PUBLIC OWNERSHIP AND ANTI-PREEMPTION*

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Abstract

Financial access is important. Market forces create variation in financial access when public and private providers interact. We document, model, and resolve puzzling anti-preemptive patterns in the expansion of a public bank. A two-player dynamic spatial-competition entry game on the actual graph of villages is solved explicitly, and estimated, yielding these patterns. Unconventionally, the public bank maximizes profit when on its own but gets out of the way of commercial banks otherwise. The chosen parsimonious model is validated through simulations on hold-out provinces. Counterfactuals entertaining alternative strategic, collusive, or political economy motivations produce significantly different financial-access patterns.

Key words: Banking, Government, Ownership, Financial Access
JEL classification: G21, G28, H11, L32

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1 Introduction

In the Covid-19-induced financial crisis private-sector banks have had trouble channeling funds to households and small businesses. New government programs have been introduced in many countries that rely on public-sector development banks for distribution of credit, including fiscally backed credit. These include stated-owned banks in Germany, Italy, Japan, Brazil, Turkey, South Korea, and Saudi Arabia (Medas and Ture, 2020), and also in the US with SBA loans in the Paycheck Protection Program. Likewise, there is a boom/bust aspect to the salience of development banks, as they were also a prominent policy vehicle in the Great Recession (Griffith-Jones and Ocampo, 2018). In prior years, the Washington consensus pushed for privatization, in an effort to minimize the role of the State. Post Great Recession and during the coronavirus disease situation, such banks are viewed more favorably, albeit with caution (de Luna-Martinez and Vicente, 2012; Aghion et al., 2013; Chandrasekhar, 2016). Finally, Central Banks as the quintessential public bank react to crypto currencies and stable coins, increasingly countering with Central Bank Digital Currency.

In this paper, we focus on the role of government development banks in providing a range of financial services, not simply credit as per the crisis motivation above, but also savings, insurance and payments, to households and to small and medium enterprises. Focusing on a developing economy, Thailand, we use a suite of unusual data and an innovative model. On the data side, we have village level data for virtually all villages in Thailand, tens of thousands of them. We supplement this with detailed data from Townsend Thai surveys. We look at salient significant reduced-form patterns in panel data, which establish an asymmetry not simply in the way public and private banks place branches in response to wealth and population of villages and distance to markets, but, more tellingly, in the way public and private banks react to each other. The government development bank places branches consistent with self-interested profit maximization in provinces when it is virtually alone. However, in other provinces with relevant presence of commercial banks, it anticipates other player’s entry and, rather than attempting to preempt, it gets out of the way. This is costly to the public bank as it means lower profits. The motive seems to be financial inclusion yet this is not traditional targeting, in which a client type is always targeted regardless. We term this behavior as anti-preemption. All the while, commercial banks
act strategically in the Nash sense, taking into account the above public sector behavior. These patterns are robust to the inclusion of each banks’ own presence in a province.

The model is a dynamic spatial-competition game between private and public sector banks (financial service providers, FSPs) on the actual graph of villages connected by roads. This model explicitly accounts for the non-stationary and rapidly changing characteristics of developing economies. It is worth noting that in such non-stationary environment standard IO techniques like Bajari et al. (2007a) are an inappropriate tool for analyzing the expansion of financial services. Thus, new methodological tools have to be developed. Figures 10-13 in the Appendix, which show bank branch openings over time, illustrate the non-stationary nature of our problem.

We use village-level financial access data to analyze the behavior of the government-operated development bank in Thailand, the BAAC.\textsuperscript{1} In particular, we focus on the BAAC role in relation to private sector commercial banks.\textsuperscript{2} Estimated parameters of technology capture heterogeneity in outreach and estimated parameters of public bank preferences allow us to entertain and distinguish profit, financial access, and political-economy-capture motives.

Specifically, we develop and solve a dynamic entry game on a graph/network of villages connected by roads, with village and branch locations taken from actual geo-locations (i.e., latitude/longitude coordinates) and with distances between villages and branch locations reflecting actual travel times. This geo-network based graph connects each actual, as well as potential, bank branch location to every village within a province. In this model, as in many actual economic problems, there are no precise market boundaries per se; though for tractability most models make that assumption at some level. Every bank branch is connected probabilistically to every village location in a province.\textsuperscript{3}

\textsuperscript{1}The BAAC acronym stands for “The Bank for Agriculture and Agricultural Cooperatives”. However, this name is quite misleading. Although the BAAC was created with the initial purpose of lending to farmers and farmer cooperatives, over time, its focus became much wider and included savings and other services commonly provided by commercial banks. Its funding was initially extended via regulation, which required commercial banks to invest at least 20\% of their deposits in agriculture directly or as deposits to BAAC. Over the years these requirements were weakened. Lending to those in need in rural areas became the criterion for commercial banks, yet increasingly over time, any loan whatsoever outside of Bangkok satisfied that lending criteria. Having lost its assured deposit base, the BAAC competed heavily for savings, which is one reason we have emphasized the savings for branch placement.

\textsuperscript{2}One caveat is worth mentioning. We do not claim that commercial banks and the BAAC are entirely homogeneous in the characteristics of products offered, though some of observed differences may be the endogenous outcome of spatial competition between them. In the model below we do explicitly abstract away from these issues to better understand the role of the selected factor: geographical structure, while keeping the computation tractable. We then validate the model in out-of-sample simulations; it performs quite well in predicting patterns in the hold-out data despite these simplifications. See also section 3 below for more details.

\textsuperscript{3}Typically this probability is a declining function of the travel-time-distance, as estimated for commercial banks.
Thus, we endogenize the relevant market that each FSP’s branch faces, where the effective (or likely) market for a given branch at a point in time depends on the configuration of existing branch locations of all FSPs in that period and is evolving endogenously over time as players make their moves. The choice of a given branch at a given point in time is dependent on the current state of financial access and the future actions of other FSPs as well as the future actions of the chosen FSP itself.\textsuperscript{4}

In more detail, for a given Thai province, we calibrate initial bank branch locations for the BAAC and the commercial banking sector, pinning them to the initial period of 1986 Thai data. The game then allows the two FSPs to make moves (i.e., to open new branches) dynamically, with the timing of moves taken from the actual data. Thus, in our model, the identification comes not from a decision about \textit{when} to open a new branch but rather \textit{where} to open it. In this regard, even though our model could accommodate a fixed cost for opening a branch, we do not need to model these costs explicitly in the notation, as they are incurred regardless of where the branch is opened, and a branch is always opened (somewhere) when the turn comes.\textsuperscript{5} This approach is virtually identical to Holmes (2011) who solves a dynamic spatial decision problem of new store openings taking the \textit{timing} of the new store opening of a single large retailer (Walmart) as fixed (from the actual data), using the locational choice (decision \textit{where} to open a new store conditional on opening) as the source of identifying variation.\textsuperscript{6} Branches can only be opened in specific locations (local centers) with the coordinates and positions within the village network taken from the actual GIS data. Each FSP is forward looking and takes into account the future behavior of the other FSP. The game ends when all potential branch locations in the province are occupied.\textsuperscript{7,8}

\textsuperscript{4}As a result, over the course of the game, it is possible for a given village to be serviced by different FSPs at different times based on when/whether FSPs open additional branches in proximity to the village.

\textsuperscript{5}In reality the cost of establishing a branch is lower for the BAAC than for commercial banks, with the BAAC as a highly regarded efficient development bank, as in Yaron (1992).

\textsuperscript{6}In Holmes’s model, Walmart is treated as a single monopoly provider, ignoring alternatives, while in our case we have two financial providers competing in dynamic context on a spatial network. Of course there are in reality several commercial banks competing with each other. We draw on the work of Rysman et al. (2022), which shows there are the usual pre-emptive patterns across commercial banks but data on branch openings and closures are consistent with the entire sector acting as a monopolist. Their analysis does not include public banks, however.

\textsuperscript{7}There were no branch closures during the study period. Thus, our model does not allow for bank branch closures. When all positions are occupied the value functions reflect continuing operations into the discounted infinite future.

\textsuperscript{8}In a way this model (with endogenous splitting of the market) is reminiscent of the early seminal contribution...
Our methodology computes the full dynamic equilibrium by backward induction. By the nature of the game setup, as in chess game, there are many configurations of state variables and many future possible paths at each decision point. We develop an estimation strategy based on the likelihood villages are served by each FSP. The probability of access depends upon the outreach technology of each provider as well as the the distance to the nearby branches given by the state of the game and the road network. Obviously, we need to repeat all the simulations every time we vary parameters searching for maximum likelihood estimates. As a result, this is computationally complex. For computational tractability, we keep the model simple, focusing on judiciously chosen key dimensions, and restrict our estimation procedure to a few key parameters and to the ten provinces with a limited number of entry episodes during our sample period. Still, we use all Thai provinces to assess the model’s quality of fit.

The model has two key sets of parameters, which rationalize empirical patterns in the bank branch expansion described above. First, we allow for the public bank to put a positive weight on commercial bank’s payoff. This parameter can account for potential altruistic behavior of the BAAC, as consistent with observed anti-preemption, and allows us in principle to reject alternative motives. In such a setup competition, preemption, and, in our case, anti-preemption are all in play as potential strategies. When deciding to place a new branch, a profit maximizing bank will maximize its own payoff by factoring in potential poaching of customers from its existing branches. However, if the public bank puts a positive weight on the payoff of its competitor (the commercial bank), then it would also factor the chance of taking customers from its competitor when making branch expansion decisions. The second set of parameters quantify the financial service outreach technologies employed by the public bank and commercial banks. These parameters are allowed to be different for the BAAC and commercial banks, as noted previously in the discussion of probabilistic outreach as a function of distance. Yet we need both sets of parameters, strategic and technological. Our results cannot be explained by differential technologies alone.

The dynamic entry game on a network at estimated parameters provides three primary insights. First, at the best fitting point estimate, the BAAC’s behavior is consistent with the goal of max-
imizing total financial access, regardless of which financial institution provides it. In its objective function, the BAAC puts the same weight on customers served by the commercial banks as it does on the customers served by the BAAC itself. As the BAAC seems to weight both its own payoff as well as its competitor’s payoff to the same degree, we term this an altruistic motive and it gives us anti-preemption, stepping out of the way.\(^9\) Second, the BAAC has wider financial outreach from each of its branches than the commercial bank. When evaluating the customers served at a given branch, the BAAC is more likely to successfully reach out to more distant villages relative to commercial banks. Homogeneity in financial outreach technologies is also rejected.\(^10\) Third, the estimated preference and technology parameter values do allow us to rationalize the otherwise puzzling behavior of the BAAC. Specifically, we can explain both the BAAC’s choice to open branches serving poorer and more isolated locations conditional on high commercial banks presence in the area and the choice of the BAAC to enter more lucrative (profit maximizing) locations when commercial banks are either absent from or have (will have) low presence in the local area.\(^11\)

In order to assess the quality of fit of our baseline model, we go beyond statistical criteria and also use the baseline model at estimated structural parameter values to simulate the profiles of financial access and then contrast the simulated data with actual (village-level) data.\(^12\) We find that our model, estimated on 10 selected provinces, performs well on the whole sample of Thai provinces, much alleviating concerns of a sample selection problem, that the subset of provinces we use in baseline estimation is somehow special. More importantly, the artificial data generated by our model exhibit the same dichotomy in the BAAC’s behavior as in the actual data: anti-preemptive

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9As we discuss in more detail in Section 4.1.4 below, such anti-preemptive behavior by the BAAC does not necessarily imply that BAAC simply cares about profits of commercial banks (in addition to or instead of its own). While this might be a potential motive, the more plausible alternative explanation is that BAAC cares about consumer welfare from access to financial services, as higher payoff of commercial banks, in our model, is positively related to a higher number of customers served.

10It is worth noting that the finding that the BAAC has a wider financial outreach, suggests that the observed anti-preemptive behavior by the BAAC is unlikely to stem from the inability to compete with commercial banks.

11Such dichotomy in the BAAC’s expansion patterns is crucial for the identification of our model, as it illustrates that BAAC’s behavior can be explained neither by profit maximization nor by the mandate (common for development banks) to provide services for the poorest areas. Indeed, had we looked only at the subsample of areas where commercial banks are active, we would have concluded that BAAC is targeting poorest locations. On the other hand, the BAAC’s behavior on the subsample of areas where commercial banks are absent would be more consistent with profit maximization. In either case, taken one at a time, there would be less compelling reasons to estimate a structural model; our goal is to explain the puzzling switch in the BAAC’s behavior depending on the intensity of local penetration of commercial bank’s services.

12Though we use only villages from the ten selected provinces to estimate parameters of our model, we assess the model quality of fit (as well as perform counterfactual exercises) on the villages from the full set of Thai provinces.
behavior when the presence of commercial bank is high and more profit maximizing behavior when such presence is low.

We also are able to rule out other objective functions (and therefore behavior). It appears that the BAAC is neither narrowly concerned with its own profits nor does it put all weight on commercial banks payoff. As the standard error bands for our estimates are relatively tight, we are able to reject such alternative behaviors statistically. We also construct counterfactual predictions for financial access outcomes for the alternative parameter values and contrast those predictions with financial access patterns predicted by the baseline model in order to show that the baseline not only statistically differs from the counterfactuals, but can also be distinguished from those in terms of economic outcomes (i.e., characteristics of which villages get financial access and when).

Finally, remarkably, the anti-preemptive behavior by the BAAC coupled with strategic Nash behavior of the commercial banking sector under the baseline achieves similar, albeit slightly lower, levels of total financial access with few differences in the characteristics of population served relative to a counterfactual scenario in which the economy is served by the single benevolent FSP maximizing total financial access and having wider financial outreach technology (as the BAAC). This finding brings us back to the debate about the proper role of development banks in channeling credit and, in the aftermath of COVID-19 pandemic, potential implementation of various government support programs, Medas and Ture (2020). Our results speak (if not to the efficiency) to the efficacy with which the government development bank in Thailand, the BAAC, was able to extend credit and financial services to maximize total financial access. To what extent the lessons from Thailand could be extended to other developing and developed economies remains the focus of future research.

