Estimating Economic Interactions of Financial Suppliers in Thailand *

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Abstract

This paper presents a methodology to estimate and identify different kinds of economic interaction, whenever these interactions can be established in the form of spatial dependence. First, we apply the semi-parametric approach of Chen and Conley (2001) to the estimation of reaction functions. Then, the methodology is applied to the analysis financial providers in Thailand. Based on a sample of financial institutions, we provide an economic framework to test if the actual spatial pattern is compatible with strategic competition (local interactions) or social planning (global interactions). Our estimates suggest that the provision of commercial banks and suppliers credit access is determined by spatial competition, while the Thai Bank of Agriculture and Agricultural Cooperatives is distributed as in a social planner problem.

JEL Classification: C14, O16, O18, R12.

Key words: spatial econometrics, semi-parametric estimation, financial suppliers.

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1 Introduction

Although the interaction among agents is at the core of a large portion of the economic toolbox, it has been neglected by the traditional models in econometrics. The usual assumption of independence in cross-section analysis establishes that the outcome of an agent is not affected by the outcome of the others. Nevertheless, economic decisions might be characterized by a significant degree of interdependence due to strategic behavior, sequential decisions, resource constraints, transportation costs, and others.

The purpose of this paper is twofold. First, we provide a regression model for cross-section data to estimate reaction functions which is able to contrast different types of interaction, whenever these interactions can be established in the form of spatial dependence, i.e., when the interdependence between agents can be represented as a function of some notion of distance. This approach is particularly useful because it leads to the spatial autoregressive specifications for reaction functions which are well known in the geostatistics and regional sciences [Ord (1975), Anselin (1988)]. However, the traditional parametric approach of the problem has important drawbacks because it is based on the adoption of specific functional forms of interactions.

For this task, the paper contributes using a simple adaptation of the semiparametric approach of Chen and Conley (2001) to the generalization of the autoregressive component of these models. The semiparametric formulation allows more flexible specifications. Although there is a (potential) loss of efficiency if compared with the proper parametric alternatives, there is an evident gain in consistency. Since the identification of adequate parametric forms is a very hard task in empirical applications, the latter effect is more likely to prevail. It assures improvements in the estimation of substantive economic effects mentioned above and, even if spatial dependence or economic interactions are not an end in itself, a better estimation of the spatial autoregressive term might enhance other parameter's estimates. In some cases, measurement errors generate artificial spatial dependence, which determines that OLS estimates are inconsistent.

The second purpose of the paper is to understand the type of interaction explain the spatial distribution of financial suppliers in Thailand, which is done as an application of this econometric model for spatial regressions. Given a sample of bank locations, we provide a framework to test if it is generated by strategic competition or by a social planner. We show that models of spatial competition such as Hotelling (1929), Eaton and Lipsey (1975) and Prescott and Visscher (1977) generate a pattern of local interaction, while a typical resource allocation problem faced by a social planner displays global interaction due to the budget constraint.

The paper is organized as follows. Next section presents the spatial autoregressive model in its general form. In Section 3, the semiparametric approach of Chen and Conley (2001) is used to inference. Some parametric alternatives are also discussed for the sake of completeness. The empirical application is the object of Section 4. In this section, we provide an economic framework to guide the empirical strategy and the estimates of the model. Data from the Thai Community Development Department (CDD) surveys across more than three thousand villages in four provinces of Thailand is used to characterize the profile of financial providers. Last section concludes.

2 An econometric model of interaction

Consider a set of N economic agents indexed by i. For each agent i, there is a dataset represented by $(y_i, \mathbf{x}_i) \in \Re \times \Re^K$, where y_i is a choice variable and $\mathbf{x}_i$ is a vector of characteristics. A general linear formulation for economic interaction can be stated as:

$$y_i = \sum_{i \neq j} w_{ij} y_j + \mathbf{x}_i' \beta + u_i, \tag{1}$$

where the choice of agent i is determined not only for her own characteristics but also by the choice of others. Notice that in eq. (1) each agent is allowed to be affected differently by the others. Unfortunately, there is no degree of freedom for the estimation of such a general specification.

In order to estimate a model of economic interaction such as eq. (1) it is necessary to restrict the analysis to *structured* weights. The proposal of this paper is to use a structure induced by the notion of spatial dependence.

Let $D_{i,j}$ an exogenously defined distance function between agents i and j. For example, it can be considered simply as $D_{i,j} = \|\mathbf{s}_i - \mathbf{s}_j\|$, where $\mathbf{s}_i \in \Re^L$ is the location of agent i. Therefore, eq. (1) can be written as a general spatial autoregressive model given by:

$$y_i = \sum_{i \neq j} g(D_{i,j}) y_j + \mathbf{x}_i' \beta + u_i, \tag{2}$$

where u_i is i.i.d. and normally distributed with mean 0 and variance σ^2. The function $g(\cdot)$ incorporates the spatial dependence into analysis and corresponds to the structure needed for identification.[1] This representation im-

[1] If $D_{i,j} = \min\{i - j, 0\}$, eq. (2) becomes the well known AR model in time series. In this case, since $D_{i,j} = 0$ for all $i < j$, eq. (2) can be written as

$$y_i = g(1) y_{i-1} + ... + g(i-1) y_1 + \mathbf{x}_i' \beta + u_i.$$

plies that the value of y_j, for every $j \neq i$, affects y_i through the spatial weight $g(D_{i,j})$. If $g(\cdot)$ is equal to zero there is no interaction and eq. (2) can be estimated by OLS, which provides an efficient and consistent estimate for β. If $g(\cdot) \neq 0$, there is spatial dependence and economic interaction is relevant for the estimation of β.

Using matrix notation, eq. (2) can be expressed as:

$$\mathbf{Y} = \mathbf{AY} + \mathbf{X}\beta + \mathbf{u}, \tag{3}$$

where

$$\mathbf{A} = \begin{bmatrix} 0 & g(D_{1,2}) & \cdots & g(D_{1,N}) \\ g(D_{2,1}) & 0 & \cdots & g(D_{2,N}) \\ \vdots & \vdots & \ddots & \vdots \\ g(D_{N,1}) & g(D_{N,2}) & \cdots & 0 \end{bmatrix}. \tag{4}$$

In this case, $\mathbf{Y}$ is normally distributed with mean $(\mathbf{I}-\mathbf{A})^{-1}\mathbf{X}\beta$ and covariance matrix $\mathbf{C} \equiv \sigma^2 (\mathbf{I}-\mathbf{A})^{-1}(\mathbf{I}-\mathbf{A})^{-1}$.

The properties of estimators and hypothesis tests for eq. (2) are derived from the asymptotics for stochastic processes. As in time series analysis, regularity conditions are needed to limit the extent of spatial dependence in order to assure consistency and asymptotic normality. In fact, eq. (2) defines a stationary stochastic process with higher-order moments if $\rho(\mathbf{A}) < 1$, where $\rho(\mathbf{A})$ is the spectral radius of $\mathbf{A}$.[2]

3 Estimation

The log-likelihood of eq. (2) can be expressed as:

$$\ln L = -\frac{N}{2}\log 2\pi - \frac{N}{2}\log\sigma^2 - \frac{1}{2\sigma^2}\sum_{i=1}^{N}\left(y_i - \sum_{i\neq j} g(D_{i,j})\,y_j - \mathbf{x}_i'\beta\right)^2. \tag{5}$$

Although we consider two different approaches to estimate eq. (2), we focus on the semiparametric estimation of eq. (2) since the parametric approach is treated in a large body of literature [e.g. Anselin (1988, 2001)].

