trends. *Fiscal Studies*, 26(3), 301–333. <https://doi.org/10.1111/j.1475-5890.2005.00014.x>
- Stigler, G. J. (1957). The tenable Range of functions of local government. In *Federal expenditure policy for economic growth and stability* (pp. 213–219). Washington, U.S: Congress Joint Economic Committee.
- Thanh, S. D. (2015). Threshold effects of inflation on growth in the ASEAN-5 countries: A panel smooth transition regression approach. *Journal of Economics, Finance and Administrative Science*, 20(38), 41–48. <https://doi.org/10.1016/j.jefas.2015.01.003>
- Tiebout, C. M. (1956). A pure theory of local expenditures. *Journal of Political Economy*, 64(5), 416–424. <https://doi.org/10.1086/257839>
- Timmons, J. F. (2010). Does democracy reduce economic inequality? *British Journal of Political Science*, 40(4), 741–757. <https://doi.org/10.1017/S0007123410000165>
- Tselios, V., Rodríguez-Pose, A., Pike, A., Tomaney, J., & Torrissi, G. (2012). Income inequality, decentralisation, and regional development in Western Europe. *Environment and Planning A: Economy and Space*, 44(6), 1278–1301. <https://doi.org/10.1068/a44334>
- Uslaner, E. M. (2006) Corruption and inequality, research paper, UNU-WIDER, United Nations University (UNU), No. 2006/34, UNU-WIDER, Helsinki
- Wooldridge, J. M. (2010). *Econometric analysis of cross-section and panel data*. MIT Press.

## Appendix

### Appendix 1: The idea of Taylor expansion

Assumptions function  $y = f(x)$  has all derivatives to order  $n + 1$  (including derivative  $n + 1$ ) in a range that contains the point  $x = a$ .

We hope to find a polynomial  $y = P_n(x)$  whose value and its derivatives are equal (or approximately equal) to the corresponding values of  $f(x)$  or  $P_n(x) = f(x) + R_n(x)$ .

The Taylor series expansion of a function  $f(x)$  around the value  $x = a$  is as follows:

$$f(x) = f(a) + f'(a)(x - a) + \frac{f''(a)}{2!}(x - a)^2 + \dots + \frac{f^{(n)}(a)}{n!}(x - a)^n + R_n(x)$$

Where:  $R_n(x) = f(x) - P_n(x)$  is the remainder of the Taylor expansion.

Applying Taylor expansion to the function  $f(x)$  around the value  $x = 0$  is written as follows:

$$f(x) = f(0) + f'(0)x + \frac{f''(0)}{2!}x^2 + \frac{f^{(3)}(0)}{3!}x^3 + \frac{f^{(4)}(0)}{4!}x^4 + \dots + \frac{f^{(n)}(0)}{n!}x^n + \dots$$

**Table A1. Definitions and descriptive statistics of variables**

Variable	Definition and descriptive statistics of variables	Source	Obs	Mean	Std. Dev.	Min	Max
Regional inequality—PW_CV	$PW\_CV_{it} = \frac{1}{gdp_{cn}} \sqrt{W_i(gdp_{cn} - gdp_{it})^2}$	GSO	1197	0614264	1131741	0003925	1.084187
Self—financed spending—ED1	$ED1_{it} = \frac{S_{it}-TRR_{it}}{G_{it}}$	MOF	1197	2982339	1.38819	0002748	20.43596
Direct spending—ED2	$ED2_{it} = \frac{S_{it}-TRR_{it}}{G_{it}}$	MOF	1197	5450995	1.662856	0416235	23.09422
Autonomous own revenue—RD1	$ED_{it} = \frac{OTR_{it}-NTC_{it}}{G_{it}}$	MOF	1197	2531311	8560512	0002369	11.28109
Autonomous and Shared own revenue -RD2	$ED1_{it} = \frac{OTR_{it}+STR_{it}+NTC_{it}}{G_{it}}$	MOF	1197	4912488	1.0639	0137896	12.69528
Autonomous own tax revenue—TD	$TD_{it} = \frac{OTR_{it}-STR_{it}}{TRR_{it}}$	MOF	1197	5252298	8150781	0517608	7.013664
Openness	$OPEN_{it} = \frac{EXPORTS_{it}+IMPORTS_{it}}{GDP_{it+10^8}} * EXCHANGERATE_{it}$	GSO, WDI, WB	1197	69302	1.048941	0	8.941681
gdp	$gdp_{it} = \frac{GDP_{it}}{DS_{it}} * 10^8 * 100$	GSO, WDI, WB	1197	16.70059	27.26411	1.726125	446.3168
Current spending rate (CSR <sub>it</sub> )	Provincial recurrent expenditure value year t/ nominal provincial GDP year t	GSO, WDI, WB	1197	1490656	1087249	0093561	7268516
Investment spending rate (ISR <sub>it</sub> )	Provincial value of investment spending year t/nominal GDP of the province year t	GSO, WDI, WB	1197	0797914	0732522	0077742	8548093
Provincial foreign direct investment (FDI <sub>it</sub> )	Provincial FDI in year t/ nominal GDP of the province year t	GSO, WDI, WB	1197	0442963	0965645	0	1.6984434

Source: Data statistics are over the period of 2000–2018.