The rest of paper is organized as follows. Section 2 provides literature review. Section 3 describes the background of the Thai economy during the 1986-1996 period and documents empirical facts that will be incorporated in our model. Section 4 presents the model. Section 5 uses key examples to illustrate the strategic and dynamic aspects of the model. Section 6 describes our estimation procedure and presents the estimates of the model parameters. The estimated model fit and counterfactual exercises are explored in Section 7. Section 8 concludes.
2 Related literature

Our paper has foundations in the literature on industrial organization (IO), development economics, and public banks. On the IO side, our paper is related to the literature on preemption, spatial competition and dynamic entry. As in much literature, our paper features the supply side of the problem at the cost of simplifying the demand side. Specifically, we make the demand at the village level an inelastic function of population or wealth (as in Holmes (2011)) insensitive to pricing (equivalently imposing same pricing at all stores/bank branches), drawing on large preexisting literature\textsuperscript{13} and on the fact that interest rates are set at the national level in Bangkok.\textsuperscript{14}

In our analysis distance is used in determining the probability of a village receiving financial access, implying that banks are competing in space, but not on price. In this regard, our paper relates to the approach presented in Zheng (2016), who studies competition between the two largest US discount retailers as a dynamic game on a network of possible locations. Large dimensions in this deliberately realistic setting could make computation impossible. She limits the number of combinatorial possibilities by two-stage budgeting and makes an assumption of independence across markets, with the latter empirically estimated and derived. In our context, no independence assumption is necessary, and we run the second stage estimation (FSP’s decision on where to open a new branch)\textsuperscript{15} based on the full characterization of the equilibrium.\textsuperscript{16}

While the concept of preemption is widely understood, much of the extant literature on preemption is theoretical.\textsuperscript{17} Our paper adds to a still limited empirical literature on the topic. Schmidt-\textsuperscript{13}Likewise, Ellickson et al. (2013) estimates parameters in profit functions via the revealed-preference comparison of actual choices relative to a large set of counterfactual actions that each firm (big retailer) could have chosen in a commuter-based statistical area with demographic characteristics. The authors assume that profits are a function in part of exogenous market attributes (income, population, etc.) and analyze spatial interaction between stores of different providers within a given fixed market. Houde (2012) features commuting patterns on road networks using observed mergers to validate the logit demand system, based in part on gasoline station exogenous characteristics and posted price.\textsuperscript{14} Again, more realism on these dimensions would make the model intractable, as solving it would require computing power currently not available; see below. The test of how well our model abstraction captures reality is in the model validation section, where we show that the model has a good quality of fit on the full sample of Thai villages.\textsuperscript{15} An additional simplification, which allows us to estimate the model, is that we do not endogenize the decision of FSP when to open branches: those decisions are taken from the actual data. Instead, we model a decision where to locate a new branch and use the implied financial access at the village-level to identify our model.\textsuperscript{16} For tractability, we limit ourselves to impacts from the three closest branches as a good approximation to having yet higher dimensions. We considered alternative formulations: with two closest branches only and the estimation results were quite similar. In this regard, we take “three-closest-branches” case as a realistic but still parsimonious way to account for financial outreach.\textsuperscript{17}

\textsuperscript{13}See Schmalensee (1978), Eaton and Lipsey (1979), Judd (1985) or Fudenberg and Tirole (1985) for references.
Dengler (2006) studies the preemption motivation of MRI adoption decision in US hospitals. He finds that preemption plays a limited, although significant, role in the adoption timing decisions. Another related feature of his analysis is showing the distinction between nonprofit and for-profit hospitals, showing that ownership matters. Igami and Yang (2016) study cannibalization and the preemptive entry of hamburger chains in Canada using the BBL approach. Zheng (2016), in her analysis of big retail stores, estimates relevant preemptive incentives for stores’ locations that lead to loss of production efficiency. So far as we are aware, there is no literature that features negative preemption (or anti-preemption) as we do in this paper.

Our work is also related to the IO literature on spatial competition. Many papers featuring spatial competition are largely static.\textsuperscript{18} Several papers examine spatial competition amongst large retailers but use either static models or feature a single player.\textsuperscript{19} The literature on entry dates back at least to the seminal contribution by Bresnahan and Reiss (1991).\textsuperscript{20} Much of this literature incorporates some form of independence across markets as a salient feature of the analysis.\textsuperscript{21} By contrast, we do not impose any kind of independence in our analysis.

There is a connection between what we do with Eaton and Kortum (2002) in that the option for a village to be served by any branch on the entire map is received probabilistically. The probabilities are a key object in the model. We do not, however, utilize the concept of geographically fixed sub-markets at any level within a given province. In addition, our approach features transitional dynamics rather than steady state dynamics or stationarity assumptions. In fact, our setup is highly non-stationary, as the nature of the game changes every period following each player’s move. Thus, we can not follow Bajari et al. (2007a) approach, which assumes both a steady state and stationary unobserved underlying shocks to demand or supply as part of policy rules generating observed outcomes. Our focus, instead, is on long-term trends over an entire decade.

\textsuperscript{18}Ho and Ishii (2011) and Gowrisankaran and Krainer (2011) analyze regulatory changes as it relates to spatial competition. Ho and Ishii (2011) focus on the demand elasticity with respect to the first and the second closest banks, and the changes in this elasticity due to deregulation, while Gowrisankaran and Krainer (2011) study the impact of regulation in the ATM machine market, focusing on entry, pricing and consumer welfare. Ellickson et al. (2013) and Houde (2012) were commented on earlier in footnote 13.

\textsuperscript{19}For example, Jia (2008) and Zhu and Singh (2009) study Walmart, Kmart, and Target with static models.\textsuperscript{20}The authors use information on market size and the number of firms in order to make inferences about the nature of competition. Additionally, Berry (1992) focuses on inferences about firm-specific sources of profit in the presence of a large number of heterogeneous potential entrants.

\textsuperscript{21}Jia (2008) allows for limited interdependence, which is assumed to be a function of the store density. Zheng (2016) takes one step forward and allows for more general forms of interdependence.
On the development economics side, there is a vast long-standing literature on finance and growth summarized e.g. by Levine (1997, 2005). Much of this literature focuses primarily on the consequences of financial access. The evidence on the supply-side aspects is much more limited. There are a few notable exceptions. Salim (2013) evaluates the objective functions of two microfinance institutions in Bangladesh, the Grameen bank and BRAC, using a static model, based on Jia (2008), showing those institutions do not seem to behave as profit maximizers. Assunção (2013), based on Bresnahan and Reiss (1991), evaluates how a novel contract arrangement reduced the entry costs for financial provision in Brazil. We contribute to this literature showing non-trivial strategic interactions on the supply side of financial provision.

Additionally, our work is related to the literature on government ownership of banks, as we noted at the outset. Government ownership of banks is a common phenomenon around the world. For example, in examining banks in 92 countries, it was found that on average, 42% of the equity of 10 largest banks were state-owned in 1995 (Shleifer et al., 2002). The literature on the consequences of government ownership provides mixed messages. Some have argued that, at least in some countries, government development banks can be quite effective. Notable examples include the BAAC, which is examined in this study, and Bank Rakyat Indonesia (BRI) in Indonesia (see e.g., Seibel (2000, 2007)). Others primarily focus on the influence of political objectives in the determination of lending policies of state-owned banks and find them inefficient in economic terms (Carvalho, 2014; Dinç, 2005; Khwaja and Mian, 2005; Micco et al., 2007; Sapienza, 2004). A recent contribution by Hastings et al. (2017) studies the effect of privatization of Mexican Social Security system in a spatial context. They analyze the pricing implications of a counterfactual introduction of government competitive player and find that it, in fact, might have unintended consequences: equilibrium fees increase as a result of such intervention.


We look at the market of financial services emphasizing the interaction of commercial banks and the BAAC in their choices to serve villages. Commercial banks are viewed as players motivated by profit maximization. The BAAC, on the other hand, requires a more detailed assessment. In particular,
two features of the BAAC operation are important as background for the modeling exercise.

First, the operation of the BAAC is decentralized. Branches and field officers are the front line of contact with local communities. Each field office has an average of three to five officers, each one being responsible for around 700 clients. This establishes a two-layer approach in which provision is given by the interaction of branch location and the outreach provided by these officers. For these reasons, we proxy the presence of banks by the existence of at least one loan contract in the village, representing the work of the field officers on a wide range of services including the mobilization of savings. This allows us to characterize financial access in a more comprehensive way, combining branch locations and the outreach provided by field officers.\(^{22}\)

Second, the profile of services provided by BAAC has relevant overlap with commercial banks. As we have noted earlier, the BAAC is not a simple agricultural development bank. To verify this from facts on the ground, we turn to Townsend Thai urban data 2005-2011, covering 7 provinces, comparing loans and saving accounts across the two financial service providers. We present urban rather than rural statistics because from the stereotypical view of its charter, one might not expect the BAAC to be prominent, e.g., lending, in urban areas to small business. Yet, this is exactly what is found in the data.\(^{23}\) In the randomly sampled population of the survey, the percent of households holding a loan in 2005 were 6.2% from commercial banks versus 11.9%, from the BAAC. So, in fact the BAAC is more active in extending credit in urban areas. All other years are similar.

Lending interest rates do not seem to be a relevant margin of competition among providers. As described in Ahlin and Townsend (2007), the BAAC adopts a pre-specified, uniform national schedule, mapping loan sizes into interest rates. For example, in 1997, all loans under a threshold of 60,000 baht carried a 9% interest rate, while loans between 60,000 baht and 1,000,000 baht carried 12.25% interest rate. Commercial bank loan rates also appear to be following guidelines set by headquarters in Bangkok. The BAAC does not seem to have laxer lending standards than the commercial banks. Townsend and Yaron (2001) find that the levels of loan defaults were similar.

\(^{22}\)The data on access to financial services of each village are collected from the Thai Community Development Department (CDD) village census interviews with the village headman/headwoman. Unfortunately, those interviews do not contain information about the extent of financial services used (such as loan amount or number of households with bank loans). At the same time, a headman’s/headwoman’s positive answer to a survey question about whether the village’s residents have access to a particular FSP is likely to mean that a substantive number of village residents do (or are able to) get access to financial services from this FSP.

\(^{23}\)We use the earliest year available, recognizing this does not overlap with our data period 1986-1996.
between the BAAC and commercial banks and, if anything, slightly lower for the BAAC taking into account eventual loan repayment.  

One caveat, however, is worth mentioning. Tabulations in the urban data of the loan terms show that, averaging up the sample, the BAAC loans are substantially smaller than loans from commercial banks, have shorter duration, and involve lower collateral. These vary within and across provinces, and, more to the point, the BAAC does not only offer joint liability, smaller short-term loans — it also offers longer term collateralized loans above the 60,000 baht threshold mentioned above. These types of loans are much closer in all characteristics with commercial bank loans. So what we see in sample averages is not reflective of what the BAAC offers. The larger point is that the loan characteristics in the data are an endogenous object reflecting competition between the providers and actual take up, which is what our paper is about. It is not as if, as an agricultural development bank, the BAAC has a set of loan products entirely distinct from those of commercial banks.

On the savings side, the initial requirement that commercial banks either lend to farmers or deposit money in the BAAC became moot as virtually any client outside Bangkok fell under the quota. Again, having lost a source of funds, and no money coming from the government, the BAAC scrambled to raise deposits from the public: Seibel (2000) notes that the BAAC was transformed. There is slight product differentiation, as the BAAC offers savings accounts with a lottery component in addition to regular savings, to attract customers. Interest rates are, however, for both financial service providers set at the national level.

From the Townsend Thai urban data, in 2005 the percentage of households with BAAC savings accounts was lower than for commercial bank, but there is variation across provinces. The BAAC saving account ownership ranges from 2.1% to 36.7%. Commercial bank saving account ownership

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24 See Figure 3 on p. 44 in Townsend and Yaron (2001) for graphs of paid loans (and loans overdue) over time. On average, 85% of loans are paid at the due date for both public and private providers. This fraction rises to over 95% in the course of 2-3 years after the initial due date.

25 In particular, Seibel (2000) writes: “BAAC’s reforms were actually staggered over more than thirty years. In the beginning, the bank depended almost exclusively on capital from the government for operating funds. Allocations often arrived late, and the inflow of funds was difficult to synchronize with farmers’ seasonal credit needs. The result was a chronic funding shortage. ... In 1975, the Bank of Thailand adopted an agricultural credit policy stipulating that commercial banks would initially have to lend 5 percent—and 20 percent subsequently—of their portfolios to the agricultural sector. Under this policy, the banks could either lend the amount directly to farmers or deposit with BAAC any portion of the quota that they could not disburse directly. This policy marked a turning point in BAAC’s operations, and the increasing availability of commercial bank deposits made up for the BAAC’s shortage of funds. Between 1988 and 1996 [this is the period of our data including 1986 as the base year],... BAAC was increasing its outreach and savings mobilization {so that} deposits became its main source of funds.”
ranges from 39.2% to 79.6%. When the percent is higher for the BAAC, it is lower for commercial
banks, and so in some provinces the levels are within 10%. The take away is obvious — that
outcomes are endogenous and reflect endogenous decision on provinces, branches and products,
which again is what our paper is about.

3.1 Markets and the Anti-preemptive Behavior of the BAAC

Next, we present stylized facts concerning the patterns of financial access to the BAAC and com-
mmercial banks that we address in our structural model. Namely, we investigate the expansion of
financial services by the two FSPs at the village level. We look at two pieces of evidence. First, we
look at longer-term horizon evidence by relating FSPs expansion patterns over our whole sample
period (1986-1996) to the initial level (i.e. circa 1986) of village characteristics (population, wealth
etc), and conduct a robustness check using end of period 1996. Second, we consider bi-annual
frequency data (as our CDD wave survey happens every two years) and for each biannual cycle
\( t \in \{1986, 1988, 1990, 1992, 1994\} \) relate the village characteristics measured in \( t \) to subsequent
\( t \rightarrow t + 2 \) expansion of a FSP.

3.1.1 Evidence from long-term expansion patterns

Denote \( FSP_{i,t} \) a dummy indicating that village \( i \) reports having a loan contract with financial
service provider \( FSP \), (where \( FSP \in \{BAAC, COMM\} \)) in a given year \( t \). In this subsection,
our dependent variable, \( \Delta FSP_{i,1986\rightarrow1996} \), is the change in the state of financial access to financial
service provider \( FSP \) between 1986 and 1996 for a given village \( i \):

\[
\Delta FSP_{i,1986\rightarrow1996} = FSP_{i,1996} - FSP_{i,1986}
\]  

(1)

We relate this dependent variable to the following observable village characteristics (measured at
the beginning of the sample period, 1986). To account for the potential market size of a given
village we include (log of) villages population, \( \log(population)_{i,1986} \), and a wealth per capita index,
To account for the effect of geographical connectedness of village’s position (and hence ease of difficulty of its reachability by loan officers) we include log of time travel (in minutes) from a given village to the nearest marketplace location. Namely, we consider the following empirical specification:

\[
\Delta FSP_{i,1986\rightarrow1996} = \beta_1 \log(\text{population})_{i,1986} + \beta_2 Wealth_{i,1986}^* + \beta_3 \log(\text{Travel time})_i + \\
+ \gamma_1 BAAC_{i,1986} + \gamma_2 COMM_{i,1986} + (\pi(i)) + \epsilon_i
\]  

In all specifications we control for the initial (as of 1986) access to the both financial providers of financial services, \(BAAC_{i,1986}\), \(COMM_{i,1986}\). Importantly, in all specifications, we control for province fixed effects, \(\pi(i)\), to absorb across-province-level heterogeneity in expansion of services by the two FSP’s. In short, we remove targeting by provincial characteristics.

