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Spatio-Temporal Dependence of Corruption in Vietnam

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Abstract
Corruption levels are clustered in space and time simultaneously, and they differ not only between but also within countries. This study adds to the literature by shedding new light on the cause of corruption. Specifically, it investigates a further question that arises whether there is an effect on the corruption levels of neighboring sub-national regions within a country over time. Using the Dynamic Spatial Durbin models with provincial data during 2006–2017, this paper finds that the corruption levels of a specific province are influenced by both corruption level and its lags of neighboring provinces, and this effect decreases with more considerable geographic distance between provinces. Estimated results also show that the spatio-temporal dependence of corruption levels is explained by spatial externalities, including immigration, provincial governance and policy, but not economic development. These results provide theoretical applications for studying corruption and shed light on anti-corruption policy design in transitional countries where corruption is rampant.

Keywords Spatio-temporal dependence · Dynamic spatial model · Corruption · Anti-corruption · Vietnam

JEL Classification C23 · D73 · O18

Introduction

Corruption is a research issue that has received much attention from academics, policymakers, and practitioners (Gründler & Potrafke, 2019; Nguyen & Le, 2021). The hypothesis of modest corruption accelerating economic growth no longer exists.

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Instead, corruption impedes economic growth and efficiency (Mauro, 1995), weakens the rule of law and the functioning of government (Treisman, 2007), erodes trust in societal institutions (Rothstein & Uslaner, 2005), and reduces a country's welfare significantly. Despite the application of anti-corruption measures and initiatives at different levels, corruption is still a worldwide phenomenon, especially in emerging and transitional countries (Transparency International, 2020). Previous studies have employed four main theoretical foundations to explain the causes of corruption, including corruption as rational action, corruption as institutionalized practice, corruption as cultural norms, and corruption as a moral failure. Recently, a few studies have focused on the spatial dependency of corruption to examine the roles of closer geographical areas whose corruption may affect that of their neighbors (Becker et al., 2009; Borsky & Kalkschmied, 2019; Lopez-Valcarcel et al., 2017). Ignoring the spatial dependence of corruption would lead to biased estimates and erroneous recommendations of anti-corruption policies (Anselin, 2008; Elhorst, 2014).

An emerging strand of studies focuses on spatial dependency as a cause of corruption, and corruption spreads across the country's borders for different reasons. First, intensive economic integration among countries leads to a higher probability of corruption due to learning and peer-group effects (Becker et al., 2009). The movement of resources, such as labor, capital, and outputs among countries, carries the climate of doing business and corruption practices across borders, which may affect corrupt acts in neighboring countries. Second, there are increasing social interactions and cross-border activity of crime. From a sociological perspective, crimes or evil acts are contagious due to direct ties or indirect interactions among individuals (Pinto et al., 2008) or the quality of institutions. Thus, social networks and interactions lead to corruption practices as a conduit of corruption contagion. Corruption increases in countries with less stringent anti-corruption policies encourages illegal money and asset transfers from neighboring countries.

The spatial dependence of corruption occurs at national and sub-national levels but is empirically inconsistent. For example, few studies find corruption is contagious (Becker et al., 2009; Borsky & Kalkschmied, 2019; Goel & Nelson, 2007; Lopez-Valcarcel et al., 2017), and a few studies show no spatial effect of corruption (Donfouet et al., 2018; Márquez et al., 2011). In addition, existing studies that focus on spatial dependence do not yet consider spatial and time dependence of corruption simultaneously. In this sense, the effects of lagged corruption levels of a specific region and its neighboring regions are unintentionally ignored, and short-run direct and indirect effects on corruption are neglected. Therefore, a study on the spatio-temporal dependence of corruption could help theoretically explain the complex interactions between provincial institutions of a province and those of neighboring provinces. Specifically, anti-corruption results are not only influenced by what a province does but also the anti-corruption efforts that happen in other provinces. This idea could direct regional coordination in the anti-corruption efforts in practice.

This paper investigates a further question that arises whether there is an effect on the corruption levels of neighboring sub-national regions within a country over time; specifically, it focuses on the spatial and time dependence of corruption. First, the paper examines whether corruption has spatial effects on corruption levels of neighboring sub-national regions and whether the effects are dynamic. In other words, it investigates both spatial effects and short-run direct and indirect effects on corruption. Second, it empirically explores the main predictors of the spatial dependence of corruption in a dynamic context accounting for spatial externalities, which are seldom addressed in previous work.

Using the dynamic spatial Durbin models with provincial data in Vietnam, this paper finds that the corruption level is influenced by the spatio-temporal dependence of neighboring provinces' corruption levels, and this effect decreases with more considerable geographic distance between provinces. The results also confirm that spatio-temporal dependency of corruption levels is explained by spatial externalities, including social interactions proxied by immigration, provincial governance and policy, but not provincial economic development level.

This paper differs from the literature in three aspects. First, the corruption levels of a sub-national region are explained by the corruption levels and lags of corruption levels of neighboring sub-national regions. These determinants have seldom been addressed in previous studies. In this paper, dynamic spatial dependence models are employed to deal with the effects of corruption levels and lagged corruption of neighboring sub-national regions over time, simultaneously. Thus, this model solves the spatial lag limitation recognized in Borsky and Kalkschmied (2019). Second, this study used panel data to deal with the temporal impacts of changes in neighboring sub-national regions' corruption levels and impacts in the same party-led sub-national regions. So, it further investigates and offers a feasible solution for the limitation figured out in Borsky and Kalkschmied (2019) and responses to the call for further research of Lopez-Valcarcel et al. (2017). Third, it is among the first to provide empirical evidence of spatio-temporal dependence of corruption at the sub-national level within an emerging country, where corruption is rampant, and anti-corruption is still inefficient. This empirical result sheds light on the need for anti-corruption policy design to consider spatial interdependencies, spatial heterogeneity, and the temporal impacts of the neighboring sub-national regions' corruption levels as a cause of corruption.

Following this introduction, "Literature Review" section provides a literature review on the theoretical foundations, spatio-temporal model, and spatial determinants of corruption. "Corruption Distribution in Vietnam" section describes corruption distribution across provinces in Vietnam. "Methodology" section outlines methodology, including the development of the spatial weight matrices, spatial correlation test, estimated models, and variables used. "Empirical Results" section presents the estimated results and discussion, and "Conclusion" section concludes the paper.