Therefore, an AR(1) model can be represented by the function $g(D) = \begin{cases} \alpha, \text{ if } D = 1 \\ 0, \text{ otherwise} \end{cases}$.

[2] See proposition 2.1 in Chen and Conley (2001).

3.1 Parametric Estimation

Ord (1975) presents a parametric approach to eq. (2) in which the function $g(\cdot)$ is assumed to be known up to a constant. Formally, $g(\cdot)$ takes the form of

$$g(D_{i,j}) = \rho w(D_{i,j}), \tag{6}$$

where $w(\cdot)$ is a (known) function defining the matrix of spatial weights. Using matrix notation and defining $W \equiv [w(D_{i,j})]$, eq. (3) becomes

$$\mathbf{Y} = \rho \mathbf{W} \mathbf{Y} + \mathbf{X}\beta + \mathbf{u}. \tag{7}$$

This model can be properly estimated by maximum likelihood.[3] The condition required for stationarity in this case can be simplified to $\frac{1}{\underline{\lambda}} < |\rho| < \frac{1}{\bar{\lambda}}$, where $\underline{\lambda}$ and $\bar{\lambda}$ are the minimum and maximum eigenvalue of $\mathbf{W}$, respectively.

3.2 Semiparametric Estimation

Chen and Conley (2001) suggest a semiparametric approach to spatial models for univariate panel data. Herein, an adaptation of this approach is applied to the model (3), allowing for a general form of $g(\cdot)$. An estimator for $g(\cdot)$ is constructed by the method of sieves. This method uses a flexible sequence of parametric families to approximate $g(\cdot)$.

As Chen and Conley (2001), a shape-preserving cardinal B-spline sieve is used to facilitate the test of shape restrictions. Let B_m denote the cardinal B-spline of order m, defined as:

$$B_m(x) = \frac{1}{(m-1)!} \sum_{k=0}^{m} (-1)^k \binom{m}{k} [\max(0, x-k)]^{m-1}.$$

Notice that B_m is $m-1$ times differentiable, nonnegative and symmetric around the center of its support $[0, m]$. Therefore, the function $g(\cdot)$ can be approximated by

$$g(D) \approx \sum_{k=\underline{K}}^{\bar{K}} a_k B_m(2^n D - k), \tag{8}$$

where $\bar{K}$ and $\underline{K}$ determine the accuracy of the approximation and n is an index which provides a scale refinement.[4] This approximation allows the formulation

[3] See Anselin (1988, 2001) for comprehensive expositions of the model (7).

[4] Chen and Conley (2001) present some technical details about the choice of $\bar{K}$ and $\underline{K}$.

of useful restrictions in the shape of $g(\cdot)$. For example, $g(\cdot)$ is non-increasing if $a_k \geq a_{k+1}$ for all k.

Substituting eq. (8) into eq. (5) and rearranging we obtain the following likelihood:

$$\ln L^{sp} = -\frac{N}{2}\log 2\pi - \frac{N}{2}\log\sigma^2 - \frac{1}{2\sigma^2}\sum_{i=1}^{N}\left(y_i - \mathbf{z}_i'\alpha - \mathbf{x}_i'\beta\right)^2, \quad (9)$$

where $\mathbf{z}_i = \left(\sum_{i\neq j} B_m\left(2^n D_{i,j} - \underline{K}\right) y_j, ..., \sum_{i\neq j} B_m\left(2^n D_{i,j} - \bar{K}\right) y_j\right)$ and $\alpha = \left(a_{\underline{K}}, .., a_{\bar{K}}\right)$. As a consequence, the MLE of the vector (α, β) coincides with the OLS estimator of a regression of y_i on $\mathbf{z}_i$ and $\mathbf{x}_i$. And σ^2 can be estimated by $\hat{\sigma}^2 = \frac{1}{N}\sum_{i=1}^{N}\left(y_i - \mathbf{z}_i'\alpha - \mathbf{x}_i'\beta\right)^2$. Although this formulation is more flexible about the shape of the $g(\cdot)$ function, the computation of the sieve estimator is relatively simple.

4 Application: Financial suppliers in Thailand

This section applies the methodology above to study the profile of financial suppliers in Thailand. One important branch of the economic development literature focus on financial deepening. As suggested by Greenwood and Jovanovic (1990), the access to (costly) financial instruments enhances risk sharing and generates economic growth. The economy-wide wealth accumulation process, in turn, affects the access to financial intermediaries. This model generates a dynamic relationship between the wealth distribution and the participation in the financial sector. Therefore, the analysis of the provision of financial services arises as a key element of the development process.

Different from recent empirical studies, more interested to evaluate the role of the financial deepening channel, [5] this section investigates the type of economic interaction among financial providers prevail in our sample. We contrast two kinds of interactions; namely, strategic spatial competition and central planning. Our empirical strategy is based on the comparison of reaction functions derived from the those different economic environments.

4.1 Economic background

Let us start with the case of strategic spatial competition, in which those reaction functions are determined locally. Since the 1929 influential paper

[5] For example, Felkner and Townsend (2003) and Jeong and Townsend (2003).

by Hotelling, interesting features of the problem motivated many economists to study the location of firms in many situations - introducing or not price differentiation, analyzing simultaneous versus sequential decisions, varying the shape of the markets, the existence of relocation costs, and so on.[6]

Behind most of these models, it is possible to obtain reaction functions that exhibit local dependence in a relatively general setup. Consider a one-dimensional county where consumers are distributed along the interval $[0, 1]$ according to the distribution function $F(\cdot)$. Each consumer $x \in [0, 1]$ contracts one financial operation from the cheapest source. Suppose that in a cross-section survey we observe the provision of N bank agencies providing identical services of financial intermediation in different locations b_i, for $i = 1, ..., N$. Without loss of generality, we label those observations in a way such that $b_1 < b_2 < ... < b_N$. Next, we will derive general reaction functions for different assumptions about the interaction of these agencies in order to identify a test about the decision process behind the observed pattern.

Let x_i^* be the consumer who is indifferent between banks i and $i+1$, which is defined by the condition

$$p_i + t\left(x_i^* - b_i\right) = p_{i+1} + t\left(b_{i+1} - x_i^*\right),$$

where p_i is the price charged by bank i, t is the (linear) transportation cost, $b_0 = 0$ and $b_{N+1} = 1$. Equivalently, it is easy to check that

$$x_i^* = \frac{p_{i+1} - p_i}{2t} + \frac{b_{i+1} + b_i}{2}.$$

Therefore, the market size of bank i is given by $F\left(x_i^*\right) - F\left(x_{i-1}^*\right)$, which depends only on the provision of nearby services of banks $i-1$ and $i+1$.[7] Consequently, the decision of setup a bank in a location b_i is not affected by the location of banks which are not neighbors. And more important, this result does not depend on the type of strategic interaction we are dealing with. It can be simultaneous (as a Cournot oligopoly) or sequential (as a Stackelberg leadership). What really matters is the strategic behavior - banks presumably decide individually based on available information and expectations about the behavior of the opponents. As a result, the reaction function of bank i in such situations is expressed in terms of prices and locations of adjacent banks $i-1$ and $i+1$.