Estimation results (Table 2 Columns 1 Panel A vs Panel B) show correlations in the overall data. We focus, however, on the changes in the BAAC’s response to villages’ characteristics conditional on the overall footprint of commercial banks in a given province. For completeness and to further highlight the differences in behavior between commercial banks and the BAAC, we also look for the similar changes (of lack of those) in the behavior of commercial banks in response to the province-level footprint/presence of the BAAC. This provides a key step in subsequent model specification.

We thus estimate specification (2) for a given FSP separately on the subsamples where the presence of another FSP is “high” vs. “low”. To construct those subsamples, for a given FSP in each province we calculate the percentage of villages that have access to another FSP. We then divide the sample for a given FSP into two subsamples: “low” (where the presence of another FSP is below the 75\(^{th}\) percentile) and “high” (where the presence of another FSP is above the 75\(^{th}\) percentile). In the main text we use initial footprint, measured on the basis of 1986 financial access.

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26 The wealth index is based on a principal component analysis based on the number of motorcycles, pick-up trucks and flush toilets per 1000 villagers. Since wealth index data in 1986 is not available for 40% of villages we use wealth index measured in 1988 to impute data in place of missing observations.

27 As was mentioned above, banks do not open offices in individual villages. Instead, bank branches are usually situated in some central locations/regional centers. Distance to the marketplace measures time to travel from the villages to the nearest such potential location.

28 It is a well-known fact from econometric analysis (Green (2017)) that coefficients on the observable village characteristics would be exactly/numerically the same if we change the dependent variable to the eventual level of financial access \(FSP_{i,1996}\) in 1996 in specifications containing the initial level of FSP presence (in 1986), \(FSP_{i,1986}\).

29 The results are similar when we consider the eventual footprint in 1996. See Appendix Table A6 for the full set.
Estimation results are presented in Table 2. In column 2, we present the estimates for the subsample of villages located in provinces with “high” footprint of another FSP, while in column 3 we consider the subsample from provinces where such footprint is “low”. Estimates for the BAAC (in Panel A, Table 2) show striking differences in the BAAC’s behavior in provinces with “high” vs “low” footprint of commercial banks. On the one hand, in provinces where commercial banks’ presence is low, column 3, the BAAC is more likely to serve more populous and wealthier locations that are closer to marketplaces/regional centers. On the other hand, in provinces where commercial banks have substantial presence, column 2 , the BAAC is likely to serve more distant and less wealthy villages, and the effect of population becomes indistinguishable from zero.

At the same time, we find no change in the commercial bank behavior in response to the presence of the BAAC. Commercial banks discount distant villages and prefer to serve more populous and wealthier locations regardless of the BAAC’s presence (see Panel B, Table 2). The order of magnitude of coefficient estimates are quite significant and similar across the relevant columns.

This finding is quite robust and is observed under alternative specifications. Since there could be an asymmetry in villages getting vs. losing access to financial services, we estimated specification similar to those Table 2 on the subsamples of villages with no financial access to the given FSP in 1986 (hence dropping from Table 2 that control). Estimates presented in Table A1 portray the same patterns as before. We also used a more local definition of footprint of the other FSP provider by dividing the sample on the basis of amphoe-level30 (rather than province-level) footprint of the other FSP. The results are similar (See Table A2).

### 3.1.2 Biannual Panel data Evidence

Next, we step closer to the structural model we analyze in the following sections, focusing on short-run variation in the location of new branches of each FSP conditioned on its own and other FSP of results. The advantage of using 1996 data is that it allows us to measure the potential response of a given FSP to entry done by the other FSP over the course of the period considered: 1986–1996. Anticipating, the model will be forward looking, and so we try to capture that aspect. The disadvantage of using 1996 footprint data is that there are endogeneity concerns related to the simultaneity of the bank location choice of both FSP’s. This latter argument makes the case for the use of the initial footprint, measured on the basis of 1986 data. In the model, the array of current providers is the relevant state variable before a provider makes its move. We feature the panel more explicitly below. In the end, we use both approaches looking for the common patterns that emerge.

30Provinces in Thailand (similar to the states in the US) are comprised of amphoees, thus, amphoees are similar to counties in the US context.
previous locations. Thus, here we look for patterns in a biannual panel data, relating expansion of FSPs to the beginning of a biannual period village characteristics. Specifically, denote \( FSP_{i,t} \) a dummy indicating that village \( i \) reports having a loan contract with financial service provider \( FSP \), \( (FSP \in \{BAAC, COMM\}) \) in a given year \( t \). Since our data on financial access is bi-annual we consider \( t \in \{1986, 1988, 1990, 1992, 1994\} \). Our dependent variable, \( \Delta FSP_{i,t \rightarrow t+2} \), is the change in the state of financial access to financial service provider \( FSP \) between years \( t \) and \( t+2 \) for a given village \( i \):

\[
\Delta FSP_{i,t \rightarrow t+2} = FSP_{i,t+2} - FSP_{i,t}
\]  

Then, for every period \( t \in \{1986, 1988, 1990, 1992, 1994\} \), we relate the expansion of financial services over the next two-year time period \( \Delta FSP_{i,t \rightarrow t+2} \) to current year \( t \) village characteristics. Namely, we consider the following empirical specification:

\[
\Delta FSP_{i,t \rightarrow t+2} = \beta_1 \log(population)_{i,t} + \beta_2 Wealth_{i,t} + \beta_3 \log(Travel\ time)_{i,t} + 
\gamma_1 BAAC_{i,t} + \gamma_2 COMM_{i,t} + (\pi(i)) + \epsilon_i
\]  

In all specifications we control for the initial (as of year \( t \)) access to the both FSPs, \( BAAC_{i,t} \), \( COMM_{i,t} \). As before, we control for province fixed effects, \( \pi(i) \), to absorb province-level heterogeneity in expansion of services by the two FSP’s. Estimation results for the baseline are presented in Table 3 columns (1) and (4).

In columns (2) and (3), we allow for heterogeneity in the BAAC’s behavior depending on commercial banks’ presence in the area. Namely, we assess whether there is a change in the BAAC’s response to villages’ characteristics conditional on the overall footprint of commercial banks in a given province. For completeness (and to further highlight the differences in behavior between commercial banks and the BAAC), we also probe for the similar changes (of lack of those) in columns (5) and (6), analyzing the behavior of commercial banks in response to the province-level footprint/presence of the BAAC.

Namely, we define period-\( t \) footprint of a given FSP in a given province \( p \), \( FSP_{p,t} \), as the percentage of villages in province \( p \) that report having access to this given FSP’s services. For any given FSP, we denote \( FSP_{p,t} \) the provincial footprint of the competing FSP. We then estimate the
Following empirical specification:

\[
\Delta FSP_{i,t \rightarrow t+2} = \beta_1 \log(\text{population})_{i,t} + \beta_2 \text{Wealth}^*_{i,t} + \beta_3 \log(\text{Travel time})_{i,t} + \\
+ \delta_1 FSP_{p,t} \log(\text{population})_{i,t} + \delta_2 FSP_{p,t} \text{Wealth}^*_{i,t} + \delta_3 FSP_{p,t} \log(\text{Travel time})_{i,t} + \\
+ \gamma_1 BAAC_{i,t} + \gamma_2 COMM_{i,t} + (\pi(i)) + \epsilon_i
\]

(5)

Here, coefficients \( \beta_k, k \in \{1, 2, 3\} \) show the baseline effect of a given characteristic of a village (population, wealth, distance to market) on the access expansion. Coefficients \( \delta_k, k \in \{1, 2, 3\} \) show the differential assessment/response of a given characteristic of a village depending on the presence/provincial footprint of another FSP, while \( \delta_k, k \in \{1, 2, 3\} \) show potential differences depending on own footprint. Estimation results are presented in Table 3 columns (2) vs (5), featuring the potential heterogeneity with respect to the other FSP footprint and columns (3) and (6) add the heterogeneity with respect to own footprint while retaining the other FSP footprint.

Regarding the effect of commercial bank’s footprint on the BAAC’s expansion patterns, in column (2), we find that when commercial bank’s footprint is low the BAAC puts a considerably high (and positive) weight on both population and wealth (as do commercial banks in column (5) though the order of magnitudes are different). However, the interaction coefficients in the next three rows \( \delta_k \) are negative, which effectively counterbalances those baseline effects for sufficiently high commercial bank provincial presence. Distance discounting is also much higher (3-4 times larger than in the whole sample) in the areas with low commercial bank’s presence and again the interaction coefficient is attenuating this effect.

In column (5), we do not find such heterogeneity in assessment of village’s population and wealth by the commercial banks in response to the BAAC’s footprint. Commercial banks seem to assess villages’ population and wealth in the same way, regardless of the presence of BAAC in the province. We do find differential response in terms of distance to the market. When the BAAC’s presence is low, commercial banks do not seem to discount distance much, but increase distance discounting when BAAC’s presence increases.

An interesting question in this regard is whether such heterogeneous assessment is a response
to another FSP’s presence or the result of its own expansion within the province. To probe this, in columns (3) and (6), we include interactions with own (initial) footprint on top of another FSP’s provincial footprint. In column (3), we find that own footprint does have an effect on assessment of population and wealth for the BAAC. As the BAAC becomes more prevalent, it puts less weight on population and wealth, perhaps reacting to its initial position and what is left to choose from. Likewise, the level and interaction effects with commercial banks in column (3) are different from those in column (2) for some variables. However, the estimates suggest that commercial bank’s footprint is still relevant, as it changes BAAC’s response to villages’ population and proximity to the markets. In contrast, for commercial banks, column (6) indicates that (while there might be some heterogeneity with respect to own footprint) the presence of the other provider (the BAAC) is either insignificant (in the case of distance to the market), works towards reinforcing the baseline (positive) effect (in the case of per capita wealth), or even when attenuating the baseline effect would not be able to counter that effect completely (in the case of population).

Overall, we argue that expansions (i.e. over the whole period 1986-1996) of financial services by the BAAC and the commercial banks differ considerably from one another. Commercial banks’ behavior seems to be consistent with profit maximization: commercial banks expand into more lucrative areas that are easier to serve (i.e., closer to the market places).

In contrast, it is difficult to reconcile the BAAC’s behavior with simple profit maximization. Neither does it seem to target poorer/less populated locations (as might have been suggested by its initial published charter). Instead, we find that the BAAC’s expansion exhibits anti-preemptive patterns: the BAAC’s tends to get out of the way of commercial banks when/if those are present in the area, Yet, it behaves more in the spirit of simple profit-maximizer bank when commercial banks are absent. Intuitively, such behavior might result from a model where the BAAC takes into account in its objective (in some form) not only direct payoff/revenues/social welfare impacts received from its own branches but also from customers served by the commercial banks. For example, if the BAAC were to maximize total financial access, then its behavior could be changing depending on the presence of commercial banks in the area and that sector’s know behavior. Indeed, in areas where the footprint of commercial banks is substantial the BAAC might put negligible (or even negative) weight on population/wealth and expand into more distant villages that are less likely
to be serviced by commercial banks, leaving more populous and wealthier locations to be served by the commercial banks. At the same time, in areas where commercial banks are (and will be) scarce, the BAAC (maximizing total financial access) would first and foremost expand into more populous/wealthier areas. Below, we posit and estimate a structural model where the BAAC in its objective is allowed to put some weight on the payoff of commercial bank.

3.2 Summary of key features to be incorporated in the model

This section summarizes the key features of the data that will be incorporated in our structural model of financial access to the BAAC and commercial banks.

- The 1986-1996 period is characterized by the expansion of the financial system, with both the BAAC and commercial banks increasing their networks. Exits were not relevant in the period. We focus only on entry decisions. This is a non-stationary environment, which requires explicit modeling and computation of optimal expansion paths for the BAAC and commercial banks.

- Financial services are provided through a spatial network. Branches are opened in key locations. Given the bank office location and road network, villages are either attended by loan officers or the villages’ residents travel to the branches. We explicitly consider a two-tier structure, where branch locations affect the financial access at the village level with the road networks connecting villages to bank branches.

- There are clear differences in the expansion of the BAAC and the commercial banks, suggesting that they pursue different objectives. We allow the objective function of the BAAC to differ from the profit-maximizing behavior of the commercial banks.

- The presence of commercial banks seems to change the behavior of the BAAC. We build a framework that explicitly recognizes such strategic interaction.

- There is evidence that the outreach of the BAAC’s branches is wider than the outreach of the commercial bank branches. We allow for the heterogeneity in outreach technology between the two types of FSPs.
In our model below, we will assume that the BAAC and commercial banks provide homogeneous products. In practice, the products offered by the commercial banks and the BAAC, as reflected in data summary, are somewhat heterogeneous. However, as we argued earlier, there is a sample selection issue, in the sense that financial institutions themselves choose where to concentrate their efforts, taking each other into account. We focus in this paper on the heterogeneity in location choice and abstract away from heterogeneity in product choice, for two reasons. First the computational means are not yet sufficiently powerful to deal with more dimensions of choice. Second, geography is both a real variable and, in addition, a metaphor for the larger heterogeneity issue in the study of behavior and anti-preemption.

4 Model

We now present a dynamic spatial model that incorporates the features described in the previous section. In particular, we consider a dynamic game between two players - the BAAC (B) and the commercial bank (C) that compete for customers on a network of villages connected by roads. Branches can be opened only in key provincial centers whose locations are taken from actual data. Once opened, each branch can serve the population in connected (by roads) villages. Financial provision at the village level depends upon travel costs, which is proxied by the time to travel to the nearest FSP branch. This specification can represent both the cost of people to travel to the branch or the cost of assigning loan officers to the villages. Consistent with the empirical evidence above, the BAAC and commercial bank are allowed to discount distance differently when serving the villages. The identity of the FSP located closest to a given village dynamically changes over time depending on (own and other) FSP entry choices, thus, the relevant local market that each branch faces endogenously changes as the game progresses.

We allow different objective functions for the BAAC and the commercial bank. On the basis of the empirical patterns above, we conjecture that the BAAC is unlikely to be a pure profit maxi-

31 As was mentioned in the introduction above, we represent commercial banks as one single representative entity. This assumption makes the model estimation feasible, as our data contain information about whether a given village receives financial services from “a” commercial bank without specifying the exact name of the bank or banks involved. Additionally, with the larger number of decision makers the complexity of the problem explodes exponentially due to possible configurations of multiple FSPs presence. A justification for this assumption could be tacit collusion. See Green et al. (2014) for extensive review of the literature.
mizing agent. Instead, we explore the possibility that it takes into account own profits, commercial banks’ profits, and household welfare. This is a way of incorporating benevolent and possible anti-preemption behavior for the BAAC.