Literature Review

Theoretical Foundations of Corruption

Literature on corruption focuses on the motivations and anti-corruption measures from different perspectives. First, from an economic perspective, corruption is a rational act based on a simple cost and benefit analysis. Corruption occurs when the benefit of corruption is greater than the total potential costs of corruption, including direct costs of bribes and indirect costs; for example, costs from being caught (Lambsdorff, 2007; Shleifer & Vishny, 1993; Treisman, 2000). Corruption can be used as an instrument for beating competitors (Nguyen et al., 2016; Oliver, 1997); a way to reduce transaction costs (Lambsdorff, 2002), risk, and uncertainty in doing business (Søreide, 2009); a means to pursue governmental support (Husted, 1994); and a tactic to attain unfair favorable treatments, such as business licenses in the natural monopoly resources, conditional business, accessing government contracts, and avoidance of taxes and fines (Jeong & Weiner, 2012; Nguyen et al., 2016). Second, corruption is an institutional practice. Economic actors do not have alternatives to paying bribes as corruption is a common acceptance. They must follow the local institutions to avoid "being kicked out of the game" (Zhou et al., 2013). Some countries or government entities are passing laws that are advantageous for the interests of specific groups but disadvantage most ordinary people (Castro et al., 2020). Countries with low quality of market-supporting institutions and weak law enforcement systems are more likely to suffer institutionalized corruption, and corrupt practices institutionalized into organizations make it more challenging to fight. Third, a theoretical foundation considers corruption as a sociocultural norm. Corruption is observed as more prevalent in some cultural and social contexts. It commonly occurs in environments where culture, tradition, history, and social norms reflect an acceptance and even encourage lower standards of ethical behavior. Conversely, it is less likely in communities with strong anti-corruption will (Nguyen & Le, 2021). Also, corruption is differently perceived in different cultures and countries. Using informal rules/mechanisms or giving gifts is important in *guanxi* culture to do business; yet, in the West, these practices violate bureaucratic norms and are considered a form of corruption. Many empirical studies show the link between culture and corruption, and they are well documented in Castro et al. (2020). Fourth, corruption is a moral failure. This theoretical perspective argues that corruption results from a failure to apply ethical principles and moral reasoning, which lead to the corrupt act. According to McKinney and Moore (2008), corruption can be described as moral reprehensibility, cheating, or social disease. The decision-making of corrupt behaviors is ethical and does not relate to resources, benefits, and costs. Instead, the economic actors principally do the right things and correct ethical principles in a specific circumstance. This moral failure perspective of corruption brings essential theoretical, practical, and pedagogical implications to the anti-corruption agenda (Castro et al., 2020).

The above theoretical foundations of corruption provide alternative and practical views on explaining the causes of corruption. However, they do not address spatial effects as a determinant explaining corruption across space, and the spatial dependence of corruption is seldomly investigated.

Spatial Dependence and Spatio-Temporal Dependence in Corruption

It is widely accepted that corruption is a global problem requiring global measures (Elliott, 2002). This point of view is supported by economists who have examined how corruption spreads across borders described as a contagion effect, and whereby domestic corruption takes on the characteristics of corruption in geographically proximate countries or sub-national regions (O'Trakoun, 2017). Corruption differs not only between countries but also between sub-national levels (Becker et al., 2009; Borsky & Kalkschmied, 2019; Lopez-Valcarcel et al., 2017). Spatial dependence of corruption is explained by (i) economic integration, including the movement of resources, openness, and resources allocation across borders (Becker et al., 2009; Bologna, 2017; Borsky & Kalkschmied, 2019; Donfouet et al., 2018); and (ii) social interactions, via the spatial sharing of institutional, cultural, or other hidden values (Dong et al., 2012; Lopez-Valcarcel et al., 2017). Studies on the spatial dependence of corruption have focused on investigating whether corruption spills over geographical borders. Cross-sectional data or panel data have been commonly used for estimating this spatial dependence of corruption (Becker et al., 2009; Dong et al., 2012; Lopez-Valcarcel et al., 2017; Márquez et al., 2011). However, these previous studies have some limitations. For example, O'Connor and Fischer (2014) assert that cross-sectional analyses provide an inadequate understanding of what influences corruption over time since the spatial dependence from source regions is complex. Elhorst (2010) argues that spatial dependence includes direct and indirect effects and short- and long-term effects. The direct effect means the effect on dependent variable y_i resulting from a change in the k^{th} explanatory variable (X_k) in the i^{th} region. The indirect effect on the dependent variable y_j ($j\ ^{1}\ i$) results from a change in the k^{th} explanatory variable (X_k) in the i^{th} region. The existing empirical studies have relied on economic theory and spatial models to entail long-term equilibrium relationships.

According to Anselin (1988), spatial effects result from spatial dependence and spatial heterogeneity. Based on these two spatial impacts, three basic spatial econometric models are developed, including the spatial autoregression model (SAR), spatial errors model (SEM), and spatial lag of independent variables model (SLX). Some studies on the spatial dependence of corruption have used those model specifications for estimating spatial effects of corruption, such as Márquez et al. (2011), Lopez-Valcarcel et al. (2017), Donfouet et al. (2018), and Borsky and Kalkschmied (2019). However, these models do not allow estimating the effects of space and time simultaneously, and they are incapable of capturing the spatially short-term effects of corruption (Elhorst, 2010).

Anselin (2008) proposes dynamic spatial models with lag dependence, including the pure space-recursive model, time–space recursive model, time–space simultaneous model, and time–space dynamic models to estimate the short-term effects in spatial models. However, the literature has not documented a single study that examines whether corruption spills over geographically across areas' borders and over time simultaneously. This paper uses a spatio-temporal model previously not deployed to investigate the contagion of corruption across provinces within a country.

Determinants of Spatial Dependence in Corruption

Previous studies explain corruption by using variables, including historical and cultural tradition, levels of economic development, political institutions, and government policies (Treisman, 2000). More recently, studies have found that corruption levels can spread from a region to its neighbors due to political culture, social interactions, immigration, and geographical distances (Becker et al., 2009; Borsky & Kalkschmied, 2019; Castro et al., 2020; Dimant et al., 2014); and the level of economic development, foreign aid, investment, and trade openness (Attila, 2008; Bologna, 2017; Borsky & Kalkschmied, 2019). Lopez-Valcarcel et al. (2017) explain the spatial dependence of corruption because the country or sub-national regions share common historical cultures, institutions, and economic backgrounds. In short, there are several factors spatially influencing corruption levels across regions, of which economic development level, social interactions/networking among regions, and institutions are consistently main drivers. In more recent studies, those determinants of corruption levels are examined in spatial spillover and time dynamic contexts, which have rarely been investigated to date (Donfouet et al., 2018). However, those studies separately examine their impacts on spatial dependence of corruption in space at a specific time or overtime. It leaves the simultaneous spatial and time effect of corruption for further research.