[6] See Hotelling (1929), Eaton and Lipsey (1975) and Prescott and Visscher (1977). For the existence of equilibrium of such games in situations with discontinuous payoffs, see Dasgupta and Maskin (1986).

[7] Notice that the individual x_i^* lives in the center of banks i and $i+1$ if $p_{i+1} = p_i$. In addition, if consumers are uniformly distributed, the market size simplifies to $\frac{b_{i+1} - b_i}{2}$.

In summary, the strategic behavior of banks leads to local spatial interaction. Notwithstanding whether decisions are made sequentially or not, the financial provision in a given region is determined by the adjacent neighborhood.

On the other hand, if the provision of the services is defined by a social planner, in a resource allocation problem, the interaction is global. To be more precise, let $W(b_1, ..., b_N)$ denote the social welfare associated with the existence of banks at locations $b_1, ..., b_N$. If the setup cost of each bank i is c_i, the problem of a social planner with a budget I is given by:

$$\max_{b_1,...,b_N} W(b_1, ..., b_N)$$

subject to

$$\sum_{i=1}^{N} c_i b_i = I.$$

It is straightforward to check that the first-order conditions of this problem implies that

$$b_i = \frac{\lambda}{\partial W / \partial b_i} \left[I - \sum_{j \neq i} c_j b_j \right],$$

where λ is the multiplier related to the budget constraint. Note that, in the social planner problem, the position of bank i is affected by all other banks, even if W is separable, because of the budget constraint. Therefore, we expect to observe global interactions in public provision of bank services and local interactions whenever the locations are defined privately by strategic competition.

4.2 Data

We consider data from four of Thailand's 73 provinces (*changwats*) - the semi-urban provinces of Chachoengsao and Lop Buri in the Central region relatively near Bangkok, and the more rural Sisaket and Buriram in the poorer Northeast region (see figure 1). Each village was vectorized into a Geographic Information System.

The four changwats considered here were chosen to represent the strong regional economic and environmental variation exhibited in Thailand. Chachoengsao and Lop Buri belong to the Central region, representing wealthier and more dynamic areas than other provinces such Sisaket and Buriram. Due to the proximity to the Bangkok metropolitan area, provinces from the Central region present greater investment in infrastructure and entrepreneurship, higher levels of education, wealth and access to financial institutions. The four provinces selected can be ordered in economic terms decreasing from Chachoengsao to Lop Buri to Buriram to Sisaket.

The data used hereafter is extracted from the Thai Community Development Department (CDD) survey, conducted every two year from 1986-1996. Figure 2 shows a total of 3391 geo-located villages which were linked to the CDD database. There are 1300 villages in Sisaket, 1230 in Buriram, 419 in Lop Buri and 442 in Chachoengsao. Despite the availability of a panel, the following analysis considers only data from 1996.

Thailand is a very interesting case study for us. During the period from 1976 to 1996, the real GNP per capita grew at 5.7% annually while financial participation increased from 6% in 1976 to 26% in 1996. The fraction of population that did not participate in financial intermediation and was not engaged in entrepreneurial activities fell from 80% to 60%.

From the CDD database, there are binary variables indicating the presence or absence of credit providers. The Thai Bank of Agriculture and Agricultural Cooperatives (BAAC) had the highest number of villages reporting its access, ranging from 85% in Chachoengsao to 69% in Sisaket. It is also used variables reporting the suppliers credit access (62% in Chachoengsao) and commercial banks (34% in Chachoengsao).

A wealth index was created using a principal component analysis of four variables - per capita TVs per village, per capita motorcycles per village, per capita pick-up trucks per village, and the percentage of household having flush toilets per villages. The other variables used from the CDD database are the percentage of individuals per village having completed secondary education and two measures of soil quality.

In addition to variables gathered from the CDD database, a measure of proximity to major roads is constructed to represent transportation or distances costs. For each village, the shortest route along road networks in terms of travel time to the nearest major highway was mapped, and the travel time calculated. Figure 3 shows the road networks and major intersection locations in each changwat.

4.3 Empirical Results

In this section, we use the econometric model presented in Section 2 to identify what type of economic interaction has generated the observed pattern of financial provision in Thailand. Based on the discussion of Section 3, we can test if the actual distribution of banks is compatible with a model of central planning or a model of strategic interaction. While the budget constraint imposes a strong relationship among all the bank agencies provided by a social planner, we should observe only local interactions for the case of strategic competition.

The degree of interaction in the econometric analysis is captured by the function $g(\cdot)$, which can is estimated below. As long as our sample includes villages which are not homogeneous with respect to observable variables, we also introduce some control variables to account for those differences.

The results are presented in Tables 1 to 3, while the estimated g functions are depicted in Figures 4 to 6. All estimations are based in the following specification:

$$\begin{aligned}\texttt{provider}_i = \sum_{j \neq i} g(D_{i,j})\, \texttt{provider}_j + \beta_0 + \beta_1 \texttt{wealth}_i + \beta_2 \texttt{ADV}_i \\ + \beta_3 \texttt{Dis2Maj}_i + \beta_4 \texttt{Soil1}_i + \beta_5 \texttt{Soil5}_i + u_i,\end{aligned} \tag{10}$$

where `provider` is the binary variable indicating the presence or not of the corresponding financial intermediary, `wealth` is the wealth index, `ADV` is the percentage of individuals per village having completed secondary education, `Dis2Maj` is the length of the shortest route to the nearest major highway, `Soil1` and `Soil5` are two measures of soil quality. Equation (10) was estimated for each provider and each province.

Figure 4 present the estimated g function for the Thai Bank of Agriculture and Agricultural Cooperatives (BAAC). As we could expect, the spatial distribution of BAAC is compatible with the central planner solution. There is no significant reduction in the relationship among villages as we increase the distance between them. This patterns is present in all four provinces considered. On the other hand, Figures 5 and 6 suggest that the process behind the provision of commercial banks and suppliers credit access due to strategic competition. Except for the province of Lop Buri, where the g function is not significant, there is a clear pattern of local interaction in Chachoengsao, Buriram and Sisaket.

In addition to analyze the provision of financial services in Thailand, we are also interested in the comparison of the results obtained from different specifications. Based on this, Tables 1 to 3 present 4 columns for each province. The first one corresponds to the OLS estimation of (10), assuming that $g(D) = 0$ for all $D \geq 0$. Second and third columns present two different parametric specifications commonly used in the spatial econometrics literature.[8] The specifi-

[8] See, for example, Anselin (1988, 2001, 2002).

cation with a binary W matrix implies that

$$g(D) = \begin{cases} \rho, & \text{if } D \leq c; \\ 0, & \text{otherwise;} \end{cases}$$

while the specification with the inverse of distance matrix (column 3) is $g(D) = \frac{\rho}{D}$ for all D. Finally, the last column shows the estimates of the parameters considering the semiparametric formulation for the spatial autoregressive term.

From the comparison of the results depicted in Tables 1 to 3, we learn that the OLS or parametric estimates of g can mislead the estimation of the other parameters of the regression. Specially for the case of the BAAC in Sisaket, where the semi-parametric estimate of g is very precise and very distinct from the functional forms traditionally used in spatial econometrics, we get significant differences. The coefficient of wealth is not significant in the semi-parametric specification and significant in the others. For the case of distance to major roads, we observe the opposite.