The model focuses on the location aspects of entry decisions. The timing of entry is taken from the data. We allow for a cost of branch opening, which may differ between the two FSPs. However, our identification comes from where a new branch is open with the timing (i.e., decision when) being fixed by the data. In this regards, if a given FSP opens a new branch, it always incurs a cost regardless of the choice of the location. While a branch opening is costly, these costs net out of the objective functions of both FSPs and, as a result, we dispense with the notation.

4.1 Geographic network and marketing

There is a large finite number of villages $M$ with known coordinates. Each village $i$ has known population $Y_i$. There is a smaller number $N$ of potential locations indexed by $j = 1, .., N$ where FSPs might open their branches, also with known coordinates. Villages are connected to potential branch locations by a network of roads. This setup approximates real life conditions where FSPs do not open branches in individual villages but instead locate in local regional centers and then either (i) the FSPs send their loan officers to nearby villages or (ii) village residents travel to those centers to get financial services.

4.1.1 Financial outreach technology

If an FSP has a branch in a given location, it then could send loan officers to service nearby villages that are connected to this location by roads. The probability that a village $i$ would be visited by a loan officer from a FSP branch location $j$ depends on FSP’s type $k$ ($k \in \{C, B\}$: commercial bank and the BAAC, respectively) this officer is coming from and the travel time $D_{ij}$ between village $i$ and that location $j$. We use an explicit functional form for this probability of contact:

$$r^k_{ij} = Y_k exp(-\tau_k D_{ij}).$$

(6)

32We present the model using population as the main index for the welfare and profits of FSPs. However, in the empirical application, we also consider wealth as an alternative index.
Parameters $\Upsilon_B$ and $\Upsilon_C$ capture the overall differences in the effectiveness of marketing messages from each FSP type $k$. The parameters $\tau_B$ and $\tau_C$, on the other hand, reflect the impact of distance on bank financial outreach. This could reflect an FSP’s unwillingness to lend to borrowers located far away due to higher monitoring costs or village residents’ unwillingness/inability to travel to distant branches. These parameters represent technology and are not chosen by providers. Appendix C.1 shows evidence that this specific functional form fits our data well.\textsuperscript{33}

Note that we do not model the error structure explicitly and go directly to the implied probabilities in (6). One could easily incorporate a (village-specific) error term $\epsilon_{ij}^k$ by considering a latent index model for the propensity of getting financial services. This particular functional form would be obtained when the error term has an extreme value type 1 distribution, which is commonly assumed in the industrial organization literature. Since $r_{ij}^k$ is already a probability it fits nicely into the likelihood function (18) below.

4.1.2 Households in Villages: Decision Problem

Though the decisions of households in a given village are trivial, it is important to lay this out clearly. If a village $i$ is contacted by a loan officer from some FSP, then households in that village can gain the services of that provider with welfare benefit $\omega$ per household. Benefits $\omega$ do not depend on the provider and are supplied or gained inelastically.

In this regard, for a given village $i$ there are three possibilities to get access to financial services: (i) village $i$ is reached by only one provider from one branch; (ii) village $i$ receives multiple messages from different providers/branches; or (iii) village $i$ is reached by no one. Thus, one can group possibilities into these three scenarios and, given the location of village $i$ relative to branch locations $j(k)$, compute the overall probabilities of each scenario.

In case (i), all households attain a welfare benefit $\omega$ from the specified branch. In case (ii), as

\textsuperscript{33}One could consider more general functional forms for the financial outreach technologies: e.g. one could assume that financial outreach parameters depend on the configuration of financial access, such as presence of the competitor’s offices nearby, etc. To probe this, in Appendix C.1 Table A4 we reestimate (6) for subsamples of our data with “high” vs “low” level of presence of the other FSP and find that the financial outreach technologies parameters are pretty stable across those subsamples for both providers. Statistical tests indicate that (for the most part) they are not statistically distinguishable from each other (particularly for the BAAC). There could also have been a potential “selection” issue due to the BAAC going to more distant areas because of its financial outreach efforts are less effective when commercial banks are present in the area. Our findings in Table A4 suggest that such “selection” concerns do not seem to be important.
village $i$ is contacted by multiple sources, its population $Y_i$, for simplicity, is divided equally among financial access options and the welfare gain remains at $\omega$ for each household. In case (iii), village $i$ is not contacted and gets no welfare benefit, naturally normalized to 0. (Alternatively, all welfare numbers are defined relative to the outside option).

### 4.1.3 Endogenous market “boundaries”

In order to define payoffs of financial services providers, we need first to compute the expected population served by each FSP in a given period. The state of the economy in each period is described by a vector indicating whether the BAAC or the commercial bank has a branch in each one of the possible locations $j = 1, \ldots, N$. Denote this state vector as $F = (F_B, F_C)$, where $F_k = (f^1_k, \ldots, f^K_k)$ ($k \in \{B, C\}$) and $f^j_k = 1$ if FSP $k$ has a branch in location $j$ and $f^j_k = 0$ otherwise, where again $k = B$ for the BAAC and $k = C$ for the commercial bank, but we use the notation $-k$ to refer to the other provider - i.e., $k = B$ implies that $-k = C$ and vice-versa.

Given the branch locations of each FSP and the matrix of travel times, we define the $j(i, m)$ as the index of the $m$th closest branch location to village $i$. Based on that, denote $q_{i,m}^k = f^k_{j(i, m)}f^k_{i,j(i, m)}$ the probability that village $i$ is served by the FSP $k$ located in the $m$th nearest location. We also define the complementary probability by $\tilde{q}_{i,m}^k = 1 - q_{i,m}^k.$

To keep the model tractable we assume that a given village can get financial services only from up to $np$ closest potential branch locations, provided there are FSPs in those locations. For example, in the case of $np = 2$ the expected population served by bank $k$ would be:

$$
\Psi^k(F) = \sum_{i=1}^{M} Y_i \left[ q_{i,1}^k \tilde{q}_{i,1}^{-k} \tilde{q}_{i,2}^{-k} + \tilde{q}_{i,1}^k \tilde{q}_{i,2}^{-k} + \frac{1}{2} (q_{i,1}^k \tilde{q}_{i,1}^{-k} \tilde{q}_{i,2}^{-k} + 2q_{i,1}^k \tilde{q}_{i,1}^{-k} q_{i,2}^{-k} + q_{i,1}^k \tilde{q}_{i,1}^{-k} q_{i,2}^{-k} + \tilde{q}_{i,1}^k \tilde{q}_{i,2}^{-k} + q_{i,1}^k \tilde{q}_{i,2}^{-k} + \tilde{q}_{i,1}^k \tilde{q}_{i,2}^{-k} + \tilde{q}_{i,1}^k \tilde{q}_{i,2}^{-k} ) \right]$

### Notes

34 For tractability purposes, we assume “no path dependence”, i.e. the probability that the village is reached from a given FSP branch does not depend on whether it happened to be served by this branch in the previous period. What determines villages’ access to financial services in our model is, thus, the contemporaneous configuration of FSPs branches $F$, and the resulting probabilities $q(F)$. Such formulation could be a reflection of a more general model of demand with a stochastic component where each period agents face logistically distributed shocks to demand, such as in Gowrisankaran and Krainer (2011).

35 This is not very restrictive as the impact of more distant locations is likely to be minimal due to distance discounting.
where the sum is taken over all villages \( i \) and \( Y_i \) is the population of a given village \( i \).

Each term in the expression above is associated with a possible configuration of the two nearest locations case, in which village \( i \) is served by one, two, three or four branches simultaneously, with all possible type branches at the two locations. For example, \( q_{i,1}^k \tilde{q}_{i,1}^k q_{i,2}^k \tilde{q}_{i,2}^k \) represents the probability of having only FSP \( k \) serving village \( i \) from the nearest branch location \( j(i, 1) \), with neither the other FSP in this nearest location \( j(i, 1) \) nor any of the FSPs having offices in the second nearest potential location for the FSP branch, \( j(i, 2) \). These probability values differ across villages, reflecting the road network and specific distances to branch locations. Note also, that when multiple FSP branches reach a given village then customers are split equally between the branches.\(^{36}\)

The complexity of the expression above increases exponentially with the number of nearest locations included in the computation. We focus on the two nearest locations (\( np = 2 \)) here for exposition purposes. In our empirical application we consider the three nearest locations case (\( np = 3 \)). The resulting expression has 56 terms where each term is a product of six probabilities.

Thus, in our model, as in many real-life applications, the effective market size that a branch/office of a given FSP is facing is not fixed. Terms inside the sum in equation (7) shows how “boundaries” of a market shift over time depending on actions of any particular FSP and its competitors.

4.1.4 FSPs’ payoffs

Now let’s calculate payoffs of financial services providers. Suppose a FSP \( k \) is expecting to reach a population of \( \Psi^k(F) \) customers. We assume a constant per capita profit represented by \( \pi^k \), considering an inelastic demand for financial services.\(^{37}\) Thus, the total profits obtained by provider

\(^{36}\)Thus, the payoff of a financial services provider from a village depends on the composition of FSPs that reach the village from different branches. The FSP gets the higher share of the market of a given village, when the higher share of branches that “contact” this village belong to this FSP. For example, in the second line of expression (7) we have the case when a village is reached from exactly two FSP branches. In the case of 2 nearest locations there are 6 potential cases of exactly 2 bank branches reaching a given village. However, provider \( k \) gets the whole market if both branches that reach the village belong to it (which happens with \( q_{i,1}^k \tilde{q}_{i,1}^k q_{i,2}^k \tilde{q}_{i,2}^k \) probability), and it gets no payoff if both branches belong to the other provider \( \tilde{k} \) (which happens with \( q_{i,1}^k \tilde{q}_{i,1}^k q_{i,2}^k \tilde{q}_{i,2}^k \) probability). In all other cases (of 2 branches reaching the village), market of this village is split equally.

\(^{37}\)We consider such a simple model of demand for tractability purposes. As in the IO literature dealing with complex spatial competition models (e.g. Jia (2008), Ellickson et al. (2013)), the primary determinants of demand for financial services at the village level in our paper are geographical factors: distance to bank branches, which is determined by the village’s position within the network of roads and current configuration of FSPs branch locations.
in a given period with the state $F$ will be $\Pi^k(F) = \pi^k \Psi^k(F)$.\footnote{In principle, one should also subtract entry costs from those payoffs. But, as we mentioned above, since our identification comes from \textit{where} entry happens \textit{conditionally} on FSP entries happening, the cost of opening a branch would subtract out from the payoffs under every possible location entry decision and would not affect estimation.} Similarly, the households welfare will be represented by $\Omega(F) = \omega(\Psi^B(F) + \Psi^C(F))$. This welfare gain $\omega$ and FSP profits $\pi^k$ can come out of some bargaining solution between households and banks that we do not model.

The payoff of the commercial bank in a given period, with state $F$, is represented by its aggregate profit. Since the per capita profit is constant, profits will be proportional to the expected population served by the commercial banks. More formally this payoff can be written as:

$$\Phi^C(F) = \Pi^C(F) \sim \Psi^C(F).$$

(8)

where ”$\sim$” denotes equality modulus some positive multiplicative constant.

For the BAAC, we adopt a broader approach, allowing it to pursue goals other than simply maximizing its own profits as a way of motivating altruistic or anti-preemptive behaviors. Namely, we use a payoff specification that combines the BAAC profits (with weight $\alpha^B$), the commercial bank profits (with weight $\alpha^C$), and the households’ welfare (with weight $1 - \alpha^B - \alpha^C$):

$$\Phi^B(F) = (1 - \alpha^B - \alpha^C)\Omega(F) + \alpha^B \Pi^B(F) + \alpha^C \Pi^C(F) \sim \Psi^B(F) + \lambda \Psi^C(F)$$

(9)

where $\lambda = \frac{(1 - \alpha^B - \alpha^C)\omega + \alpha^C \pi^C}{(1 - \alpha^B - \alpha^C)\omega + \alpha^B \pi^B}$.

In the case when the BAAC maximizes profits, we have $\alpha^B = 1, \alpha^C = 0$ and $\lambda = 0$. Only the population served by the BAAC itself generates profits and hence the payoff for the BAAC. Evidently, this is the only case when $\lambda = 0$. There is zero weight on commercial banks’ profits and contribution of commercial banks to the total financial access is not taken into account. Alternatively, the BAAC might care only about the profits of the commercial bank, $\alpha^C = 1, \alpha^B = 0$ and $\lambda \to \infty$.\footnote{One can think about this as taking the limit $\alpha^C \to 1$, so that $\lambda \to \infty$.} In this case the BAAC is acting in favor of the commercial banks (in disguise, as it retains its own institutional identity). This is the only case when the denominator in expression for $\lambda$ can be zero. The BAAC perceives no benefit from its own profits or from the welfare of the population and all the weight is instead put on the commercial bank profits.
Incorporating altruistic motives, suppose the BAAC puts weight on the welfare of the population only. Specifically, if the BAAC puts all weight on total welfare from financial access, we have $\alpha^B = \alpha^C = 0$ and so $\lambda = 1$. This results in negative preemption. The BAAC considers the population served by the commercial bank with the same weight it assigns to its own customers; households get the welfare gain in either case, from either FSP.\(^{40}\)

Thus, we assume the following objectives for the commercial bank and the BAAC, respectively:

\[
\Phi^C(F) = \Psi^C(F),
\]

\[
\Phi^B(F) = \Psi^B(F) + \lambda \Psi^C(F).
\]

Here $\Psi^C(F)$ and $\Psi^B(F)$ are number of customers served by the commercial bank and the BAAC respectively if the state of financial access is $F$ and $\lambda \geq 0$ is the weight that the BAAC puts on the population served by the commercial banks. This formulation is flexible enough to account for various scenarios of the BAAC’s attitude towards social surplus, payoff and costs of commercial banks, etc. In our analysis below parameter $\lambda \geq 0$ would be one of the main parameters that might potentially account for the anti-preemptive behavior of the BAAC that we observe empirically.

### 4.2 Dynamics

Entry in each one of the $N$ possible locations is sequential. The entry sequence is deterministic and is represented by the vector $S = (s_1, ..., s_T)$, where $s_t = k$ if the financial provider $k$ is called to choose a location in period $t$, $t = 1, ..., T \leq 2N$. The two FSPs are allowed to enter in the same location. We are implicitly assuming that benefits of entry are always higher than such costs, focusing exclusively on the locational aspect of the entry decision. The entry timing is exogenous in the model and is taken from the actual entry data in the empirical application.\(^{41}\) Notice that this

\(^{40}\) An alternative explanation, also consistent with negative preemption, arises when $\lambda \geq 1$. Assume that there is no altruism towards customers $(1 - \alpha^B - \alpha^C = 0)$ and that $\alpha^B \pi^B \leq \alpha^C \pi^C$. With $\pi^C > \pi^B$, as may be presumed for a government development bank relative to profit maximizing commercial banks, this inequality is satisfied when $\alpha^C \geq \alpha^B$ and also is likely to be satisfied even when the weight $\alpha^C$ is less than or equal to $\alpha^B$ but not by much. When $\lambda > 1$ the anti-preemption motive of the BAAC is the most dramatic, as the BAAC prefers the customers to be served by the commercial banks and, thus, has an incentive to “get out of the way” of commercial banks.