Corruption Distribution in Vietnam

Anti-corruption is a political agenda and priority of the Vietnamese Party and Government. The anti-corruption legal framework has significantly improved over the past few years with the adoption of the new Anti-Corruption Law and Penal Code. Several corruption measures are newly recognized and regulated, such as conflicts of interest, asset declaration, and sanctions against heads or deputies of corrupt organizations. The anti-corruption measures have been strictly implemented to narrow the policies' discretion, with administrative reforms reducing the discretion of civil servants and controlling conflicts of interest to minimize collusion between enterprises and civil servants. Many grand corruption cases, which have been recently put to trial, positively affect anti-corruption efforts in Vietnam. For the first time since 2011, a decrease in perceived corruption in public services was reported in Provincial Competitive Index (PCI) and Towards Transparency surveys (Towards Transparency, 2020). Despite improvement in anti-corruption efforts, corruption is still rampant throughout the country, and anti-corruption achievements lag behind other Asian countries regarding corruption perception and governance index. The corruption perception index constructed by Transparency International (2020) shows that Vietnam ranks 117 out of 180 participating countries. The "control of corruption" sub-index in Worldwide Governance Indicators of Vietnam (34.1) is even lower than that of neighboring regional countries like Singapore (99.5), Malaysia (62.5), Thailand (39.4), and Indonesia (38.0); and lower than the average level of the lower-middle-income countries (36.9) (Kaufmann & Kraay, 2020).

Corruption in Vietnam has a clear geographical pattern. Corruption is more prevalent in some specific regions but less in others. The spatial distribution of corruption among provinces has been clearly recognized over time. Data on corruption adapted from PCI and the Vietnam Provincial Governance and Public Administration Performance Index (PAPI) surveys on the perception of corruption from enterprises and citizens, respectively, show that corruption levels are either high or low among provinces in certain economic regions. For example, the Red River Delta region, an economic center in the North, including the capital of Hanoi, has a high proportion of citizens and businesses perceiving corruption; meanwhile, provinces in the Mekong River Delta region have lower rates of perceived corruption. Similar corruption levels occur in geographically close provinces in other economic regions in Vietnam. A notable pattern is that the corruption levels among provinces are clustered over time. This result is shown clearly in Fig. 1. Red provinces are corrupt, and more lightly colored ones are less corrupt. Local corruption has been prevalent across regions in Vietnam, but importantly, some of red and some of the similar lighter-color areas are clustered in space and over time. In other words, there is a local geographical pattern among provinces accused, and this spatial distribution of corruption at the provincial level is clustered over time.

Methodology

The empirical estimation strategy of this paper has three steps: (i) testing whether spatial dependence of corruption exists, (ii) checking the best fitted spatial dependence model with sample data, and (iii) estimating the spatial effects of corruption in spatio-temporal models. This methodology focuses on four issues: spatial weight matrix, spatial correlation test, estimated models, and data/variables.

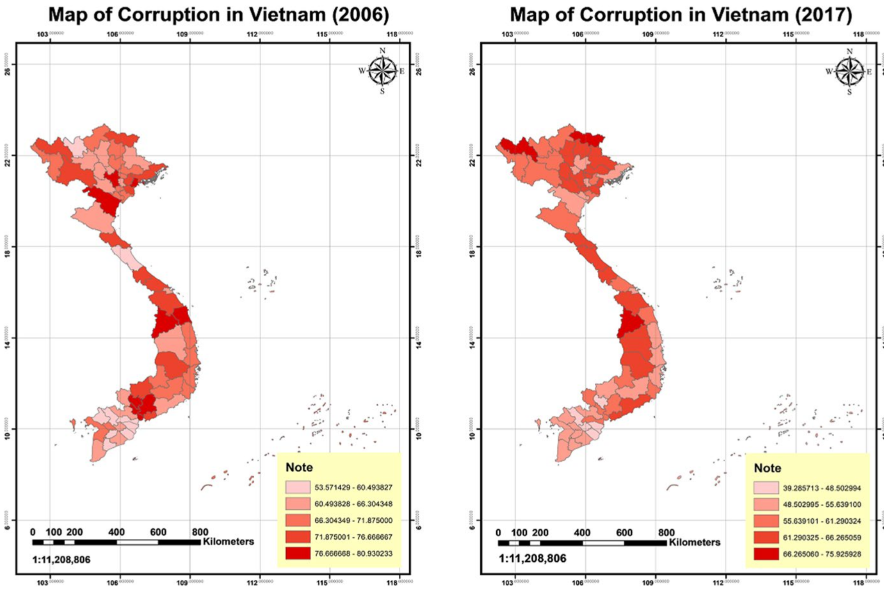

Fig. 1 Map of corruption distribution in Vietnam

Spatial Correlation Test

The paper uses Moran's I to check whether spatial dependence of corruption exists. Moran's index depends on the spatial weight matrix and reflects the degree of spatial correlation between observations. The value of Moran's I of variable *x* can be calculated using the following formula:

$$I = \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \times \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \overline{x})(x_j - \overline{x})}{\sum_{i=1}^{n}\left(x_i - \overline{x}\right)^2} \quad (1)$$

where w_{ij} is an element of the spatial weight matrix, showing the spatial dependence between geographical areas i and j; and n is the number of geographical areas in the sample data. Moran's I test performs the null hypothesis with no spatial correlation in the data. When the null hypothesis is rejected, a spatial correlation is in the sample data, or variable *x* of a geographical area correlates to variable *x* of neighboring areas.

Spatial Weight Matrix

Estimation of a spatio-temporal model requires a spatial weight matrix. It is a square matrix with a dimension of *N x N*, where N is the number of geographical areas/regions. Previous studies have provided several ways to build a spatial weight matrix. In this paper, two different types of spatial weight matrices are used: a spatial contiguity weight matrix and a centroid distances-based weight matrix. They are exogenously computed by the geographic information system (GIS).

First, the spatial contiguity weight matrix includes weight elements showing whether spatial units share a boundary. If the set of boundary points of unit i is denoted by bnd (i), then queen contiguity weights are defined by formula:

$$w_{ij} = \begin{cases} 1, bnd(\mathrm{i}) \cap bnd(\mathrm{j}) \neq 0 \\ 0, bnd(\mathrm{i}) \cap bnd(\mathrm{j}) = 0 \end{cases}$$

This spatial weight matrix is normalized by the row to avoid the asymmetry issue of the spatial weight matrix.

Second, weights are defined as a function of the distance between region i and j, d_{ij}, where d_{ij} is usually computed as the distance between their centroids or another important unit. Let $Lon_{d(i)}$ and $Lon_{d(j)}$ be the longitude and $Lat_{d(i)}$ and $Lat_{d(j)}$ the latitude coordinates of region i and j measured by degrees, respectively. $Lon_{r(i)}$ and $Lon_{r(j)}$ are the longitude and $Lat_{r(i)}$ and $Lat_{r(j)}$ the latitude coordinates of region i and j measured by radians, respectively. Two ways are used to measure d_{ij}:

(i) Euclidean distance. Few previous studies use the Euclidean distance to measure the distance between region i and j, and it is calculated as:

$d^e_{ij} = \sqrt{(Lon_{d(i)} - Lon_{d(j)})^2 + (Lat_{d(i)} - Lat_{d(j)})^2}$. However, the Euclidean distance does not take into account the curvature of the Earth (Arbia et al., 2010).