5 Conclusion

This paper provides an econometric analysis of economic interactions for situations that can be represented by spatial dependence. We provide both an econometric model and an economic framework that can be combined to identify important features of the interaction among economic agents. In particular, we have applied the methodology to study the profile of financial suppliers in Thailand.

The econometric model presented here is a straightforward adaptation of the semi-parametric approach to spatial problems developed by Chen and Conley (2001). This simple adaptation enable us to estimate reaction functions which are at the core of the empirical strategy adopted to investigate economic interactions. The flexibility to estimate the functional form of the spatial structure is a clear advance with respect to the traditional parametric approach suggested by Ord (1975), whose recent developments can be found in Anselin (2001). A better accounting of spatial dependence is not only a more accurate measure of the interaction between agents but also a means of improving the estimation of the other parameters of the regression.

In the second part of the paper, which is an application of the econometric spatial model of interaction, we also provide an empirical strategy to contrast two types of interactions. Starting from a sample constituted by the location of different financial suppliers and a set of control variables, we analyze what kind of reaction functions is more likely to produce these observations as an equilibrium. We show that a general model of strategic can be associated to local reaction functions, i.e., the location of a given bank is affected only by their neighborhood. On the other hand, in a typical social planner problem, the budget constraint imposes a global structure of interdependence among the locations of the banks. Our estimates suggest that the Thai Bank of Agriculture and Agricultural Cooperatives is more likely to be spatially distributed according to a social planner problem (global interaction), while the provision of commercial banks and suppliers credit access is defined by spatial competition (local interaction).

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Figure 1 - Thai Geographic Regions and Study Changwats