\(^{41}\) Optimality/equilibrium conditions for financial providers dictate that both timing and location of branch opening should be chosen to maximize the FSP’s payoff. Since we take the timing of new branch openings from actual data, the
structure, although simplified, still accounts for preemption issues. Earlier location choices may 
preempt profitable future moves of a competitor. In addition, since customers can travel, branches 
can intercept customers from competitors by locating nearby.

Given the state of financial access $F$, we define the set of feasible actions for the FSP $k$ 
as the set of possible states $F'$ that differ from state $F$ in one single possible entry location:
$\Gamma_k(F) = \{F' : F'_{i_0}^k = F_{i_0}^k - 1 \text{ for only one } i_0, \text{ and } F'_i^k = F_i^k \text{ for all } i \neq i_0\}$. We also say that financial 
provider $k$ is active (A) if $s_t = k$ and non-active (NA) otherwise. When all the locations are 
occupied, there is no feasible action for either bank, but payoffs continue to arrive in each period 
discounted into the infinite future.

From the commercial bank’s payoff in Equation (7), we can write the value function of the 
active and non-active commercial banks, respectively, as:

$$V^C_A(F) = \max_{F'_C \in \Gamma_C(F)} \Psi^C(F'_C, F_B) + \beta[1\{s' = A\}V^C_A(F'_C, F_B) + 1\{s' = NA\}V^C_{NA}(F'_C, F_B)] \quad (12)$$

$$V^C_{NA}(F) = \Psi^C(F) + \beta[1\{s' = A\}V^C_A(F') + 1\{s' = NA\}V^C_{NA}(F')] \quad (13)$$

Here $S'$ indicate whether the given FSP is active or non-active in the next period.

In the payoff for the BAAC, on the other hand, we explicitly incorporate the possibility that 
it takes into account not only its own customers, but also the customers served by the commercial 
bank and potentially commercial bank profit, as per Equation (9). The value functions for the 
active and non-active BAAC are:

$$V^B_A(F) = \max_{F'_B \in \Gamma_B(F)} \lambda \Psi^B(F'_C, F_B') + \Psi^B(F'_C, F_B') + \beta[1\{s' = A\}V^B_A(F'_C, F_B') + 1\{s' = NA\}V^B_{NA}(F'_C, F_B')] \quad (14)$$

$$V^B_{NA}(F) = \lambda \Psi^B(F) + \Psi^B(F) + \beta[1\{s' = A\}V^B_A(F') + 1\{s' = NA\}V^B_{NA}(F')]] \quad (15)$$

locational choices of new branch opening should be chosen to maximize the FSP’s payoff. Thus, the main identification 
of structural parameters in our model comes not from when different financial providers open new branches but rather 
from where the new branches are being opened (conditionally on branch opening being fixed at equilibrium values). 
Mathematically speaking, if $(X^*_i, Y^*_i) \in \arg \max X_i, Y_i \Phi_i(X_i, Y_i|X^*_{-i}, Y^*_{-i})$ then $X^*_i \in \arg \max X_i \Phi_i(X_i, Y_i|X^*_{-i}, Y^*_{-i})$. Here $X^*_i, Y^*_i$ are optimal/equilibrium strategies of player $i$ and $X^*_{-i}, Y^*_{-i}$ are equilibrium strategies of the other player. 
This is the same identification approach as used in Holmes (2011).
4.3 Equilibrium

Although we formulate the problem with an infinite time horizon, the number of possible locations is finite, \( N < \infty \). Since the entry game is finite, we can solve for the subgame-perfect equilibrium by backward induction. The number of possible paths becomes really large as we increase the number of entry decisions. For example, if we restrict entry only to empty locations, the number of paths is \( N! \). This is because in period \( t = 1 \) there are \( N \) possible locations. In period \( t = 2 \), for each one of the \( N \) possible entries in \( t = 1 \) there are \( N - 1 \) available choices, establishing \( N(N - 1) \) possible moves in the first two periods. Thus, iterating this computation, we have \( N(N - 1)(N - 2)\ldots1 = N! \) possible moves in a game with \( T = N \) periods. In the more general case, where FSPs can share a given location, the problem’s complexity is even higher.

In order to solve the game, we start with a payoff matrix of all possible paths with columns representing periods and different rows represent all possible game paths. Each entry in the matrix is the payoff of the respective active FSP in that period. We then eliminate dominated paths (rows) sequentially in a backward induction exercise. The algorithm starts in period \( T - 1 \), when the respective active FSP has to choose one among two possible choices (in period \( T \) there is no choice to be made). For each possible subgame in \( T - 2 \), we eliminate the dominated strategies/rows (those with lower payoffs) in \( T - 1 \). We then move sequentially to periods \( T - 2, T - 3, \ldots, 1 \), eliminating dominated rows. The resulting set of paths are the subgame-perfect equilibria.

5 Exploring the model through examples

Before estimating the model parameters from the actual data, in this section we present a set of semi-artificial examples to explore the mechanics of the model, emphasizing how the behavior of the BAAC and commercial bank change with the parameter values.\(^{42}\) The examples are semi-artificial in the sense that we use actual data from the Phatthalung province in Southern Thailand on the location of villages and possible branches, road network as well as proxy for potential revenues by a wealth index. We only consider the six locations for which we observe entry in the 1986-1996

\(^{42}\)This also illustrates the variation in locational choices by financial providers that identifies the structural parameters of the model.
period. We also assume, for illustrative purposes (which is different from the actual data), that the BAAC and commercial banks alternate in the location choice, with the BAAC moving first.

Figures 1-4 consider four parameter configurations. In each figure, there are six maps representing each one of the six periods of the game. Empty circles are possible branch locations. Blue stars represent the BAAC branches while the red triangles refer to commercial bank branches. The size of the villages are proportional to potential revenues.\footnote{Villages are painted according to the closest branch, in order to identify the most important branch for each village. But notice other branches are relevant as well.} As new branches open, the colors of the villages change, illustrating the endogenous evolution of branch markets. On the other hand, what is not evident from the figures, are the second and higher order closest branches which also provide revenue. This is more evident in Table 4.

For simplicity, we assume the same baseline probability for a village to get access to the FSP branch ($\gamma_B = \gamma_C = 1$). But, consistent with empirical evidence in the previous section, we allow for lower discounting of the distance by the BAAC: $\tau_B = 0.001$ and $\tau_C = 0.01$.

In order to describe the expected payoff associated to each location, Table 4 shows the expected contemporaneous (own) population associated with each branch location considering there are no other past or future branches. These numbers indicate that the top-right and the bottom-left locations are the less lucrative ones. Differences in spatial outreach ($\tau$) are also relevant: the best location for the BAAC is the top-left, while the best location for the commercial bank is the central-right.

Table 4 also illustrates how the composition of the served population varies with the specific geographic structure, suggesting that things can change substantially over time. In the central-left location, for example, a substantial part of the serviced population comes from villages for which this location is the third closest branch. In the central-right location, on the other hand, most of the customers comes from villages for which it is the closest location. So, although the central locations are relatively similar in terms of the total expected population, their relative attractiveness depends on which locations are expected to be occupied by whom in the subsequent moves.

We start our analysis abstracting from dynamic effects, by setting the discount factor $\beta$ at a very low level. The resulting game outcome is depicted in Figure 1. In this case, locations are chosen
on the basis of contemporaneous payoffs following the ordering presented in Table 4. The BAAC starts with the top-left location; then, the commercial bank chooses the central-right location, etc.

In Figure 2, where the dynamics play a role ($\beta = 0.9$), there is an important change. The BAAC starts with the central-left location, which is its third best location in Table 4 and has most of its revenue coming from distant villages. As weight on commercial banks’ payoff $\lambda$ is set equal to one, this is consistent with the BAAC caring about the total consumer welfare, represented by the overall financial access of villages regardless the FSP. In this case the BAAC anticipates that the commercial bank will move to the central-right location in period 2 and prefers to start with central-left. Now, with the dynamic interaction playing a role, the best location from a static perspective (figure 1) is only chosen by the BAAC in period 3. The BAAC takes advantage of the induced behavior of the commercial bank in the game. This is the case in which the anti-preemption behavior of the BAAC becomes visible, especially in early moves done by the players.

Figure 3 shows the case in which the BAAC behaves as a commercial bank, i.e. cares only about its own profits as $\lambda = 0$. In that case, the BAAC starts in the central-right location, which is its second-best location from a static perspective. This highlights the importance of dynamics in the game. Although the top-left location has a higher immediate profit, the geographical location of the central-right location is better in the longer-run, with a higher fraction of the profits coming from closer villages, thus, making this profit stream more difficult to be intercepted by the other FSP. Indeed, the configuration in the period 2 in Figure 1 shows that the top-left location can lose quite high number of villages with the actions of the commercial bank. The choice of the BAAC in this example shows another dynamic feature, as, under some circumstances, it prefers to enter into its own market rather than compete with the commercial bank.

Finally, Figure 4 analyzes the case in which the BAAC is the only financial services provider in the market. In this case, it starts, as in the static case, with the top-left location, which has the largest expected serviced population. In periods 2 and 3, the BAAC chooses locations with relatively high population in a pathway that mitigates preemption among its own branches, with a

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44As our discussion about alternative interpretations of $\lambda$ in Section 4.1.4 suggests, there can be several reasons for $\lambda$ in the middle range, especially not near zero nor very large: (i) the BAAC caring about total welfare benefits of financial services accrued to households, (ii) the BAAC caring about profits of commercial banks, or (iii) various combinations of (i) and (ii).
widespread coverage of the market. For instance, the central-right location, which is the second-best location from a static perspective, is only chosen in period 4. As in Table 2, the BAAC behavior changes when it is playing alone.

These examples shed light on the richness of the interaction between geographical and dynamic effects, showing how the parameters of the model affect the behavior of the BAAC and the commercial bank. The road network and specific location of the villages create endogenous financial markets for each financial services provider. More importantly, the boundaries of those markets are allowed to change over time depending on entry choices of FSPs. These examples also illustrate the differences in expansion paths of financial providers depending on the parameters of their objective functions. This is precisely the kind of variation that is used to identify the structural parameters of our model below. In the estimation section below, we will select model parameters that result in the closest model fit to actual financial access at the village level.

6 Estimation of the model

In this section, we describe the procedure that we use to estimate the parameters of our model.

We set the annual discount factor to $\beta = 0.9$, which leaves us with five parameters to estimate: four parameters describing financial outreach technology for the BAAC and commercial banks ($\Upsilon_B, \tau_B, \Upsilon_C, \tau_C$) and the weight the BAAC puts on the payoff of commercial banks $\lambda$.

In order to estimate the parameters of the model, we consider 10 selected provinces in the period of 1986-1996, for which the number of entry episodes is less than or equal to 6, for computational tractability. The selected provinces are depicted in Figure 8. We interpret each province of Thailand as an independent economy that can be described by our model above.

The dataset used in the analysis contains, for each province, $N$ possible branch locations, $M$ villages with population $Y_i, i = 1, \ldots, M$, the travel cost/distance from a given village to the three nearest branch locations $D$, the sequence $S$ of observed entry decisions, financial access at the

45 This is an annual discount factor; in our estimation we explicitly account for the timing of the entry (number of periods since the initial year 1986) and discount payoffs accordingly. When years go by without a new location choice, we take that into account with corresponding discounting.

46 Using only a few provinces for estimation also allows us to perform “out-of-sample” evaluation of our model. See Section 7 for more details on model “out-of-sample” behavior below.
village level (\(B\) and \(C\)), and initial locations of FSPs \(F\).

The travel distance is computed from the actual road network, considering travel times that take into account the quality of roads. Financial access at the village level is characterized by two dummy variables indicating whether villages have at least one credit contract with the BAAC, \(B_i\), or with the commercial bank, \(C_i\).

The data on availability of services of the financial providers at the village level are collected by interviews with the village headmen/headwomen, asked about whether any of the households in their village have bank loans and whether those loans are from the BAAC or a commercial bank. Headmen in Thai villages play a prominent political role and typically are closely involved in matters facing ordinary villagers. A headman’s/headwoman’s answer “Yes” to a question about whether his/her village has access to loans from a particular FSP is likely to indicate not that just a single household having access to finance, but that a nontrivial number of village’s households do get and might get (if needed) access to financial services from a particular FSP. Hence, such answers are likely to be more accurate representation of actual access to financial services at the village level for our estimation purposes.\(^{47}\)

The location of branches in 1986 is considered to be the initial state. The set of possible locations is given by the actual branch locations in 1996. The sequence of decisions \(S\) is exogenous and is taken from the observed sequence of branch openings.\(^{48}\) See Appendix for more data description.

### 6.1 Likelihood

Our model yields an analytical expression for the probability of a given village to get services from a given FSP. Considering the three nearest branch locations case, the probability of observing financial access to the BAAC and commercial bank, respectively, can be written as:

\(^{47}\)Tailoring our estimation approach to the available data at hand, we model only the probabilities of each village being served by a financial provider (extensive margin) without modeling the degree/depth of such services (intensive margin). However, as just mentioned, given our data, those probabilities should be interpreted as “substantial” access to financial services by a given village. It is worthwhile noting that even such (necessarily) simplified approach is able to capture vital patterns in financial access exhibited by the data and shows decent performance “out-of-sample”. See Section 7 below.

\(^{48}\)The timing of the model (and its implications for the discount factor) is also adjusted according to the timing of entry decisions observed in the data.
Thus, we can write the likelihood function on the basis of our data as:

\[
\begin{align*}
\lambda(\Gamma_B, \gamma_B, \tau_B, \Gamma_C, \tau_C) &= \prod_{i=1}^{N} Pr\{B_i = 1\} Pr\{B_i = 0\}^{1-B_i} Pr\{C_i = 1\} Pr\{C_i = 0\}^{1-C_i}.
\end{align*}
\] (18)

### 6.2 A two-step procedure

The likelihood above suffers from a curse of dimensionality. We propose a two-step procedure to estimate the five parameters of the model \((\lambda, \Gamma_B, \gamma_B, \tau_B, \Gamma_C, \tau_C)\) with reduced computing time. First, given the distance to the nearest branch locations \(D_{i,j}\) and the information on whether each village has access to the BAAC or the commercial bank, we estimate \(\gamma_k\) and \(\tau_k\) directly from equation (6) by non-linear least squares. Second, given these parameters, we choose \(\lambda\) through maximum likelihood, relying on equation (18) above. This way, we can implement a much finer grid for \(\lambda\) in a reasonable amount of time. Together with our baseline model we also estimate and assess the relative performance of two restricted models. In the first, we restrict financial outreach parameters to be the same for the BAAC and commercial banks \((\Gamma_B = \Gamma_C, \tau_B = \tau_C)\). In the second model we shut down the altruistic or anti-preemption motive in the BAAC’s behavior and set \(\lambda = 0\).