(ii) Great circle distance. Previous studies usually preferred the great circle distance to overcome the ignorance of curvature of the Earth when using the Euclidean distance. The great circle distance is calculated using the Haversine formula as follows:

$$d_{ij} = r * arccos\left[\cos\left(Lon_{r(i)} - Lon_{r(j)}\right) * \cos Lat_{r(i)} * \cos Lat_{r(j)} + \sin Lat_{r(i)} * \sin Lat_{r(j)}\right]$$

where r is the Earth's radius.

This paper measures the distance between provinces by using the Great circle distance and calculating a spatial distance weight matrix. According to Mitchel (2005), the conceptualization of spatial distance has three types: inverse distance, threshold distance, and zone of indifference (the combination of inverse distance and threshold distance). The zone of indifference is used to measure the distance weight matrix, which has its elements as:

$$w_{ij} = \begin{cases} \frac{1}{d_{ij}} if 0 \le d_{ij} < d_{max} \\ 0 if d_{ij} \ge d_{max} \end{cases}$$

where d_{max} is the distance band.

This paper uses the incremental spatial autocorrelation (spatial statistics) from ArcGIS Pro to choose the distanced band (d_{max}). With a certain distance, spatial autocorrelation provides a Z-score. Distances between the peaks of Z-scores reflect distances where the spatial processes promoting clustering are most pronounced. Based on the distanced band (d_{max}), the distance-based spatial weight matrix is obtained. The centroid great circle distance procedure calculation implies that the greater the distance between regions i and j, the smaller the spatial weight.

Estimated Models

A general time–space dynamic model or spatio-temporal model includes all three possible lags of the dependent variable. It can be described as follows:

$$Y_{i,t} = \varphi Y_{i,t-1} + \delta WY_{i,t-1} + \rho WY_{i,t} + \theta WX_{i,t} + X_{i,t}\beta + u_{i,t} \quad (2)$$

where $u_{i,t} = \lambda Wu_{i,t} + \varepsilon_{i,t}$; Y is the dependent variable as corruption. X is a vector of explanatory variables, including two important variables (i) economic integration, including the movement of resources, openness, and resources allocation across borders (Becker et al., 2009; Bologna, 2017; Borsky & Kalkschmied, 2019; Donfouet et al., 2018); and (ii) social interactions, via the spatial sharing of institutional, cultural, or other hidden values (Dong et al., 2012; Lopez-Valcarcel et al., 2017). Those variables make corruption spatially spread out. W is the spatial weight matrix. u is the error terms; $\varepsilon = (\varepsilon_1, \ldots \varepsilon_N)$ is a vector of disturbance terms. ε_i are independently and identically distributed error terms for all i with zero mean and variance σ^2. The parameter φ is a serial autoregressive parameter showing the dependent variable lagged in time. δ is the space and time autoregressive parameter measuring the dependent variable lagged in both space and time. ρ is the spatial autoregressive coefficient measuring the dependent variable lagged in space. λ is the spatial autocorrelation coefficient; θ measures the exogenous interaction effects among the independent variables. β measures the impact of the independent explanatory variables.

The spatio-temporal model in Eq. (2) is a general specification, but its estimation may be complicated because of identification problems. With the development of technology and statistical software, the model has been extensively applied in regional studies recently but has seldom been used in measuring the spatial dependency of corruption. Following model specification of the spatio-temporal model developed by Belotti et al. (2017), the empirical model with three different possible lags of corruption levels and explanatory variables that spatially determine the corruption of a specific geographical area is used.

According to Elhorst (2014), the dynamic spatial dependence model provides both short- and long-run direct and indirect effects, also known as spatial spillover effects:

– The short-run direct effect measures the average impact of a unit change of the explanatory variables in a specific region on the dependent variable in the same region. It can be expressed as: $[(I-\rho W)^{-1} \times (\beta_k I + \theta_k W)]^{\bar{d}}$, where superscript $\bar{d}$ denotes the operator that calculates the average of diagonal elements of the spatial weight matrix. Other parameters are defined above.
– The short-run indirect effect measures the average influence of a unit of the explanatory variables in a region on the dependent variable in all neighboring sub-national regions. It can be calculated by $[(I-\rho W)^{-1} \times (\beta_k I + \theta_k W)]^{\overline{rsum}}$, where the superscript $\overline{rsum}$ denotes the operator that calculates the average row sums of the off-diagonal elements of the spatial weight matrix. Other parameters are defined above.
– The long-run direct effect is measured as $[((1-\varphi)I - (\rho+\delta)W)^{-1} \times (\beta_k I + \theta_k W)]^{\bar{d}}$, where superscript $\bar{d}$ and other parameters are defined above.
– The long-run indirect effect is measured as $[((1-\varphi)I - (\rho+\delta)W)^{-1} \times (\beta_k I + \theta_k W)]^{\overline{rsum}}$, where superscript $\overline{rsum}$ and other parameters are defined above.

The estimation strategy is as follows: (i) we conducted several tests to determine if the spatio-temporal model is the most efficient or best fitted for studying spatial dependence of corruption in the sample data; and (ii) the spatio-temporal model is estimated by using two different spatial weight matrices to check whether the spatio-temporal effects of corruption are robust and how they respond to the distance among geographical areas/regions. The spatio-temporal model or time–space dynamic model is estimated by procedures developed by Elhorst (2014) and Belotti et al. (2017).

Variables and Data

Data of this paper are adapted from two sources: the PCI survey conducted by the Vietnam Chamber of Commerce and Industry (VCCI) and the General Statistics

Office of Vietnam (GSO). The PCI survey is conducted annually to assess and rank the economic governance quality of provincial authorities in creating a favorable business environment for developing the private sector. The overall PCI comprises ten sub-indices, reflecting economic governance areas that affect private sector development. Among these are the three variables: corruption, transparency, and proactivity of provincial leadership. Other variables/measures are from GSO sources; all variables are measured at provincial levels during 2006–2017.

The within-country panel data controls for the province-invariant and time-invariant variables in the econometric analysis (Hsiao, 2014). Thus, the within-country panel data control regional heterogeneity and differences in culture and institutional variation across provinces when using cross-sectional within-country data or cross-province datasets (Dong et al., 2012). This paper uses the spatio-temporal dependence model specified in Eq. (2) to investigate the changes of corruption clustered in space and time.