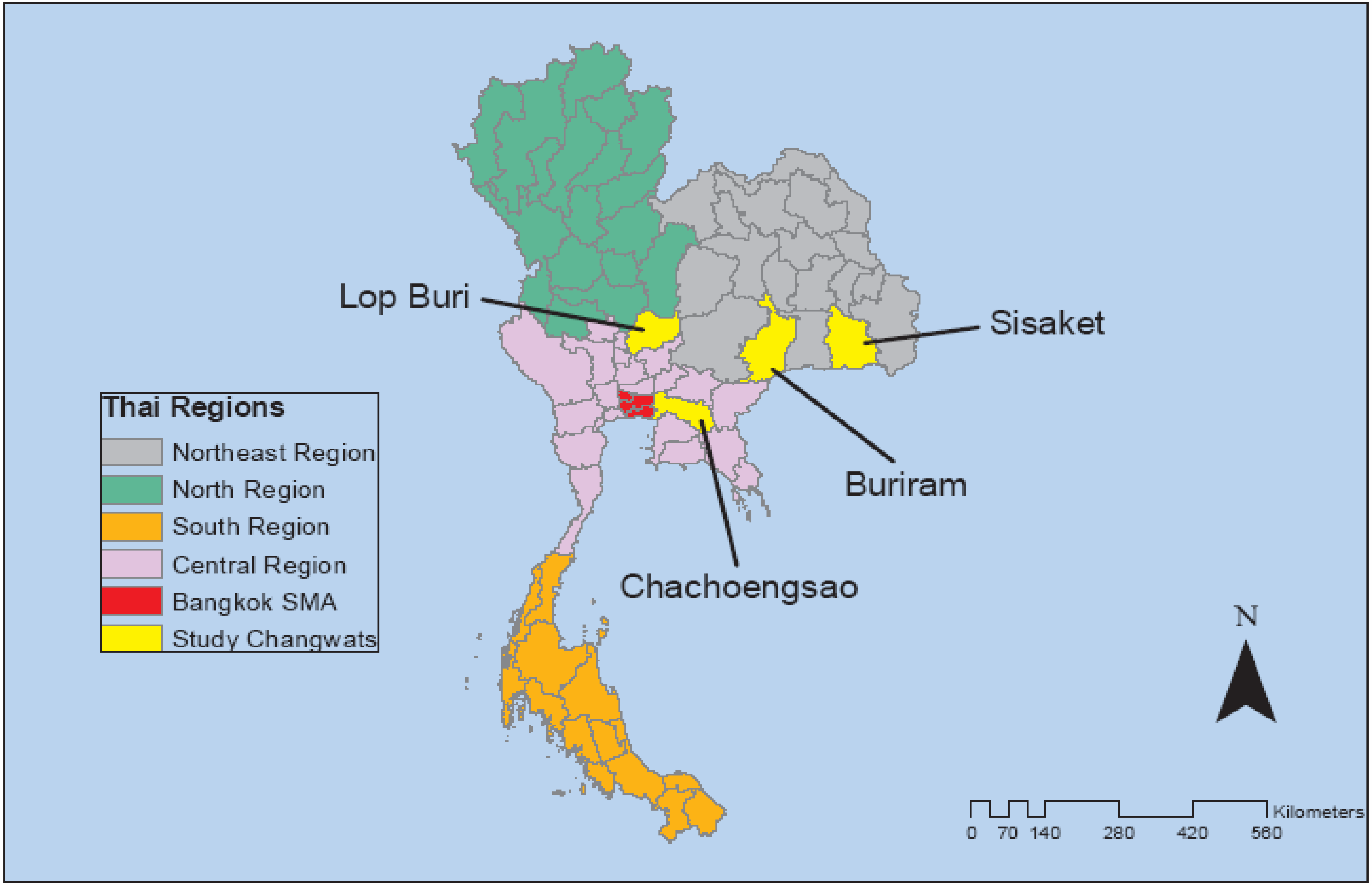

Figure 2 - CDD Village and Amphoe District Center Locations

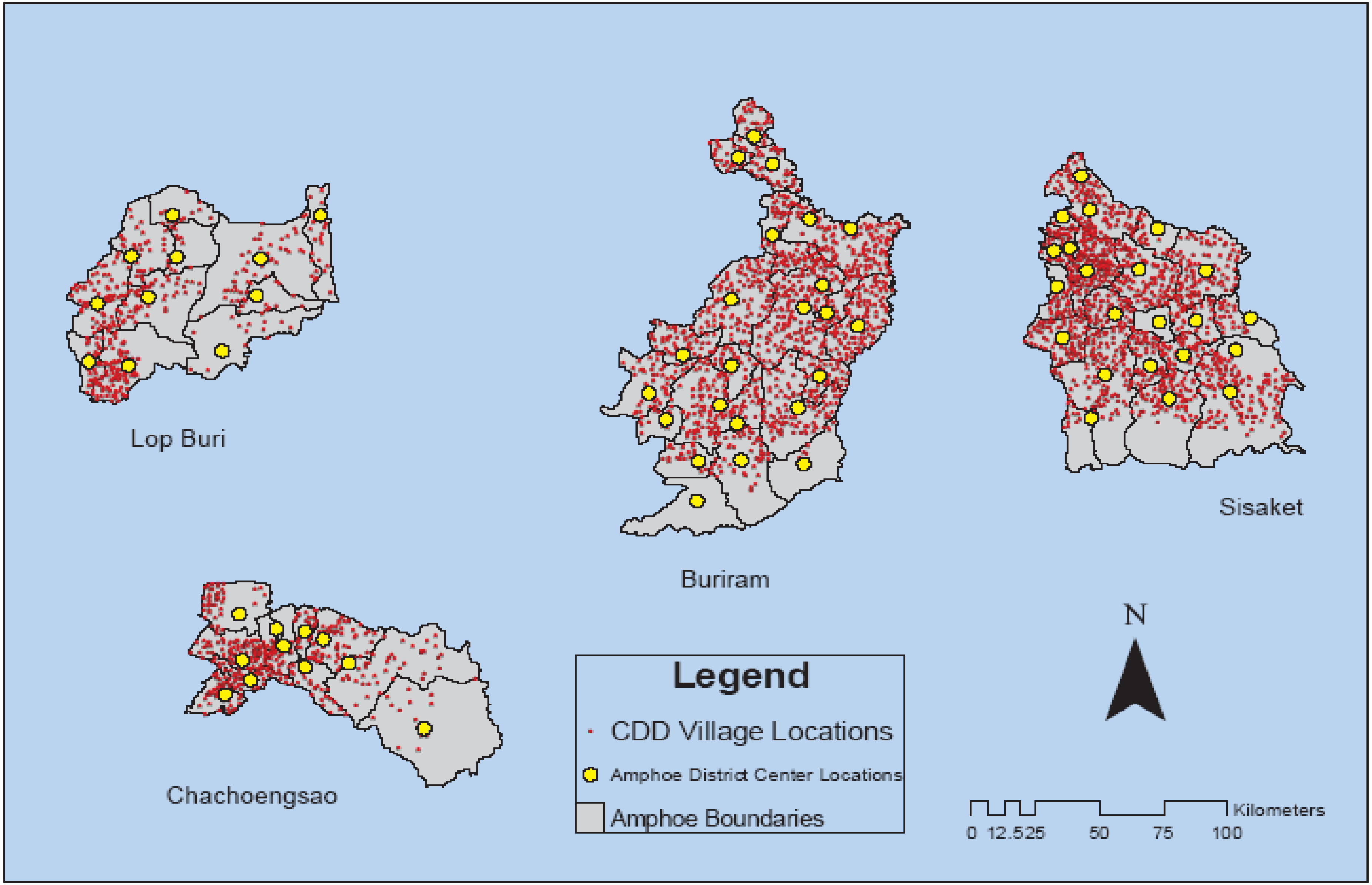

Figure 3 - Road Networks and Major Intersection Locations

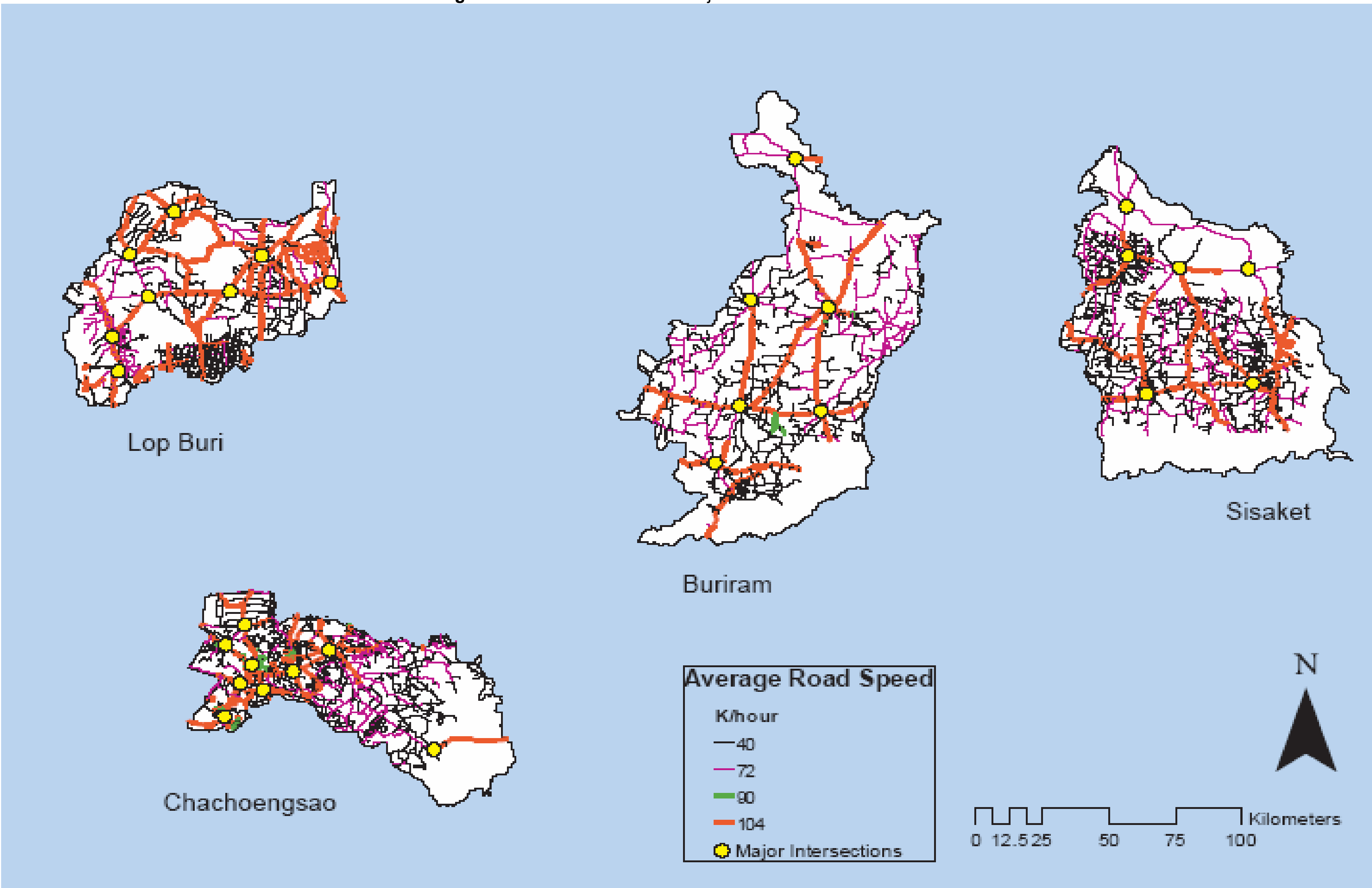

Figure 4 - Semiparametric Estimates of G - BAAC

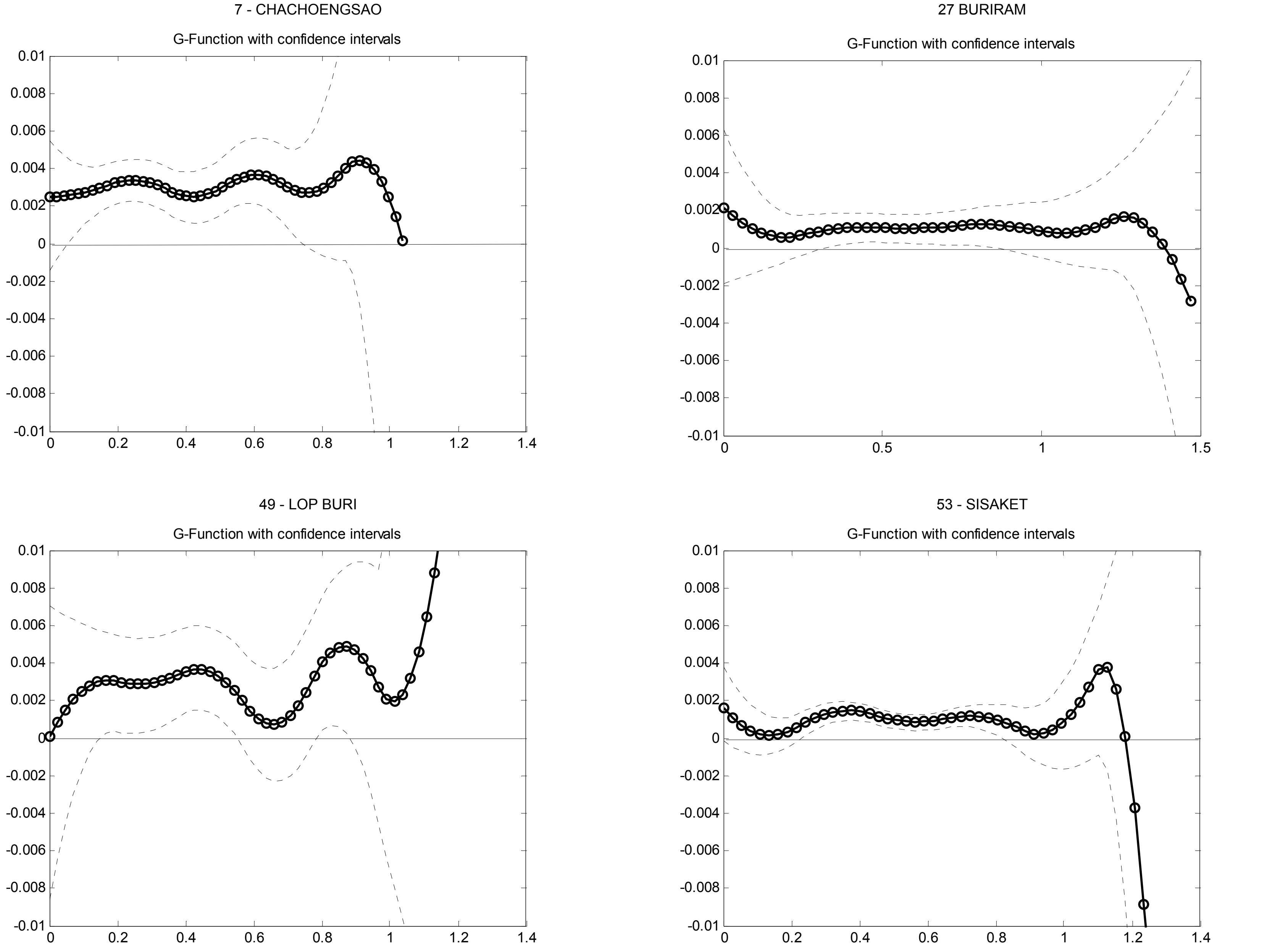

Figure 5 - Semiparametric Estimates of G - Commercial Banks

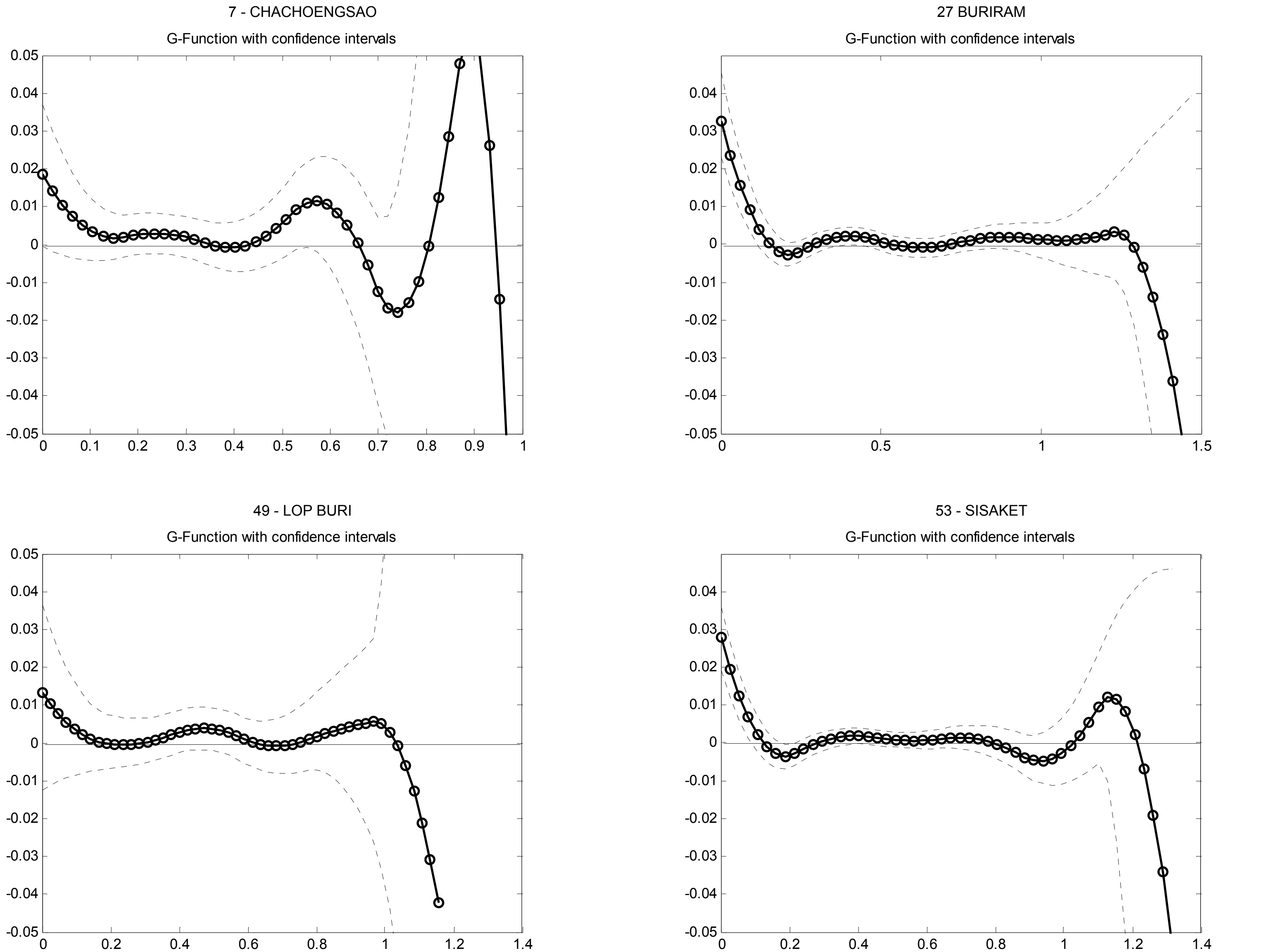

Figure 6 - Semiparametric Estimates of G - Suppliers Credit Access

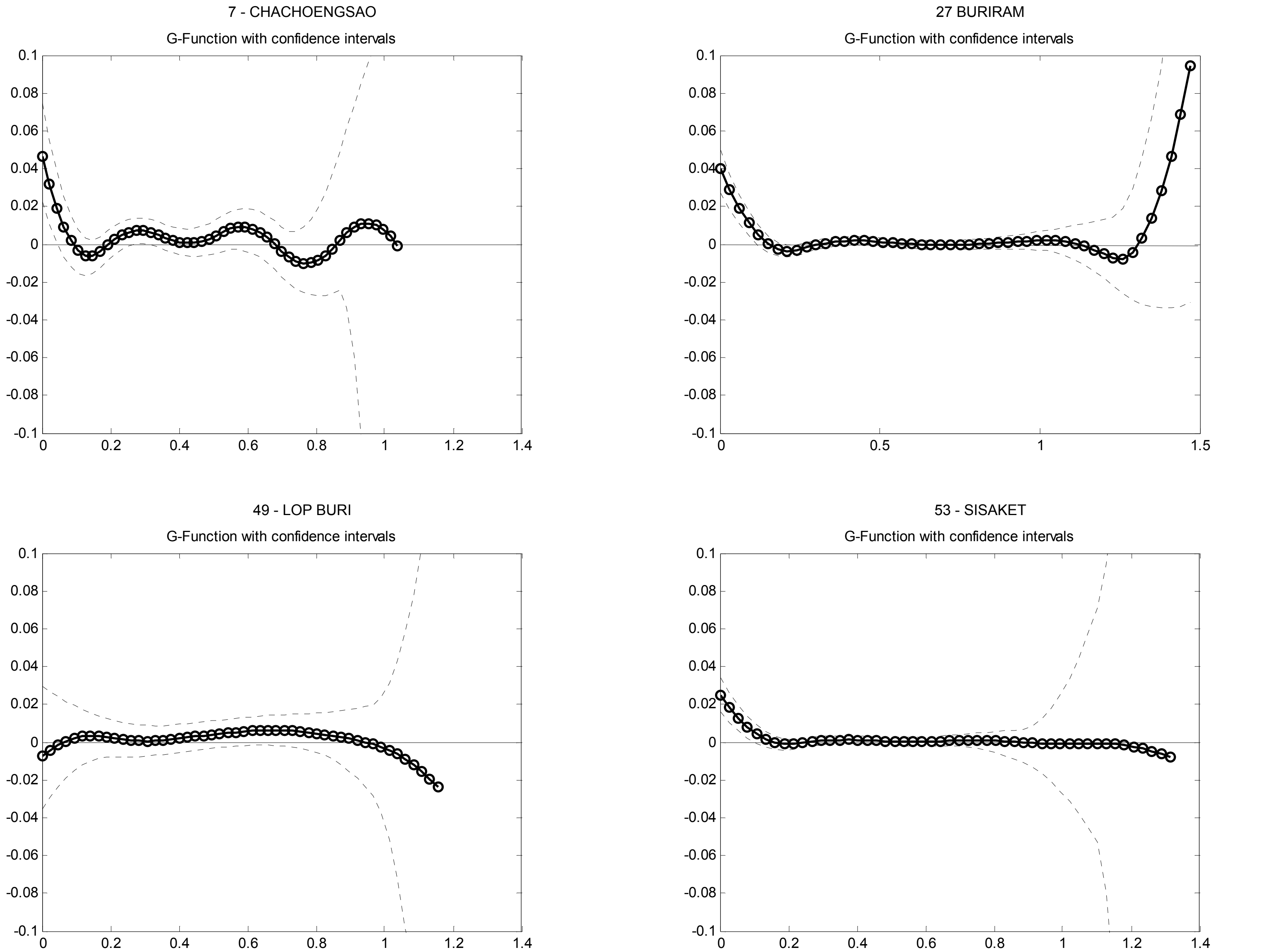

Table 1 - Results for the Thai Bank of Agriculture and Agricultural Cooperatives (BAAC)

	7 - CHACHOENGSAO				27 - BURIRAM				49 - LOP BURI				53 - SISAKET			
	OLS	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*
		Binary W	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*
const	**1.0007**	**1.0175**	**1.0212**	NaN	**0.9262**	**0.9113**	**1.0985**	NaN	**0.9540**	**0.9436**	**0.9293**	NaN	**0.9620**	**0.9688**	**-2278.59**	NaN