### 6.3 Estimation results

We use bootstrap to obtain point estimates and standard errors for the parameters of financial outreach technologies \((\tau_B, \tau_C, \Gamma_B, \Gamma_C)\) and the weight that the BAAC puts on commercial bank payoff \(\lambda\). We consider 100 bootstrap subsamples of villages. For each bootstrap subsample we perform our two-step procedure. Given the actual data on profile of financial access to the BAAC and commercial banks in a given bootstrap subsample we estimate \(\tau\)’s and \(\Gamma\)’s via non-linear least squares and then we run a grid search for \(\lambda\) on a grid from 0 to 2 with a 0.01 step.

This procedure gives us a distribution of \(\tau_B, \tau_C, \Gamma_B, \Gamma_C\) and \(\lambda\). We take the means from this
bootstrapped distribution to be point estimates of the corresponding parameters and use 5th and 95th percentiles to construct confidence intervals.

Estimation results from this two-step procedure for the BAAC and commercial banks are reported in Table 5. In columns 1-3, we use villages’ population while in columns 4-6 we use villages’ wealth as the proxy for the payoff each FSP could get from a given village. Column 1 reports the estimates for the complete model, where FSPs are allowed to have different outreach technologies and \( \lambda \geq 0 \). Column 2 considers the case where the BAAC and commercial bank have the same outreach technology. Column 3 presents the case where \( \lambda \) is set to 0.

We find that the BAAC put the same weight on its own customers and the customers of the commercial banks: estimated \( \lambda \) is very close to unity. Conditional on being present in a given node the BAAC additionally provides a wider outreach of financial services from each of its branches. The baseline probability of getting access to finance from the BAAC is higher (\( \Upsilon_B > \Upsilon_C \)) and the discounting effect of distance is much lower (in effect almost absent) for the BAAC branches than for commercial banks’ branches (\( \tau_C > \tau_B \approx 0 \)). It is worth noting that using wealth or population as a proxy for the payoffs from serving a given village does not have much effect on estimated \( \lambda \)’s.

We also estimate two restricted models. In the first model we restrict financial outreach technology to be the same for the BAAC and commercial banks (columns 2 and 5 of Table 5). In this case we find that the estimated weight that the BAAC puts on commercial banks’ population is still positive but less than one \( \lambda \approx 0.5 - 0.6 \). Financial outreach technology parameters are somewhat closer to those of commercial banks from the unrestricted model (\( \tau_C \) and \( \Upsilon_C \) from columns 1 and 4). When we perform a likelihood ratio test of this model and the baseline, we find that this re-

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49 The parameters from the outreach technologies \( (\tau_B, \tau_C, \Upsilon_B, \Upsilon_C) \) are estimated only with the data on branch and villages locations along with the road network. Despite of that, we consider one bootstrap sample for each proxy (population and wealth), generating small (and non-significant) differences in the point estimates across columns.

50 Both point estimates are different from each other and the hypothesis that \( \Upsilon_B = \Upsilon_C \) is rejected.

51 In economic sense, the distance discounting coefficient of 0.0035 for commercial banks suggests that an increase in travel time by one hour (60 minutes) is associated with a decrease in probability of financial access by 19 percent (as \( \exp(-0.0035 \times 60) = 0.81 \)). There is effectively no distance discounting within the support of observed travel times for the BAAC. In our model estimation, we do effectively have distance discounting for the BAAC since we consider travel only to two (three in a robustness check) closest branches.

52 In Appendix C.1 we also consider a flexible specification for financial outreach technology and show that it results in the similar pattern of distance discounting as the assumed exponential distance discounting functional form (6). We further estimate financial outreach technology on the sample of all provinces and contrast it to the ones presented here for the sample of 10 selected provinces. Estimated \( \Upsilon \)'s for the BAAC and commercial banks are almost the same, at 0.94 and 0.53, respectively. \( \tau_C \) is even higher at 0.006 vs 0.003 for the 10 selected provinces, and \( \tau_B \) is, in fact, estimated to be even more negative at -0.0007 vs -0.000022.
stricted model is rejected. In the second model we shut down the second stage by setting \( \lambda = 0 \), i.e. we assume that the BAAC maximizes profits, while still retaining differences in financial outreach technologies. The financial outreach technology estimates do not depend on choice of \( \lambda \) and as a result estimates of \( \tau \)’s and \( \Upsilon \)’s are the same as under the baseline. When we perform a likelihood ratio test of this model it is decisively rejected in favor of the baseline.

7 Exploring the model: simulations and counterfactuals

Above, we found that the model with the altruistic/anti-preemptive BAAC (\( \lambda \approx 1 \)) and wider financial outreach of the BAAC branches seem to be statistically superior to models with the pure profit-maximizing BAAC (\( \lambda = 0 \)) or with symmetric financial outreach technologies. In this section we explore whether this statistical superiority translates into economically meaningful advantage of our baseline model in explaining the patterns observed in the data. Does our baseline model predict patterns that are different (in substantive economic sense) from those of the two competing restricted models or other counterfactual models? We perform such assessment in two steps. First, we compare the profile of financial access predicted by the baseline model with what is observed in the data. Second, we perform counter-factual exercises to evaluate how financial access in Thailand could be affected by changes in anti-preemption motive in the BAAC’s objective function, alternative strategic interaction configurations, and ownership.

7.1 The profile of financial access: baseline model versus actual data

To what extent does the baseline model capture the empirical patterns of financial access observed in the data? How well can it explain the differences in financial access to the BAAC and commercial banks depending on village characteristics? In order to answer these questions, we consider the data generated by the baseline model on financial access for the period of 1986 – 1996 for the selected provinces and regress the resulting (model-predicted) change financial access (to the BAAC and commercial banks) on village characteristics: population, per capita wealth and distance to market places, as we did for the actual financial access data in Section 3.1. Since model evaluation and counterfactual analysis do not involve computation-intensive backward induction, we perform the
analysis of the goodness of fit using the whole sample of Thai provinces. This exercise has an additional benefit, as it allows us to evaluate model performance not only on the subset of 10 provinces used in estimation, but also enables us to assess “out-of-sample” behavior of the model. Namely, as in Table 2 for the actual data, we estimate the following specification similar to equation (2) on the model-simulated data on predicted financial access:

$$
\Delta FSP_{i,1986\rightarrow1996}^{PR} = \beta_1 \log(\text{population}_{i,1986}) + \beta_2 \text{Wealth}_{i,1986}^* + \beta_3 \log(\text{Travel time})_{i,1986} + 
$$

$$
+ \gamma_1 \text{BAAC}_{i,1986} + \gamma_2 \text{COMM}_{i,1986} + \pi(i) + \epsilon_i
$$

(19)

Here, the dependent variable $\Delta FSP_{i,1986\rightarrow1996}^{PR}$ is the change in financial access between over 1986-1996 predicted by our model for village $i$. As before, to test for antipreemption effects we estimate specification (19) for a given FSP on the whole sample and on subsamples: where the initial footprint of the other FSP is “High” (above 75th percentile) vs “Low” (below 75th percentile).

Estimates from the whole sample of simulated data (columns 1 and 4 in Table 6) exhibit the empirical patterns that resemble our findings on the whole sample in the actual data in Table 2. The BAAC pays much less (and even negative) attention to village’s population and wealth, while commercial banks tend to focus on more populouswealthier locations that are closer to marketplaces.

More importantly, estimates presented in Table 6 portray the same “anti-preemption” story as the estimates from the actual data in Table 2 above. Our model delivers/predicts a clear shift in the behavior of the BAAC in response to the (initial) footprint of commercial bank. Namely, in provinces where commercial banks have higher presence, the BAAC pays less attention to population and wealth (columns 2 vs 3 and columns 5 vs 6). In fact, in areas where the footprint of commercial banks is above the 75th percentile, both the village’s population and wealth have a negative effect on (predicted) propensity of the village to have access to BAAC’s financial services. At the same time, the effect of wealth becomes positive in provinces with low (below the 75th percentile) presence of commercial banks. The effect of population also increases (as a real number) and from a negative (and statistically significant) becomes positive (and statistically indistinguishable from zero).\(^{53}\)

\(^{53}\)Statistical tests reject the equality of coefficients between the two subsamples.
commercial bank in our model predicted data. Regardless of the presence of the BAAC, commercial
bank prefers to expand into more populous, wealthier, and closer to the marketplace villages. The
only exception to the anti-preemption observed in the actual data is heterogeneity for distance to
the marketplace for the BAAC, which goes in the opposite way to the data. Thus, we argue that
the model (for the most part) does a good job at capturing the anti-preemptive behavior of the
BAAC and the lack of such behavior on part of commercial banks.

It is worth noting that these results indicate that the model performs quite well “out-of-sample”,
as the data generated by the model estimated on the subset of villages from the ten selected Thai
provinces exhibit similar qualitative patterns as the actual data for the full set of Thai villages.
Moreover, in our estimation population was used to proxy for the payoff attainable at a given
location. This makes it even more intriguing that the model-generated data deliver anti-preemptive
patterns for per capita wealth of the correct sign. We argue that our parsimonious model estimated
on a subset of provinces captured some salient aspects of the BAAC and commercial banks’ behavior.

To summarize, the objective function we estimate for the BAAC, with the BAAC caring equally
about financial access provided through its own branches as well as commercial banks’ branches,
seems to capture the anti-preemptive behavior by the BAAC observed in the actual data.\footnote{As
was shown above in Section 4.1.4, such behavior ($\lambda \sim 1 > 0$) might arise due to a variety of factors: (i) the
BAAC caring about total welfare of the population with access to financial services and/or (ii) the BAAC taking
into account profits received by the commercial banks.} Below we consider several counterfactual scenarios for the BAAC objective function to highlight the role
of the BAAC objective function with $\lambda = 1$ and wider financial outreach in generating the anti-
preemption patterns observed in the data and generated by the baseline model.

\section*{7.2 Counterfactuals on anti-preemption and strategic interaction}
We now present counter-factual exercises to better understand the implications of different objective
functions for the BAAC. Our goal in these counterfactuals is to assess whether alternative assump-
tions about model structural parameters result in economically meaningful differences in financial
access from the baseline model and the actual data.\footnote{As in the previous section, we take the baseline parameters estimated on the 10 selected provinces as above, but
carry (counterfactual) simulations on a set of all Thai provinces, for which we have income and population data.}

We use the actual data on road structure (represented by respective travel times), potential
revenues (proxied by population), and distance to market, all as measured in the CDD data. We then create artificial games, where two financial providers alternate their entry moves. In each game, we set (randomly) one of the banks as the first mover.

For each counterfactual exercise, we apply the estimated parameters from Table 5 that pertain to a particular objective function (\( \lambda \)) and financial outreach technology configuration (\( \tau' \)s and \( \Upsilon' \)s) and compute the probability of financial access at the village level. We then calculate the difference between the probability of financial access in each counterfactual and the probability of financial access in the baseline model at the village level. Finally, we relate these differences in financial access between the counterfactual and baseline model to village-level characteristics (i.e., population size, wealth, proximity to markets) using a linear probability model.

Table 7 examines how the counterfactual simulations affect the profile of the financial access for a particular FSP. Effectively, each coefficient in these tables shows to what extent a particular counterfactual exercise changes the effect of some village characteristic (population size, per capita wealth, proximity to the markets) on financial access compared to the effect of this characteristic in the baseline model. More formally we are taking the difference in probabilities of access, counterfactual minus baseline and regressing on these characteristics.

First, we evaluate the role of the BAAC putting positive weight on commercial bank’s payoff. In columns 1-2 in Table 7, we eliminate this weight by setting \( \lambda = 0 \) in the BAAC’s objective function. Thus, the BAAC and commercial bank are competing against each other. Our estimates indicate, that in this counterfactual scenario the BAAC would expand into wealthier locations and locations closer to marketplaces compared to the baseline. This is consistent with our conjecture that, absent any weight on commercial bank’s payoff (\( \lambda = 0 \)), the BAAC increases the competitive pressure on the commercial bank. At the same time, the commercial bank, facing such increased competition from the BAAC, occupies less lucrative (i.e., less populous) locations compared to the baseline.

Next, we examine the opposite case — collusion. That is, we assume that both FSPs are altruistic towards each other (\( \lambda = 1 \) for both). We call this a “collusion” counterfactual, as the placement of branches is done as if by a multi-branch monopolist, while still respecting the heterogeneous outreach technologies for the two types of FSPs. This counterfactual is presented in columns 3 and 4 in Table 7. In this case, the BAAC serves more populous locations than under the baseline.
while commercial banks tend to focus on less populated ones. This counterfactual resembles the pure competition case in the sense that the BAAC gains ground at the expense of the commercial bank. Yet, the important difference is that distance to the market place works in opposite directions between these two counterfactuals. In the pure competition case, the BAAC was going into more central locations (which resulted in villages closer to the market place being served). In the collusion scenario, the BAAC and commercial bank have the same common objective (they do not compete with each other per se but try to maximize common goal). Thus, they split the markets respecting the difference in their outreach technologies with the BAAC placing its branches to serve more distant locations (which commercial bank cannot reach).\textsuperscript{56}

Finally, in Table 7 columns 5 and 6, we consider the case where the BAAC completely discounts its own financial services and prefers the economy to be served by commercial banks. We label this counterfactual an “extreme anti-preemption” case. Setting $\lambda = +\infty$ effectively puts all weight on the commercial bank in the BAAC’s objective. In our model we approximate this by picking a very large $\lambda$ ($\lambda = 100$). One might consider this counterfactual as a conspiracy theory/political economy setting, in which the BAAC seems to be present to serve the population, but in fact is only helping the commercial bank sector.\textsuperscript{57} In this case, the BAAC expands to poorer/less populated locations compared to the baseline.\textsuperscript{58} As a result, facing less competition from the BAAC, commercial banks place branches in wealthier more centrally located areas (compared to the baseline).

Overall, we argue that these counterfactuals differ from the baseline model scenario, for the most part, in expected directions. More importantly, we argue that the results in Table 7 illustrate that the model is quite sensitive to alternative parameter values. Different counterfactual scenarios (which utilize those alternative parameter values) produce patterns of financial access that are dramatically different from those predicted by our baseline model. In this regard, alternative parameter values are not only rejected statistically (as in Table 5) but they result in economically meaningful differences in predicted behavior of the two FSPs compared to the baseline.