The dependent variable is measured by the agreement rates once asking if “enterprises in your line of business have to pay for informal charges”, and it is aggregated to the provincial level. Provincial corruption is a function of its lags, current and historical corruption levels of neighboring provinces, and current and historical factors of province-specific and neighboring provinces. Previous studies explain corruption by using historical, cultural traditions and social interaction, levels of economic development, political institutions and government policies, and other factors (Dimant et al., 2014; Dong et al., 2012; Le et al., 2021; Treisman, 2007). Based on the determinants of corruption found in the literature, this study uses net-migration rate, immigration rate, and freight traffic as proxies for social interaction; GRDP, openness, imports, investment, and provincial budget expenditures as proxies for economic development; transparency and proactivity of provincial leadership as proxies for political institutions and government policies; and other factors such as labor to control for province-specificity. The definitions, measures, and descriptions of variables are presented in Table 1.

Empirical Results

Spatial Correlation Test

Descriptive analysis shows a geographical pattern of local corruption in Vietnam, but it would be helpful to test whether a spatial pattern in the distribution of local corruption exists. This paper uses a classical test of Moran with two different weight matrices: contiguity and distance weight matrices. The Moran test results are presented in Table 2.

Using two weight matrices helps to assess the robustness of the findings. Moran test results with two different spatial weight matrices are consistent and statistically significant at the conventional significance level. All the local Moran I indices are statically positive and significant, showing a positive spatial autocorrelation of sub-national regions’ corruption levels. It implies a robust spatial pattern in

Table 1 Description of variables (2006–2017)

Variables	Description	Mean	Std. Dev	Source
Corruption	Corruption is measured by rates of agree once asking if "enterprises in your line of business have to pay for informal charges."	60.59	10.86	Provincial Competitiveness Index
Net-migration rate	Net-migration rate reflects the status of in-migration and out-migration of the population into/out from a territorial unit in the reference period	-1.27	8.07	General Statistics Office of Vietnam
In-migration rate	The number of people from different territorial units in-migrates to a territorial unit in the reference period on average per 1,000 people of the in-migration territorial unit	5.86	8.24	General Statistics Office of Vietnam
Openness	Openness is the ratio of export and import to provincial gross regional domestic products	1.09	1.66	General Statistics Office of Vietnam
Log of Import	Transactions in goods and services to a resident of a jurisdiction from non-residents	8.78	2.01	General Statistics Office of Vietnam
Log of GRDP	Log of gross value added of all resident producer units in the region, and analogous to national gross domestic product	9.99	0.92	General Statistics Office of Vietnam
Log of Investment	Log of capital spending to increase or maintain capacity and resources for production	8.96	0.90	General Statistics Office of Vietnam
Log of Labor	Log of labor includes those aged 15 years or older employed or unemployed during the reference period (7 days prior to the time of observation)	6.52	0.56	General Statistics Office of Vietnam
Log of Freight traffic	Log of freight traffic, which is calculated by multiplying the volume of freight carried with the actual transported distance	8.95	1.12	General Statistics Office of Vietnam
Log of PBE	Provincial Budget Expenditures (PBE) made by the provincial government on collective needs and wants such as pension, provisions (such as education, healthcare, and housing), security, infrastructure, etc	9.07	0.61	General Statistics Office of Vietnam
Transparency	Transparency is a measure of whether firms have access to the proper planning and legal documents necessary to run their businesses, whether those documents are equitably available, whether new policies and laws are communicated to firms and predictably implemented, and the business utility of the provincial webpage	5.91	0.83	Provincial Competitiveness Index
Proactivity of provincial leadership	A measure of the creativity and cleverness of provinces in implementing central policy, designing their own initiatives for private sector development, and working within sometimes unclear national regulatory frameworks to assist and interpret in favor of local private firms	5.05	1.29	Provincial Competitiveness Index

Table 2 Test Moran's I for spatial autocorrelation of corruption

Year	Moran's I with contiguity weight matrix	Moran's I with distance weight matrix
2006	0.2222***	0.1197***
2007	0.1412*	0.0553***
2008	0.1324*	0.0575***
2009	0.4543***	0.2655***
2010	0.5415***	0.3575***
2011	0.3710***	0.1994***
2012	0.1349*	0.0868***
2013	0.4535***	0.2525***
2014	0.4169***	0.2037***
2015	0.4532***	0.2242***
2016	0.4036***	0.2004***
2017	0.4963***	0.2462***

***, ** and * are significant at 1%, 5% and 10%, respectively

the distribution of provincial corruption levels in Vietnam over time. Investigating which spatial dependence models explain the geographical pattern of local corruption is naturally necessary to have appropriate anti-corruption measures and policy recommendations.

Estimated Results

Several spatial dependence models can explain the geographical pattern in the distribution of local corruption. Following Belotti et al. (2017) to determine which spatial econometric model offers the best fit with the sample data, the study first estimates the spatial Durbin model (SDM), then tests to exclude variables for nested models using the LR tests. To test the spatial autocorrelation model (SAC) and dynamic SDM models, this study employs the modified AIC criterion as Burnham and Anderson (2004). Testing for model selection results is presented in Table 3. The test results show that dynamic models are better than static ones, and the dynamic SDM model is better than dynamic SAR. Therefore, the dynamic SDM model is best fitted to study the spatio-temporal dependence in corruption across provinces in Vietnam.

Estimated results from the spatio-temporal dependence model are obtained from the specification in Eq. (2). They include the main effect in column (1), main effects with spatial impacts in column (2), short-run direct and indirect effects in columns (3) and (4), long-run direct and indirect effects in columns (5) and (6) of Tables 4 and 5, respectively. The estimated results are obtained from two spatio-temporal dependence models using the spatial continuity weight matrix and spatial distance weight matrix. These empirical results are also used for robustness checking and show that estimates from Tables 4 and 5 are robust and consistent.

Table 3 Spatio-temporal dependence – Test for model selection

	Contiguity weight matrix		Distance weight matrix	
	χ^2	AIC	χ^2	AIC
SAR vs Dynamic SAR	465.17***		456.29***	
SDM vs Dynamic SDM	430.67***		432.11***	
SEM vs Dynamic SDM	515.52***		507.39***	
Dynamic SAR vs Dynamic SDM	43.04***		46.93***	
Spatial Autocorrelation Model (SAC)		5041.8		5032.6
Dynamic SDM		4645.2		4619.4

We are interested in coefficients Rho (ρ), the spatially lagged levels of corruption in space, and Sigma (δ), measuring the effects of spatially lagged corruption levels in both space and time. Also, the paper empirically explores the main predictors of the spatio-temporal dependence of corruption geographically across provinces in Vietnam by investigating the indirect effects of independent variables specified in Eq. (2).