std.dev.	0.0191	0.0227	0.0363	NaN	0.0146	0.0225	0.0147	NaN	0.0340	0.0376	0.0534	NaN	0.0124	0.0187	158.27	NaN
wealth96	-0.0052	-0.0062	-0.0061	-0.0069	0.0105	0.0102	0.0128	0.0128	0.0207	0.0212	0.0208	0.0095	**0.0166**	**0.0163**	10.59	0.0116
std.dev.	0.0051	0.0051	0.0052	0.0066	0.0080	0.0080	0.0079	0.0164	0.0118	0.0118	0.0117	0.0121	0.0060	0.0060	11.57	0.0093
ADV96	**-0.0908**	**-0.0803**	**-0.0859**	-0.0735	0.0615	0.0595	0.0911	0.0994	0.0778	0.0703	0.0656	0.0224	**0.1269**	**0.1295**	**-376.69**	**0.1449**
std.dev.	0.0400	0.0404	0.0403	0.0555	0.0766	0.0765	0.0757	0.0656	0.0940	0.0942	0.0955	0.0864	0.0520	0.0522	117.01	0.0398
Dis2Maj	0.0024	-0.0216	-0.0181	-0.0811	0.0285	0.0308	-0.0066	-0.0334	0.0522	0.0704	0.0624	0.0555	-0.0074	-0.0133	**1155.94**	**-0.0596**
std.dev.	0.0740	0.0754	0.0796	0.0686	0.0330	0.0331	0.0327	0.0374	0.1742	0.1759	0.1738	0.1822	0.0335	0.0358	88.80	0.0256