**Table A2. Estimated coefficients of dummy variables by year**

YR	YR 02	YR 03	YR 04	YR 05	YR 06	YR 07	YR 08	YR 09	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15	YR 16	YR 17
-4.68*** (1.28)	-4.81*** (1.23)	-4.38*** (1.17)	-3.81*** (1.08)	-3.41*** (1.06)	-2.80*** (0.95)	-2.52*** (0.86)	-2.20*** (0.76)	-1.72*** (0.66)	-1.12*** (0.52)	-0.61*** (0.44)	-0.02*** (0.38)	-0.39*** (0.31)	-1.25*** (0.42)	-1.30 (0.54)	0.36 (0.48)	-0.56 (0.39)

Source: Author's estimation using RATS software.

Note:

The estimated coefficient and standard error have been multiplied by 100;

The robust standard error is enclosed in parentheses ();

(\*\*\*) denotes significance at 1%, respectively.

**Table A3. PSTR model estimation results with  $m = 1$**

<b>Variable</b>	<b>Estimated coefficient</b>	<b>Standard Error (Robust)</b>	<b>T- Statistics</b>
DMTM1	-0.003	0.001	-1.893
CDT1	-0.012	0.016	-0.751
CTX1	0.013	0.022	0.591
YR01	-0.047	0.013	-3.660
YR02	-0.048	0.012	-3.908
YR03	-0.044	0.012	-3.743
YR04	-0.038	0.011	-3.508
YR05	-0.034	0.011	-3.222
YR06	-0.028	0.010	-2.945
YR07	-0.025	0.009	-2.945
YR08	-0.022	0.008	-2.882
YR09	-0.017	0.007	-2.608
YR10	-0.011	0.005	-2.143
YR11	-0.006	0.004	-1.375
YR12	0.000	0.004	0.044
YR13	-0.004	0.003	-1.239
YR14	-0.012	0.006	-2.652
YR15	-0.015	0.005	-2.507
YR16	-0.013	0.007	-2.103
YR17	-0.008	0.005	-1.255
ED11	-0.010	0.027	-0.367
ED21	0.043	0.024	1.823
RD11	-0.007	0.019	-0.354
RD21	-0.033	0.010	-3.324
TD1	0.003	0.013	0.207
GDP 1	-0.038	0.006	-6.377
FDI1	-0.069	0.011	-6.082
ED11* G(G1.C1.GDP 1)	0.429	0.054	8.008
ED21* G(G1.C1.GDP 1)	-0.497	0.049	-10.194
RD11* G(G1.C1.GDP 1)	0.265	0.047	5.685
RD21* G(G1.C1.GDP 1)	-0.149	0.037	-4.054
TD1* G(G1.C1.GDP 1)	0.233	0.023	10.289
GDP 1* G(G1.C1.GDP 1)	0.056	0.007	8.031
FDI1* G(G1.C1.GDP 1)	0.727	0.125	5.800

Source: Author's estimation using RATS software

**Table A4. Summary of the distribution of per capita income in the high LGDP group**

Year	Number of provinces in high LGDP group	$g(LGDP_{it-1}, \gamma, c)$	Average income (million VND/person/year)	Province/City
2000	0	< 0.5		
2001	0	< 0.5		
2002	0	< 0.5		
2003	1	0.53	76.43	Ba Ria—Vung Tau
2004	1	0.62	88.73	Ba Ria—Vung Tau
2005	1	0.75	111.14	Ba Ria—Vung Tau
2006	1	0.80	123.41	Ba Ria—Vung Tau
2007	1	0.76	113.98	Ba Ria—Vung Tau
2008	1	0.85	141.73	Ba Ria—Vung Tau
2009	1	0.80	124.40	Ba Ria—Vung Tau
2010	1	0.85	142.66	Ba Ria—Vung Tau
2011	1	0.94	214.84	Ba Ria—Vung Tau
2012	1	0.84	143.73	Ba Ria—Vung Tau
2013	1	0.83	128.40	Ba Ria—Vung Tau
2014	1	0.91	136.86	Ba Ria—Vung Tau
2015	1	0.93	235.14	Ba Ria—Vung Tau
2016	3	(1)		
2017	4	(2)		
2018				

Source: Author's estimation using *Excel software*.

Note: (1) Binh Duong province, Ba Ria—Vung Tau province and Ho Chi Minh City with the transition function and per capita income (million VND/person/year) respectively (0.51; 0.99; 0.58) and (74.05; 370.24; 82.63)

(2) Bac Ninh province, Binh Duong province, Ba Ria—Vung Tau province and Ho Chi Minh City with the transition function and per capita income (million VND/person/year) respectively: (0.66; 0.54; 0.99 and 0.65) and (94.52; 78.39; 379.49 and 92.86).



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