The interested estimated parameter Rho (ρ) is positive and statistically significant at the one percent level, meaning the corruption levels among provinces in the research sample are positively autocorrelated. This empirical result is formerly explained by historical and contemporary economic, cultural, and political exchanges among regions, and corruption of a province is influenced by that of its neighboring regions (Becker et al., 2009; Bologna, 2017; Borsky & Kalkschmied, 2019; Donfouet et al., 2018; Goel & Nelson, 2007; Lopez-Valcarcel et al., 2017). On the one hand, provinces do not have policy-making authority in the Vietnamese context, resulting in similar institutional structures in neighboring regions. Corruption acts in these provinces would share a similar pattern when the geographical distance is smaller (Bologna, 2017; Seldadyo et al., 2010). On the other hand, although provinces have similar central policies, they have a considerable autonomy in the implementation. It would provide notable discretions among those provinces with a small degree of spatial dependence (Seldadyo et al., 2010). As a result, the corruption levels of a province reflect those of the neighboring provinces; the corruption levels of provinces in geographically close neighborhoods are similar.

The most interesting estimated parameter Sigma (δ) is positive and statistically significant at the conventional significance level. It implies that the corruption levels of a specific province are influenced by lagged corruption levels of other neighboring provinces. The result is essential to show that provincial corruption levels are affected by corruption levels of neighboring provinces in both space and time. In other words, better anti-corruption of neighboring provinces in the past is also helpful for corruption control of other provinces. Further, the estimate of Phi (φ) is positive and statistically significant at the one percent level, implying that the change in corruption levels is partly attributed to the temporal lag of corruption itself. These empirical results show a similarity in corruption levels among geographically and temporally close provinces in Vietnam.

Table 4 The estimation results of the dynamic SDM model with the contiguity weight matrix

Variables	Main (1)	Wx (2)	SR_Direct (3)	SR_Indirect (4)	LR_Direct (5)	LR_Indirect (6)
Lagged corruption (φ)	0.134***					
	(0.038)					
Spatially lagged corruption (δ)	0.117**					
	(0.056)					
Net-migration rate	-0.203*	0.454***	-0.150	0.574**	-0.140	0.858**
	(0.107)	(0.163)	(0.101)	(0.224)	(0.122)	(0.370)
In-migration rate	0.368***	-0.735***	0.296**	-0.896***	0.294*	-1.307***
	(0.138)	(0.204)	(0.129)	(0.263)	(0.154)	(0.426)
Openness	0.094	0.139	0.107	0.216	0.144	0.412
	(0.368)	(0.667)	(0.359)	(0.917)	(0.444)	(1.528)
Ln(Import)	0.286	-0.394	0.235	-0.384	0.256	-0.517
	(0.660)	(1.108)	(0.677)	(1.677)	(0.853)	(2.842)
Ln(GRDP)	-9.002*	-1.571	-9.203*	-6.455	-11.513*	-15.038
	(4.789)	(7.364)	(4.892)	(11.156)	(6.096)	(19.001)
Ln(Investment)	2.634	0.694	2.709	1.938	3.387	4.443
	(2.423)	(4.100)	(2.566)	(6.316)	(3.213)	(10.709)
Ln(Labor)	-0.376	8.306	0.793	11.059	1.725	18.435
	(7.444)	(12.014)	(7.086)	(17.460)	(8.517)	(28.599)
Ln(Freight traffic)	-1.359	0.766	-1.410	0.115	-1.684	-0.467
	(1.965)	(3.560)	(1.874)	(5.450)	(2.343)	(9.112)
Ln(PBE)	-0.615	1.951*	-0.379	2.572	-0.277	3.996
	(0.660)	(1.155)	(0.697)	(1.681)	(0.865)	(2.833)
Transparency	-0.008	3.799***	0.426	5.737***	0.910	9.525***
	(0.476)	(0.890)	(0.473)	(1.324)	(0.599)	(2.299)
Proactivity of PL	-1.918***	-0.550	-2.077***	-1.930***	-2.631***	-4.151***
	(0.309)	(0.506)	(0.305)	(0.676)	(0.378)	(1.177)

Table 4 (continued)

Variables	Main (1)	Wx (2)	SR_Direct (3)	SR_Indirect (4)	LR_Direct (5)	LR_Indirect (6)
Rho (ρ)	0.383***					
	(0.039)					
Lambda (λ)	46.257***					
	(2.308)					
Observations	693					
R-squared	0.198					

Standard errors are in parenthesis; ***, ** and * are significant at 1%, 5% and 10%, respectively

Table 5 The estimation results of the dynamic SDM model with the distance weight matrix

Variables	Main (1)	Wx (2)	SR_Direct (3)	SR_Indirect (4)	LR_Direct (5)	LR_Indirect (6)
Lagged corruption (φ)	0.115***					
	(0.037)					
Spatially lagged corruption (δ)	0.116**					
	(0.058)					
Net-migration rate	-0.165	0.384**	-0.120	0.520**	-0.111	0.776*
	(0.104)	(0.163)	(0.099)	(0.243)	(0.117)	(0.400)
In-migration rate	0.325**	-0.686***	0.261**	-0.889***	0.255*	-1.300***
	(0.133)	(0.200)	(0.126)	(0.278)	(0.147)	(0.452)
Openness	-0.066	0.123	-0.061	0.110	-0.065	0.157
	(0.355)	(0.774)	(0.351)	(1.159)	(0.429)	(1.915)
Ln(Import)	0.429	-0.024	0.425	0.290	0.513	0.667
	(0.644)	(1.342)	(0.673)	(2.176)	(0.838)	(3.644)
Ln(GRDP)	-9.806**	-6.447	-10.575**	-15.755	-13.270**	-30.716
	(4.769)	(7.961)	(4.879)	(12.828)	(5.924)	(21.784)
Ln(Investment)	3.377	1.694	3.593	4.297	4.446	8.697
	(2.384)	(4.278)	(2.529)	(7.085)	(3.081)	(11.943)
Ln(Labor)	2.185	2.156	2.752	3.778	3.436	7.494
	(7.256)	(11.690)	(7.039)	(18.381)	(8.305)	(30.067)
Ln(Freight traffic)	-1.287	2.634	-1.141	3.065	-1.159	4.419
	(1.973)	(3.741)	(1.905)	(6.183)	(2.325)	(10.302)
Ln(PBE)	-0.794	2.638**	-0.505	3.721*	-0.380	5.754*
	(0.643)	(1.213)	(0.685)	(1.924)	(0.832)	(3.245)
Transparency	-0.104	4.689***	0.401	7.522***	0.895	12.321***
	(0.462)	(0.940)	(0.466)	(1.498)	(0.578)	(2.629)
Proactivity of PL	-1.805***	-0.891*	-1.995***	-2.660***	-2.485***	-5.279***
	(0.305)	(0.510)	(0.303)	(0.730)	(0.365)	(1.291)

Table 5 (continued)

Variables	Main (1)	Wx (2)	SR_Direct (3)	SR_Indirect (4)	LR_Direct (5)	LR_Indirect (6)
Rho (ρ)	0.420***					
	(0.040)					
Lambda (λ)	44.515***					
	(2.219)					
Observations	693					
R-squared	0.237					

Standard errors are in parenthesis; ***, ** and * are significant at 1%, 5% and 10%, respectively

The positive and statistically significant parameters of Rho and Sigma and construction of the distance weight matrix imply the spatial effect of corruption cross provinces is smaller when the distance between provinces is greater. It means that corruption levels of a province are more strongly influenced by those of geographically and temporally closer provinces. In addition, Rho is larger than an estimated coefficient of Sigma, meaning a province's corruption levels are more strongly influenced by the corruption levels of neighboring provinces in more recent periods. Therefore, the spatio-temporal effect of corruption is more substantial for geographically closer provinces at more recent periods. This empirical result is meaningful for recommendations on anti-corruption policy design.