Soil1_94	-0.0274	-0.0236	-0.0257	-0.0255	0.0358	0.0349	**0.0429**	**0.0402**	-0.0599	-0.0651	-0.0661	-0.0530	**-0.0644**	**-0.0650**	67.83	**-0.0729**
std.dev.	0.0157	0.0158	0.0157	0.0197	0.0214	0.0213	0.0211	0.0175	0.0351	0.0360	0.0363	0.0373	0.0194	0.0194	37.14	0.0265
Soil5_94	0.0069	0.0047	0.0052	0.0141	0.0105	0.0095	0.0136	0.0089	-0.0537	-0.0563	-0.0578	-0.0544	-0.0052	-0.0051	-1.55	-0.0073
std.dev.	0.0276	0.0273	0.0274	0.0126	0.0149	0.0149	0.0147	0.0160	0.0375	0.0376	0.0378	0.0363	0.0115	0.0115	24.78	0.0106
rho	NaN	-0.0015	0	NaN	NaN	0.0014	-0.0001	NaN	NaN	0.0014	0	NaN	NaN	-0.0004	0.5279	NaN
std.dev.	NaN	0.0011	0	NaN	NaN	0.0016	-Inf	NaN	NaN	0.0023	0	NaN	NaN	0.0008	0.0408	NaN
R2	0.0275	0.0327	0.0297	0.0357	0.0059	0.0067	0.0211	0.0275	0.0188	0.0197	0.0201	0.0689	0.0228	0.023	-3523848	0.0722
n. obs.	344	344	344	344	1002	1002	1002	1002	377	377	377	377	1045	1045	1045	1045
s. radius	NaN	0.0346	0.0238	1.0209	NaN	0.03	0.1865	0.9876	NaN	0.0304	0.0369	1.0379	NaN	0.0136	2257.1	1.0062