\textsuperscript{56}Even though the coefficient on distance to the market place in column 3 is not statistically different from zero, it is different from the respective coefficient in column 1. We also get somewhat of a puzzling pattern for the wealth effect: with both FSPs focusing on wealthier locations compared to the baseline. We conjecture that this might stem from the fact that in our model simulation population was the variable proxying for the bank payoff from the village.
\textsuperscript{57}In this case, the BACC still must open some branches since it is forced to make moves by our simulations.
\textsuperscript{58}Oddly, the BAAC tends to discount the distance and expands to closer markets.
7.3 Implications for total financial access

Above, we found that the baseline model does a reasonably good job in fitting the anti-preemptive patterns of the BAAC and competitive behavior of commercial bank observed in the actual data. Alternative assumptions about objective functions of either the BAAC or commercial bank are rejected both in statistical and economic senses. In this regard, we think our model might be useful in evaluating the performance of the BAAC in terms of providing total financial access, one of the attributes of state-owned banks discussed in the introductory motivation.

Namely, we compare the total financial access at the village level (i.e., both from the BAAC and the commercial bank) predicted by our model with the counterfactual outcome where the economy is served by the single FSP who (by the setup of the problem) maximizes total financial access and possesses the same (wider) outreach technology as the BAAC.

Table 8 (column 1) presents this analysis. For completeness, we also contrast the baseline model with the case when the economy is served by two commercial banks competing with each other with a narrower financial outreach technology (as estimated for commercial banks). This latter comparison is presented in column 2 of Table 8.\textsuperscript{59} Additionally, Figure 6 depicts the predicted probability of financial provision under each scenario (baseline and the two counterfactuals).

We start our discussion with this latter case, in which both financial providers behave like commercial banks, i.e., they have no altruism towards each other, with $\lambda = 0$ (thus, they are likely to compete with each other), and both possess narrower (commercial banks') financial outreach technology, i.e. both have larger distance discounting. Compared to the baseline, estimates presented in column 2 of Table 8 suggest consistently less financial provision in more isolated locations and higher access for wealthier/more populous villages, with total financial access being lower.

If the economy were to be served solely by the single benevolent FSP (the BAAC), with a wider outreach technology\textsuperscript{60}, there would be no significant changes in the effect of village population and wealth in this counterfactual case when compared to the baseline (column 1 of Table 8). The estimated coefficient on distance to the market is negative, suggesting that in the baseline total

\textsuperscript{59}As before, in Table 7 the estimated coefficients show the difference in the effects of population, wealth, and distance between the single BAAC provider prediction and the baseline model prediction for financial access.

\textsuperscript{60}This is equivalent to setting $\lambda = 1$ for both FSPs and assigning them the same/wider outreach technology.
financial access occurs in villages farther to market than in this counterfactual. At the same time, as shown in Figure 6, the total financial access in this case (i.e. if the economy were to be served only by the BAAC) is only slightly higher compared to the baseline.61

We argue that the operation of the BAAC in the baseline, with its anti-preemptive behavior towards a private sector competitor (commercial bank), seems to drive financial provision quite close to the situation in which the market is solely served by a single benevolent financial services provider. Our results indicate that limited government participation in the market can go a long way towards maximizing total financial access.

8 Conclusion

Road networks, village location, and logistics infrastructure all determine firms’ catchment areas given point-of-sale location decisions and, thus, firms’ entry decisions. Given this interdependence, and the rich variety of geographical configurations in the data, it is unrealistic to try to come up with a fixed a priori definition of a “market”; an abstraction that works well in one context does poorly in another. This issue is particularly relevant in the analysis of the dynamic and spatial interaction between the BAAC and commercial banks in the provision of financial services. However, dynamic entry models with endogenous market boundaries are inherently computationally complex. With the benefit of parallel computing and the appropriate structure of the model, we are able to implement a full backward induction procedure estimating key parameters of financial service providers’ objective functions and financial outreach technologies.

The model is then used for the analysis of the dynamic interaction (in spatial context) between the BAAC and commercial banks in Thailand. The model at estimated parameters explains surprising patterns found in the data, rationalizing the anti-preemptive behavior of the BAAC. Ironically, this, in conjunction with the strategic behavior of private players, improves financial access resulting in financial access patterns quite close to the those obtained in the case when a single benevolent FSP with a wider outreach technology were to provide financial services.

The exercise of using IO methods to study ownership and financial provision also illustrates the

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61 At the same time total financial access in the economy served by two commercial banks is considerably lower compared both to the first case and to the baseline.
potential of bridging the fields of development economics and industrial organization. In particular, the interaction between government and private players in the provision of relevant services has important welfare implications. Though we focus on financial provision, analogous issues can be formulated in other markets such as education or health and can be applied to many countries.

Returning to the broader motivation at the outset, we have shown that a public development bank in Thailand has played a useful role in providing financial access. Thus, it makes sense in the context of the current pandemic for the government to rely on it as a way of connecting households and farm and non-farm SMEs to credit. The danger is that soft credit with lax or forgiven loans might set the tone moving forward on borrowers’ expectations, if not the BAAC’s operating system. In other countries, programs with soft credit can entrench the position of inefficient banks, making future reform yet more difficult. Short-run pandemic policies, however well intended, should not avoid re-consideration of a traditional debate, but with new evidence where possible, as in this paper, on the role of state-owned financial institutions and the private sector.

References


Table 1: Descriptive Statistics - Village-level Data

<table>
<thead>
<tr>
<th></th>
<th>all provinces</th>
<th>selected provinces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>mean</td>
</tr>
<tr>
<td>ln(population in 1986)</td>
<td>44652</td>
<td>6.21</td>
</tr>
<tr>
<td>per capita wealth in 1986</td>
<td>29235</td>
<td>0.51</td>
</tr>
<tr>
<td>ln(distance to the market place in 1986)</td>
<td>42762</td>
<td>3.28</td>
</tr>
<tr>
<td>BAAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>financial access - 1986</td>
<td>44515</td>
<td>0.801</td>
</tr>
<tr>
<td>financial access - 1996</td>
<td>44536</td>
<td>0.947</td>
</tr>
<tr>
<td>change in financial access - 1986-96</td>
<td>44393</td>
<td>0.146</td>
</tr>
<tr>
<td>Commercial banks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>financial access - 1986</td>
<td>44175</td>
<td>0.267</td>
</tr>
<tr>
<td>financial access - 1996</td>
<td>44280</td>
<td>0.436</td>
</tr>
<tr>
<td>change in financial access - 1986-96</td>
<td>43802</td>
<td>0.169</td>
</tr>
</tbody>
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Table 2: Financial access provision by a FSP and the province footprint of another FSP

<table>
<thead>
<tr>
<th>Panel A: Change in access to the BAAC over 1986-1996</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>0.0052***</td>
<td>0.0010</td>
<td>0.0069***</td>
</tr>
<tr>
<td></td>
<td>(0.0020)</td>
<td>(0.0040)</td>
<td>(0.0023)</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.0065</td>
<td>-0.0038</td>
<td>0.0119**</td>
</tr>
<tr>
<td></td>
<td>(0.0048)</td>
<td>(0.0089)</td>
<td>(0.0058)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0015</td>
<td>0.0079**</td>
<td>-0.0044**</td>
</tr>
<tr>
<td></td>
<td>(0.0017)</td>
<td>(0.0035)</td>
<td>(0.0019)</td>
</tr>
<tr>
<td>Observations</td>
<td>41,297</td>
<td>9,618</td>
<td>31,679</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.738</td>
<td>0.697</td>
<td>0.746</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Change in access to commercial banks over 1986-1996</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>0.0964***</td>
<td>0.0961***</td>
<td>0.0961***</td>
</tr>
<tr>
<td></td>
<td>(0.0039)</td>
<td>(0.0076)</td>
<td>(0.0045)</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.1492***</td>
<td>0.1034***</td>
<td>0.1638***</td>
</tr>
<tr>
<td></td>
<td>(0.0087)</td>
<td>(0.0178)</td>
<td>(0.0100)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0341***</td>
<td>-0.0334***</td>
<td>-0.0341***</td>
</tr>
<tr>
<td></td>
<td>(0.0033)</td>
<td>(0.0067)</td>
<td>(0.0037)</td>
</tr>
<tr>
<td>Observations</td>
<td>41,058</td>
<td>10,145</td>
<td>30,913</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.391</td>
<td>0.420</td>
<td>0.381</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Provincial footprint of other FSP</th>
<th>Any</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy for the financial access to the BAAC in 1986</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Dummy for the financial access to commercial banks in 1986</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Province FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes: Sample includes all Thai villages in 1996. The dependent variable is the change in access to BAAC (Panel A) commercial banks (Panel B) over 1986-1996. Access to a given FSP is dummy variable indicating whether a given village was serviced by the FSP in a particular year. “Provincial footprint of other FSP in 1986 (columns 2 and 3)/1996(columns 4 and 5)” is percentage of villages in a given province with access to (commercial banks in Panel A, the BAAC in Panel B) in 1996. Sample in columns (2) and (4)/columns (3) and (5) is restricted to observations on villages from provinces where “Provincial footprint of other FSP” is “High”/“Low”: above/below the 75th percentile. “ln(distance (minutes) to market place in 1986” is the log of travel time (in minutes) from a village to the nearest provincial center (market place). "ln(population in 1986)" is the log of village’s population in 1986. "Per capita wealth” in a given year is calculated as the first principal component calculated on the basis of assets that a village’s residents own, as described in the data Appendix. “Per capita wealth in 1986 (with 1988 imputation)” is calculated as Per capita wealth in 1986 with 1988 Per capita wealth data imputed whenever 1986 data on wealth were not available. All specifications control for the financial access to both BAAC and commercial banks in 1986. Province fixed effects are included but not reported. Regression equation is estimated by OLS. Standard errors are in parentheses (clustered at the province level). *, **, And * indicate significance at 10%, 5%; and 1% respectively.
Table 3: Financial access provision by a FSP and the province footprint of another FSP

<table>
<thead>
<tr>
<th>(1) Access to the BAAC</th>
<th>(2) Access to Commercial banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(distance (minutes) to market place)</td>
<td>-0.00229***</td>
</tr>
<tr>
<td>(0.000863)</td>
<td>(0.00194)</td>
</tr>
<tr>
<td>Per capita wealth</td>
<td>0.00995***</td>
</tr>
<tr>
<td>(0.00180)</td>
<td>(0.00363)</td>
</tr>
<tr>
<td>ln(population)</td>
<td>0.0180***</td>
</tr>
<tr>
<td>(0.00257)</td>
<td>(0.0122)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place) X</td>
<td>0.0174***</td>
</tr>
<tr>
<td>Footprint of COMM</td>
<td>(0.00469)</td>
</tr>
<tr>
<td>Per capita wealth X Footprint of COMM</td>
<td>-0.0526***</td>
</tr>
<tr>
<td>(0.00764)</td>
<td>(0.00818)</td>
</tr>
<tr>
<td>ln(population) X Footprint of COMM</td>
<td>-0.0526***</td>
</tr>
<tr>
<td>(0.00631)</td>
<td>(0.00676)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place) X</td>
<td>0.00342</td>
</tr>
<tr>
<td>Footprint of BAAC</td>
<td>(0.0118)</td>
</tr>
<tr>
<td>Per capita wealth X Footprint of BAAC</td>
<td>-0.225***</td>
</tr>
<tr>
<td>(0.0233)</td>
<td>(0.0262)</td>
</tr>
<tr>
<td>ln(population) X Footprint of BAAC</td>
<td>-0.120***</td>
</tr>
<tr>
<td>(0.0142)</td>
<td>(0.0147)</td>
</tr>
</tbody>
</table>

Observations | 207,843 | 207,843 | 207,843 | 207,124 | 207,124 | 207,124 |
R-squared | 0.302 | 0.303 | 0.305 | 0.257 | 0.257 | 0.257 |

Notes: Sample includes all Thai villages in 1986-1996. The dependent variable is the change in access to BAAC (Panel A) commercial banks (Panel B) over consecutive two-year periods in 1986-1996. Access to a given FSP is dummy variable indicating whether a given village was serviced by the FSP in a particular year. “Provincial footprint of a given FSP” is percentage of villages in a given province with access to a given FSP. “ln(distance (minutes) to market place)” is the log of travel time (in minutes) from a village to the nearest provincial center (market place). “ln(population)” is the log of village’s population. “Per capita wealth” in a given year is calculated as the first principal component calculated on the basis of assets that a village’s residents own, as described in the data Appendix. In 1986 year per capita wealth data imputed whenever 1986 data on wealth were not available. All specifications control for the financial access to both BAAC and commercial banks in the current period. Province fixed effects are included but not reported. Regression equation is estimated by OLS. Standard errors are in parentheses (clustered at the province level). *, **, And * indicate significance at 10%, 5%; and 1% respectively.
Table 4: Example - Expected contemporaneous revenues ($\Upsilon_B = \Upsilon_C = 1$, $\tau_B = 0.001$ and $\tau_C = 0.01$)

<table>
<thead>
<tr>
<th>Villages</th>
<th>BAAC</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>1st closest</td>
<td>2nd closest</td>
<td>3rd closest</td>
<td>Total</td>
<td>1st closest</td>
<td>2nd closest</td>
<td>3rd closest</td>
</tr>
<tr>
<td>Top, Left</td>
<td>18625</td>
<td>10728</td>
<td>3469</td>
<td>4428</td>
<td>15899</td>
<td>9182</td>
<td>2984</td>
<td>3733</td>
</tr>
<tr>
<td>Top, Right</td>
<td>5595</td>
<td>0</td>
<td>3343</td>
<td>2252</td>
<td>4935</td>
<td>0</td>
<td>2791</td>
<td>2144</td>
</tr>
<tr>
<td>Central, Left</td>
<td>17070</td>
<td>6834</td>
<td>2301</td>
<td>7935</td>
<td>15357</td>
<td>6373</td>
<td>1913</td>
<td>7071</td>
</tr>
<tr>
<td>Central, Right</td>
<td>18235</td>
<td>12424</td>
<td>3969</td>
<td>1842</td>
<td>16265</td>
<td>11190</td>
<td>3632</td>
<td>1443</td>
</tr>
<tr>
<td>Bottom, Left</td>
<td>8158</td>
<td>6240</td>
<td>1918</td>
<td>0</td>
<td>6838</td>
<td>5197</td>
<td>1641</td>
<td>0</td>
</tr>
<tr>
<td>Bottom, Right</td>
<td>15902</td>
<td>7146</td>
<td>6313</td>
<td>2443</td>
<td>13502</td>
<td>6454</td>
<td>4806</td>
<td>2242</td>
</tr>
</tbody>
</table>

Notes: Table shows the expected revenues for each branch location in examples depicted in Figures 1-4. Six possible branch locations are named on the basis of their positions in these Figures. Potential expected revenues in each location are calculated under the assumption of no prior or future other branches, with an adjustment made for the respective financial outreach differences for the BAAC and commercial bank. Since no prior branches are assumed, the BAAC’s revenues are not affected by $\lambda$. Respective columns decompose the total expected revenue into components coming from the villages for which that location is the first, second or third closest one.
Table 5: Bootstrap estimation of $\lambda$, $\Upsilon_k$ and $\tau_k$
Selected Provinces