Tables 4 and 5 also present the direct and indirect effects in the short- and long-run, which show the impacts of independent variables on corruption levels across provinces. As mentioned, the direct effects on corruption have been well documented, but the indirect effects on corruption have been rarely examined. Thus, this study simultaneously focuses on the indirect effects of independent variables in space and time. Three important factors influence provincial corruption in space and time in the short- and long-run, including immigration, transparency, and proactivity of provincial leadership. The estimated results consistently show that the long-run indirect coefficients are larger than the short-run ones, implying the above independent variables have a more substantial impact on the corruption levels of neighboring provinces over time.

Inward immigration consistently has negative impacts on corruption in destination provinces. This empirical result can be explained by widespread rural–urban migration flows in Vietnam, and destination provinces are urban or industrialized, where corruption is much more prevalent than in the immigration-origin areas (Nguyen & Le, 2021). Immigrants from less corrupt provinces bring their low tolerance of corruption and robust anti-corruption cultural norms to the destination provinces, contributing to a decrease in corruption of destination provinces. A similar empirical result is also found in Dimant et al. (2014). Transparency consistently has a positive indirect impact on corruption in both the short- and long-run, meaning a more transparent province will positively impact the corruption of neighboring provinces. According to the empirical findings in Nguyen et al. (2016), Vietnamese firms usually use corruption as an instrument of competition and bidding winning. If the business environment is transparent, the firms cannot use corruption to win the bidding. In this circumstance, the rent-seeking firms would move to neighboring provinces where they can use corruption for competition in doing business. Therefore, a more transparent business environment province leads to higher corruption levels in the neighboring provinces.

Another estimated result is a negative direct and indirect impact of proactivity of provincial leadership on corruption levels in both the short- and long-run. The proactivity of provincial leadership measures the creativity and cleverness of provinces in implementing central policy, designing their initiatives for private sector development. More proactive leadership is strongly associated with lower corruption levels in that province and neighboring provinces. The provincial proactive leadership can support local firms and attract firms from neighboring provinces by their initiatives for enterprise development. In this sense, the proactivity of provincial leadership is a potential measure for anti-corruption because corruption is clustered in space and time.

Conclusion

Corruption levels differ among and within countries, and they are clustered in space and time simultaneously. This paper uses the dynamic Spatial Durbin models to estimate the spatio-temporal dependency of corruption levels. It investigates the main predictors of the provincial corruption levels accounting for dynamic spatial externalities, which previous studies rarely examined. Data are adapted from the PCI survey and GSO for 63 provinces in Vietnam during 2006–2017. Empirical results show that provinces' corruption levels are positively influenced by spatio-temporal dependence of neighboring provinces' corruption levels. Further, the spatio-temporal dependence of corruption levels is also explained by spatial externalities, such as immigration, provincial governance and policy, but not economic development.

A possible limitation of this study is the use of perceived corruption, which may have some drawbacks. Respondents from different sub-national regions may perceive corruption differently due to social norms and local tolerance of corruption. In addition, anti-corruption propaganda on mass media may affect respondents' perception even if the corruption cases are not in the local communities. Further research should use a measure of experienced corruption when respondents access certain public administrative services.

Although the study has limitations, the results have some theoretical and managerial implications. From a theoretical perspective, corruption is clustered simultaneously in space and time, meaning that a region's corruption levels are affected by region-specific corruption and neighbors' corruption levels over time. Thus, estimations of the impact of corruption should use spatio-temporal dependence models to avoid underestimating the effects, get the short-run direct and indirect effects of corruption levels, measure the spatial externality effects from neighboring regions, and get unbiased estimates. The result could theoretically explain the complex interactions between the region's institutions and those of neighboring regions, and the spatio-temporal impacts of the neighboring corruption levels are a cause of corruption. The results also suggest further research direction investigating the spatio-temporal effects of exogenous variables of neighboring sub-national regions on corruption levels and spatio-temporal dependence of corruption simultaneously. The proposed theoretical model could be better fitted to measure spatio-temporal effects on corruption levels, and its applications would provide more appropriate empirical evidence for anti-corruption policy design. Another theoretical contribution is an indirect spatial negative impact of income on corruption. Thus, increasing the income of neighboring regions/provinces could be a good measure for the anti-corruption of a region or province.

From a managerial perspective, the empirical results may have several implications for public policy. First, the anti-corruption policy should consider the spatio-temporal dependency of corruption. From a spatial dimension, empirical results suggest that anti-corruption measures should be applied firmly in a hub of sub-national regions that promise substantial spillover effects. It may include sub-national regions, such as the capital, highly market integrated sub-national regions, and sub-national border regions. Besides, our result suggests that anti-corruption measures should focus on the most recent corruption cases since they have robust and substantial spatial spillover effects. It is empirically true for externalities associated with the prosecution of corruption cases once limited resources are allocated to the anti-corruption effort. Second, anti-corruption programs should be coordinated at the regional or national levels to increase the effectiveness of anti-corruption efforts. As corruption is a spatio-temporal phenomenon, the corruption of neighboring provinces influences local corruption levels. Failure to control corruption in certain areas would lead to others. The local approach to anti-corruption should aim for more expansive coverage based on national institutions. It needs more effective coordination of anti-corruption policies at the sub-national level. Third, the anti-corruption policy should focus on institution reform to curb corruption in sub-national regions across space and time. Simultaneous improvement of transparency across sub-national regions and proactivity of provincial leadership enables indirectly reducing corruption levels of neighboring sub-national regions. Fourth, promoting rural-to-urban migration and increasing GDP per capita could help reduce corruption at the provincial level in Vietnam.

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Declarations

Not applicable

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References

Anselin, L. (1988). *Spatial econometrics: Methods and models*. Kluwer Academic Publishers.
Anselin, L. (2008). *Spatial econometrics: Methods and models*. Kluwer Academic Publishers.
Arbia, G., Battisti, M., & Di Vaio, G. (2010). Institutions and geography: Empirical test of spatial growth models for European regions. *Economic Modelling, 27*(1), 12–21.
Attila, J. (2008). Is corruption contagious? An econometric analysis. *NUPI Working Paper, No. 742*.
Becker, S., Egger, P. H., & Seidel, T. (2009). Common political culture: Evidence on regional corruption contagion. *European Journal of Political Economy, 25*(3), 300–310.
Belotti, F., Hughes, G., & Mortari, A. P. (2017). Spatial panel-data models using Stata. *The Stata Journal, 17*(1), 139–180.
Bologna, J. (2017). Contagious corruption, informal employment, and income: Evidence from Brazilian municipalities. *The Annals of Regional Science, 58*(1), 67–118.