Table 2 - Results for Commercial Banks

	7 - CHACHOENGSAO				27 - BURIRAM				49 - LOP BURI				53 - SISAKET			
	OLS	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*
		Binary W	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*
const	**0.6633**	**0.5383**	**0.2871**	NaN	**0.3644**	**0.2399**	0.1081	NaN	**0.3524**	**0.2915**	**0.2542**	NaN	**0.2754**	**0.0831**	-0.49	NaN
std.dev.	0.0652	0.0702	0.0945	NaN	0.0324	0.0345	Inf	NaN	0.0614	0.0633	0.0837	NaN	0.0335	0.0326	-Inf	NaN
wealth96	**-0.0588**	**-0.0472**	**-0.0381**	**-0.0452**	**-0.0422**	**-0.0427**	**-0.0466**	-0.0388	-0.0291	-0.0271	-0.0290	-0.0248	-0.0155	-0.0094	-0.02	-0.0175
std.dev.	0.0174	0.0170	0.0172	0.0182	0.0178	0.0171	0.0176	0.0220	0.0213	0.0210	0.0211	0.0223	0.0161	0.0149	0.02	0.0162
ADV96	-0.0807	-0.1425	-0.1326	-0.0890	0.2415	0.1983	0.1779	0.1697	**0.5436**	**0.4633**	**0.4796**	**0.5093**	**0.5802**	**0.4382**	**0.46**	**0.4767**
std.dev.	0.1366	0.1340	0.1332	0.1439	0.1698	0.1631	0.1671	0.1641	0.1694	0.1677	0.1714	0.1729	0.1399	0.1291	0.13	0.1422
Dis2Maj	**-1.1430**	**-0.8255**	**-0.6216**	**-0.6638**	0.0228	0.0231	0.0538	-0.0602	0.4411	0.5502	0.4757	0.5732	-0.0760	0.1018	**0.35**	0.0341
std.dev.	0.2526	0.2526	0.2592	0.3230	0.0730	0.0701	0.0718	0.0880	0.3140	0.3117	0.3123	0.2943	0.0898	0.0833	0.08	0.1062
Soil1_94	**0.1215**	0.0686	0.0792	0.0372	-0.0848	-0.0879	**-0.0962**	**-0.1046**	0.0395	-0.0092	0.0079	0.0143	0.0994	0.0875	0.09	0.0702
std.dev.	0.0536	0.0532	0.0523	0.0509	0.0476	0.0457	0.0469	0.0469	0.0633	0.0638	0.0651	0.0662	0.0520	0.0479	0.05	0.0556
Soil5_94	0.1840	0.1642	**0.1798**	**0.1847**	-0.0211	-0.0380	-0.0297	-0.0406	0.0158	-0.0024	-0.0016	0.0239	0.0257	0.0118	0.02	0.0092
std.dev.	0.0940	0.0911	0.0908	0.0847	0.0330	0.0317	0.0325	0.0346	0.0677	0.0671	0.0680	0.0618	0.0309	0.0285	0.03	0.0260
rho	NaN	0.0155	0.0003	NaN	NaN	0.0345	0.0002	NaN	NaN	0.017	0.0001	NaN	NaN	0.037	0.0005	NaN
std.dev.	NaN	0.0036	0	NaN	NaN	0.0041	Inf	NaN	NaN	0.0046	0.0001	NaN	NaN	0.002	Inf	NaN
R2	0.1411	0.1799	0.1884	0.2233	0.0117	0.0836	0.0323	0.079	0.0405	0.0608	0.0455	0.0607	0.0236	0.1664	0.0934	0.1253
n. obs.	343	343	343	343	995	995	995	995	375	375	375	375	1038	1038	1038	1038
s. radius	NaN	0.3566	0.5988	1.4801	NaN	0.6895	0.7619	1.1651	NaN	0.3742	0.2747	0.7478	NaN	1.1906	2.2313	1.2464

Table 3 - Results for Suppliers Credit Access

	7 - CHACHOENGSAO				27 - BURIRAM				49 - LOP BURI				53 - SISAKET			
	OLS	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*	*OLS*	*Parametric*		*Semi-*
		Binary W	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*		*Binary W*	*Wij=1/Dij*	*Parametric*
const	**0.5459**	**0.3756**	**0.2160**	NaN	**0.3951**	**0.2192**	**-0.1687**	NaN	**0.6011**	**0.6138**	**0.7254**	NaN	**0.4582**	**0.2877**	-0.20	NaN
std.dev.	0.0729	0.0725	0.0977	NaN	0.0337	0.0346	0.0075	NaN	0.0611	0.0666	0.1009	NaN	0.0342	0.0356	-Inf	NaN
wealth96	0.0204	0.0289	0.0340	0.0287	0.0166	0.0117	0.0090	0.0106	0.0228	0.0231	0.0251	0.0355	0.0229	0.0117	0.01	0.0032
std.dev.	0.0194	0.0184	0.0192	0.0192	0.0186	0.0173	0.0179	0.0167	0.0212	0.0211	0.0210	0.0182	0.0166	0.0160	0.02	0.0143
ADV96	-0.0747	-0.1677	-0.1291	-0.1241	**0.5115**	**0.3981**	**0.3926**	**0.4083**	-0.2206	-0.2118	-0.1783	-0.1694	0.2666	0.1530	0.17	0.1354
std.dev.	0.1527	0.1456	0.1500	0.1405	0.1766	0.1647	0.1698	0.1524	0.1692	0.1687	0.1703	0.1714	0.1429	0.1371	0.14	0.1351
Dis2Maj	0.4455	**0.5980**	**0.7203**	0.3788	0.0946	0.0746	**0.1670**	-0.0718	0.5541	0.5443	0.5643	0.5927	**-0.3887**	**-0.1784**	0.07	-0.0072
std.dev.	0.2824	0.2677	0.2822	0.3474	0.0759	0.0707	0.0730	0.0755	0.3136	0.3143	0.3111	0.3273	0.0917	0.0894	0.09	0.1216
Soil1_94	-0.0770	-0.0760	-0.0817	-0.0814	0.0596	0.0196	0.0209	0.0058	-0.0822	-0.0766	-0.0604	-0.0546	-0.0559	-0.0370	-0.03	-0.0378
std.dev.	0.0598	0.0573	0.0585	0.0585	0.0494	0.0461	0.0475	0.0493	0.0630	0.0639	0.0647	0.0648	0.0532	0.0510	0.05	0.0556
Soil5_94	0.0348	0.0480	0.0527	0.0425	-0.0513	-0.0463	-0.0461	-0.0400	-0.0076	-0.0057	0.0076	0.0035	**-0.0950**	**-0.0941**	**-0.09**	**-0.1047**
std.dev.	0.1052	0.0993	0.1026	0.0860	0.0344	0.0320	0.0331	0.0310	0.0675	0.0676	0.0679	0.0688	0.0315	0.0302	0.03	0.0316
rho	NaN	0.0296	0.0003	NaN	NaN	0.0393	0.0004	NaN	NaN	-0.0033	-0.0001	NaN	NaN	0.0274	0.0004	NaN
std.dev.	NaN	0.0032	0.0001	NaN	NaN	0.0033	Inf	NaN	NaN	0.0062	0.0001	NaN	NaN	0.0022	Inf	NaN
R2	0.0262	0.1191	0.0623	0.1873	0.0145	0.1405	0.0811	0.145	0.0245	0.0251	0.0309	0.0587	0.0272	0.1029	0.0845	0.086
n. obs.	344	344	344	344	990	990	990	990	376	376	376	376	1039	1039	1039	1039
s. radius	NaN	0.683	0.7232	1.1908	NaN	0.7847	1.2784	1.4065	NaN	0.0718	0.315	1.028	NaN	0.8822	1.6606	1.3234