Borsky, S., & Kalkschmied, K. (2019). Corruption in space: A closer look at the world's subnations. *European Journal of Political Economy, 59*, 400–422.
Burnham, K. P., & Anderson, D. R. (2004). Multimodel inference: Understanding AIC and BIC in model selection. *Sociological Methods & Research, 33*(2), 261–304.
Castro, A., Phillips, N., & Ansari, S. (2020). Corporate corruption: A review and an agenda and future research. *Academy of Management Annals, 14*(2), 935–968.
Dimant, E., Krieger, T., & Redlin, M. (2014). A crook is a crook … but is he still a crook abroad? On the effect of immigration on destination-country corruption. *German Economic Review, 16*(4), 464–489.
Donfouet, H. P. P., Jeanty, P. W., & Malin, E. (2018). Analysing spatial spillovers in corruption: A dynamic spatial panel data approach. *Papers in Regional Science, 97*, S63–S78.
Dong, B., Dulleck, U., & Torgler, B. (2012). Conditional corruption. *Journal of Economic Psychology, 33*, 609–627.
Elhorst, J. P. (2010). Dynamic Models in Space and Time. *Geographical Analysis, 33*(2), 119–140.
Elhorst, J. P. (2014). *Spatial econometrics: From cross-sectional data to spatial panels*. Springer.
Elliott, K. A. (2002). It is widely accepted that corruption is a global problem, and it requires global measures In M. l. Arnold I. Heidenheimer (Ed.), *Political Corruption* (3rd ed.). Routledge.
Goel, R. K., & Nelson, M. A. (2007). Are corrupt acts contagious?: Evidence from the United States. *Journal of Policy Modeling, 29*(6), 839–850.
Gründler, K., & Potrafke, N. (2019). Corruption and economic growth: New empirical evidence. *ifo Working Paper, No. 309*.
Hsiao, C. (2014). *Analysis of panel data*. Cambridge University Press.
Husted, B. W. (1994). Honor among thieves: A transaction-cost interpretation of corruption in third world countries. *Business Ethics Quarterly, 4*(1), 17–27.
Jeong, Y., & Weiner, R. J. (2012). Who bribes? Evidence from the United Nations' oil-forfood program. *Strategic Management Journal, 33*(12), 1363–1383.
Kaufmann, D., & Kraay, A. (2020). *Worldwide governance indicator*. Retrieved from https://info.worldbank.org/governance/wgi/. Accessed 8 Dec 2020.
Lambsdorff, J. G. (2002). Making corrupt deals - Contracting in the shadow of the Law. *Journal of Economic Behavior and Organization, 48*(3), 221–241.
Lambsdorff, J. G. (2007). *The institutional economics of corruption and reform: Theory, evidence and policy*. Cambridge University Press.
Le, Q. C., Nguyen, T. P. T., & Do, T. N. (2021). State ownership, quality of sub-national governance, and total factor productivity of firms in Vietnam. *Post-Communist Economies, 33*(1), 133–146.
Lopez-Valcarcel, B. G., Jiménez, J. L., & Perdiguero, J. (2017). Danger: Local corruption is contagious! *Journal of Policy Modeling, 39*(5), 790–808.
Márquez, M. A., Salinas-Jiménez, J., & Salinas-Jiménez, Md. M. (2011). Exploring differences in corruption: The role of neighboring countries. *Journal of Economic Policy Reform, 14*(1), 11–19.
Mauro, P. (1995). Corruption and growth. *Quarterly Journal of Economics, 110*(3), 681–712.
McKinney, J. A., & Moore, C. W. (2008). International bribery: Does a written code of ethics make a difference in perceptions of business professionals. *Journal of Business Ethics, 79*(1/2), 103–111.
Mitchel, A. (2005). *The ESRI Guide to GIS analysis, Volume 2: Spartial measurements and statistics*. ESRI Press.
Nguyen, P. A., & Le, Q. C. (2021). Socioeconomic status, norms and bribe-giving behaviors among citizens of Vietnam. *International Journal of Public Administration, 45*(1), 37–48.
Nguyen, V. T., Ho, B. D., Le, Q. C., & Nguyen, V. H. (2016). Strategic and transactional costs of corruption: Perspectives from Vietnamese firms. *Crime, Law Social Change, 65*(4–5), 351–374.
O'Trakoun, J. (2017). New perspectives on corruption contagion. *Journal of International Trade & Economic Development, 26*(5), 552–565.
O'Connor, S., & Fischer, R. (2014). Predicting societal corruption across time: Values, wealth, or institutions? *Journal of Cross-Cultural Psychology, 43*(4), 644–659.
Oliver, C. (1997). Sustainable competitive advantage: Combining institutional and resource-based views. *Strategic Management Journal, 18*(9), 697–713.
Pinto, J., Leana, C. R., & Pil, F. K. (2008). Corrupt organizations or organizations of corrupt Individuals? Two types of organization-level corruption. *Academy of Management Review, 33*(3), 685–709.
Rothstein, B., & Uslaner, E. M. (2005). All for all: Equality, corruption, and social trust. *World Politics, 58*(1), 41–72.

Seldadyo, H., Elhorst, J. P., & De Haan, J. (2010). Geography and governances: Does space matter? *Paper in Regional Science, 89*(3), 625–640.
Shleifer, A., & Vishny, R. W. (1993). Corruption. *Quarterly Journal of Economics, 108*(3), 599–617.
Søreide, T. (2009). Too risk averse to stay honest?: Business corruption, uncertainty and attitudes toward risk. *International Review of Law and Economics, 29*(4), 388–395.
Towards Transparency. (2020). *Vietnam Corruption Barometer 2019: Vietnamese citizens' view and experiences of corruption*. https://towardstransparency.vn/wp-content/uploads/2018/11/VCB-2019_EN.pdf.
Transparency International. (2020). *Corruption perception index 2020*. https://images.transparencycdn.org/images/CPI2020_Report_EN_0802-WEB-1_2021-02-08-103053.pdf.
Treisman, D. (2000). The causes of corruption: A cross-national study. *Journal of Public Economics, 76*(3), 399–457.
Treisman, D. (2007). What have we learned about the causes of corruption from ten years of cross-national empirical research? *Annual Review of Political Science, 10*, 211–244.
Zhou, X., Han, Y., & Wang, R. (2013). An empirical investigation on firms' proactive and passive motivation for bribery in china. *Journal of Business Ethics, 118*(3), 461–472.