<table>
<thead>
<tr>
<th>parameters</th>
<th>Baseline model (1)</th>
<th>Homogeneous outreach tech (2)</th>
<th>$\lambda = 0$ (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAAC weight on commercial bank payoff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\lambda$</td>
<td>1.01*** (0.52,1.38)</td>
<td>0.61*** (0.05,1.05)</td>
<td>0</td>
</tr>
<tr>
<td>BAAC financial outreach technology parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Upsilon_B$</td>
<td>0.961*** (0.952, 0.973)</td>
<td>0.801*** (0.788, 0.811)</td>
<td>0.961*** (0.952, 0.973)</td>
</tr>
<tr>
<td>$\tau_B$</td>
<td>-0.000022 (-0.0003,0.0004)</td>
<td>0.0021*** (0.0016, 0.0251)</td>
<td>-0.000022 (-0.0003,0.0004)</td>
</tr>
<tr>
<td>Commercial bank outreach technology parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Upsilon_C$</td>
<td>0.615*** (0.589, 0.636)</td>
<td>0.801*** (0.788, 0.811)</td>
<td>0.615*** (0.589, 0.636)</td>
</tr>
<tr>
<td>$\tau_C$</td>
<td>0.0035 (-0.0003,0.0004)</td>
<td>0.0021*** (0.0016, 0.0251)</td>
<td>0.0035 (-0.0003,0.0004)</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-7216.73</td>
<td>-8016.91</td>
<td>-8158.74</td>
</tr>
</tbody>
</table>

Model comparisons: likelihood-ratio test against the complete model

<table>
<thead>
<tr>
<th>Test statistic (D)</th>
<th>-1600.36***</th>
<th>1885.45***</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. bootstrap samples</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>N. of provinces</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>N. of villages</td>
<td>3036</td>
<td>3036</td>
</tr>
</tbody>
</table>

Notes: Table shows estimates of the financial outreach technologies parameters for the two FSPs ($\Upsilon_k$, $\tau_k$) and the BAAC’s weight on payoff of the commercial bank ($\lambda$). The Sample used for estimation is restricted to 10 provinces, as described in the main text. Bootstrap estimation with 100 repetition was used. For each bootstrap sample, the financial outreach parameters $\Upsilon_k$ and $\tau_k$ are estimated by non-linear least squares from the equation $r_{i,j}^k = \Upsilon_k \exp(-\tau_k D_{ij})$, using the 1996 data. Then $\lambda$ is estimated by MLE, using those NLLS estimates. Likelihood-ratio tests consider the complete model as the alternative model, taking the versions with homogeneous outreach technology and $\lambda = 0$ as null models. ***, **, And * indicate statistical significance at 1%, 5%, and 10%, respectively.
Table 6: Model prediction: Financial access provision by a FSP and the province footprint of another FSP

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>-0.0077***</td>
<td>-0.0230***</td>
<td>0.0000</td>
<td>0.0160***</td>
<td>0.0054</td>
</tr>
<tr>
<td>(0.0023)</td>
<td>(0.0056)</td>
<td>(0.0022)</td>
<td>(0.0024)</td>
<td>(0.0046)</td>
<td>(0.0028)</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>-0.0187***</td>
<td>-0.0489***</td>
<td>0.0022</td>
<td>0.0533***</td>
<td>0.0820***</td>
</tr>
<tr>
<td>(0.0058)</td>
<td>(0.0113)</td>
<td>(0.0060)</td>
<td>(0.0047)</td>
<td>(0.0093)</td>
<td>(0.0052)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>0.0024</td>
<td>-0.0048</td>
<td>0.0050***</td>
<td>-0.0128***</td>
<td>-0.0081*</td>
</tr>
<tr>
<td>(0.0019)</td>
<td>(0.0047)</td>
<td>(0.0019)</td>
<td>(0.0022)</td>
<td>(0.0043)</td>
<td>(0.0024)</td>
</tr>
<tr>
<td>Observations</td>
<td>16,283</td>
<td>5,333</td>
<td>10,950</td>
<td>16,283</td>
<td>5,572</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.814</td>
<td>0.683</td>
<td>0.883</td>
<td>0.876</td>
<td>0.848</td>
</tr>
</tbody>
</table>

- Provincial footprint of other FSP in 1986: Any, High, Low
- Dummy for the financial access to the BAAC in 1986: Yes, Yes
- Dummy for the financial access to commercial banks in 1986: Yes, Yes
- Province FE: Yes, Yes

Notes: Sample includes all Thai villages in 1996. The dependent variable is the predicted change in access to BAAC (columns 1, 2) commercial banks (columns 3, 4) over 1986-1996. Access to a given FSP in 1996 is the model’s prediction indicating whether a given village would be serviced by the FSP. Access to FSP in 1986 is taken from actual data. “Provincial footprint of other FSP in 1986” is percentage of villages in a given province with access to (commercial banks in Panel A, the BAAC in Panel B) in 1986. Sample in columns (2) and (5)/columns (3) and (6) is restricted to observations on villages from provinces where “Provincial footprint of other FSP in 1986” is “High”/“Low”: above/below the 75th percentile. “ln(distance (minutes) to market place in 1986)” is the log of travel time (in minutes) from a village to the nearest provincial center (market place). “ln(population in 1986)” is the log of village’s population in 1986. “Per capita wealth” in a given year is calculated as the first principal component calculated on the basis of assets that a village’s residents own, as described in the data Appendix. “Per capita wealth in 1986 (with 1988 imputation)” is calculated as Per capita wealth in 1986 with 1988 Per capita wealth data imputed whenever 1986 data on wealth were not available. All specifications control for the financial access to both BAAC and commercial banks in 1986. Province fixed effects are included but not reported. Regression equation is estimated by OLS. Standard errors are in parentheses (clustered at the province level). *, **, and * indicate significance at 10%, 5%; and 1% respectively.
### Table 7: Counter-factual simulations: Pure competition, Collusion, Extreme anti-preemption

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Pure competition</th>
<th>Collusion</th>
<th>Extreme Anti-preemption</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>0.0019</td>
<td>-0.0032**</td>
<td>-0.0058***</td>
</tr>
<tr>
<td></td>
<td>(0.0014)</td>
<td>(0.0015)</td>
<td>(0.0015)</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.0100***</td>
<td>-0.0015</td>
<td>0.0070**</td>
</tr>
<tr>
<td></td>
<td>(0.0030)</td>
<td>(0.0032)</td>
<td>(0.0029)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0039***</td>
<td>-0.0015</td>
<td>0.0014</td>
</tr>
<tr>
<td></td>
<td>(0.0013)</td>
<td>(0.0013)</td>
<td>(0.0014)</td>
</tr>
<tr>
<td>Observations</td>
<td>16,283</td>
<td>16,283</td>
<td>16,283</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.0552</td>
<td>0.0571</td>
<td>0.0781</td>
</tr>
</tbody>
</table>

**Weight on competitor’s payoff λ**

<table>
<thead>
<tr>
<th>Technology parameters</th>
<th>(\lambda_{BAAC} = \lambda_{COMM} = 0)</th>
<th>(\lambda_{BAAC} = \lambda_{COMM} = 1)</th>
<th>(\lambda_{BAAC} = 100, \lambda_{COMM} = 0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same as in the baseline:</td>
<td>(\tau_B = -2.22 \cdot 10^{-5}, \tau_C = 0.00351, \Upsilon_B = 0.961, \Upsilon_C = 0.615)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Province-level fixed effects: Yes, Yes, Yes, Yes, Yes, Yes

Dummies for 1986 financial access to both FSPs: Yes, Yes, Yes, Yes, Yes, Yes

Note: The dependent variable is the difference in the probability of financial access between the counter-factual and the baseline models for all Thai provinces. Counterfactual parameters are indicated in the body of the Table. “ln(distance (minutes) to market place in 1986)” is the log of travel time (in minutes) from a village to the nearest provincial center (market place). “ln(population in 1986)” is the log of village’s population in 1986. “Per capita wealth” in a given year is calculated as the first principal component calculated on the basis of assets that a village’s residents own, as described in the data Appendix. “Per capita wealth in 1986 (with 1988 imputation)” is calculated as Per capita wealth in 1986 with 1988 Per capita wealth data imputed whenever 1986 data on wealth were not available. All specifications control for the financial access to both BAAC and commercial banks in 1986. Robust standard errors in parentheses. ***, **, And * indicate statistical significance at 1%, 5%, and 10%, respectively.
Table 8: Evaluating performance of the BAAC: Counter-factual simulation for total financial access

<table>
<thead>
<tr>
<th>Parameter</th>
<th>(1) Per capita wealth 1986 (with 1988 imputation)</th>
<th>(2) ln(population in 1986)</th>
<th>(3) ln(distance (minutes) to market place in 1986)</th>
<th>Observations</th>
<th>R-squared</th>
<th>province-level fixed effects</th>
<th>Dummies for 1986 access to FSP’s</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>∆ total access BAAC</td>
<td>-0.0009</td>
<td>0.0016***</td>
<td>-0.0010***</td>
<td>18,222</td>
<td>0.1156</td>
<td>Yes</td>
<td>Yes</td>
<td>( \lambda_B = \lambda_C = 1 )</td>
</tr>
<tr>
<td></td>
<td>(0.0009)</td>
<td>(0.0010)</td>
<td>(0.0004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>( \tau_B = \tau_C = -2.22 \cdot 10^{-5} )</td>
</tr>
<tr>
<td>ln(population in 1986)</td>
<td>0.005</td>
<td>0.0016***</td>
<td>-0.0023***</td>
<td>18,222</td>
<td>0.4474</td>
<td></td>
<td></td>
<td>( \Upsilon_B = \Upsilon_C = 0.961 )</td>
</tr>
<tr>
<td></td>
<td>(0.0004)</td>
<td>(0.0004)</td>
<td>(0.0004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>( \Upsilon_B = \Upsilon_C = 0.615 )</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0010***</td>
<td>-0.0023***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>( \lambda_B = \lambda_C = 0 )</td>
</tr>
<tr>
<td></td>
<td>(0.0003)</td>
<td>(0.0004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>( \Upsilon_B = \Upsilon_C = 0.961 )</td>
</tr>
</tbody>
</table>

Note: Dependent variable is the difference in the probability of financial access between the counter-factual and the baseline models for all Thai provinces. Counterfactual parameters are indicated at the bottom of the Table. “ln(distance (minutes) to market place in 1986)” is the log of travel time (in minutes) from a village to the nearest provincial center (market place). “ln(population in 1986)” is the log of village’s population in 1986. “Per capita wealth” in a given year is calculated as the first principal component calculated on the basis of assets that a village’s residents own, as described in the data Appendix. “Per capita wealth in 1986 (with 1988 imputation)” is calculated as Per capita wealth in 1986 with 1988 Per capita wealth data imputed whenever 1986 data on wealth were not available. All specifications control for the financial access to both BAAC and commercial banks in 1986. Robust standard errors are reported in parentheses. ***., **., * indicate statistical significance at 1%, 5%, and 10%, respectively.
9 Online Appendix: Not for publication.

A Figures

Please use color printing to analyze the following graphs.

Figure 1: Example economies (i) - BAAC x Commercial Bank (Static Case)
\[ \beta = 0.01, \tau_1 = 0.001, \tau_2 = 0.01, \lambda = 1 \]

Notes: This figure depicts the solution of the model for the parameter configuration above. Village locations, road network, payoffs (proxied by wealth) and branch locations are taken from the actual data. The dynamic game is solved under the assumption that the BAAC and the commercial bank move sequentially, with the BAAC being the first mover. Villages are assigned different colors depending on the FSP being their preferred/closest provider. Empty circles are possible branch locations with no bank branches opened. The stars represent the BAAC branches and the triangles refer to commercial bank branches. Sizes of villages are proportional to potential revenues.
Figure 2: Example economies (ii) - BAAC x Commercial Bank

\[ \beta = 0.9, \tau_1 = 0.001, \tau_2 = 0.01, \lambda = 1 \]

Notes: This figure depicts the solution of the model for the parameter configuration above. Village locations, road network, payoffs (proxied by wealth) and branch locations are taken from the actual data. The dynamic game is solved under the assumption that the BAAC and the commercial bank move sequentially, with the BAAC being the first mover. Villages are assigned different colors depending on the FSP being their preferred/closest provider. Empty circles are possible branch locations with no bank branches opened. The stars represent the BAAC branches and the triangles refer to commercial bank branches. Sizes of villages are proportional to potential revenues.
Figure 3: Example economies (iii) - BAAC x Commercial Bank

$\beta = 0.9, \tau_1 = 0.001, \tau_2 = 0.01, \lambda = 0$

Notes: This figure depicts the solution of the model for the parameter configuration above. Village locations, road network, payoffs (proxied by wealth) and branch locations are taken from the actual data. The dynamic game is solved under the assumption that the BAAC and the commercial bank move sequentially, with the BAAC being the first mover. Villages are assigned different colors depending on the FSP being their preferred/closest provider. Empty circles are possible branch locations with no bank branches opened. The stars represent the BAAC branches and the triangles refer to commercial bank branches. Sizes of villages are proportional to potential revenues.
Figure 4: Example economies (iv) - Only BAAC
\[ \beta = 0.9, \tau_1 = 0.001, \lambda = 1 \]

Notes: This figure depicts the solution of the model for the parameter configuration above. Village locations, road network, payoffs (proxied by wealth) and branch locations are taken from the actual data. The dynamic game is solved under the assumption that the BAAC and the commercial bank move sequentially, with the BAAC being the first mover. Villages are assigned different colors depending on the FSP being their preferred/closest provider. Empty circles are possible branch locations with no bank branches opened. The stars represent the BAAC branches and the triangles refer to commercial bank branches. Sizes of villages are proportional to potential revenues.
Figure 5: Distribution of the estimated $\lambda$ across bootstrap samples

(i) Population as proxy for revenues

Notes: The figure depicts the histogram of the ML estimates of $\lambda$ across 100 bootstrap samples.
Figure 6: Counter-factual simulations for total financial access

Notes: Each line represents the average in the estimated probability of financial access at the village level for the baseline case and the counterfactuals as indicated.
### B Additional robustness checks for “anti-preemption”

Table A1: Financial access provision by a FSP and the province footprint of another FSP: Subsample with no financial access in 1986

<table>
<thead>
<tr>
<th>Panel A: Change in access to the BAAC over 1986-1996</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0034</td>
<td>0.0219</td>
<td>-0.0095</td>
<td>0.0297**</td>
<td>-0.0110*</td>
</tr>
<tr>
<td></td>
<td>(0.0056)</td>
<td>(0.0142)</td>
<td>(0.0060)</td>
<td>(0.0122)</td>
<td>(0.0062)</td>
</tr>
<tr>
<td>ln(population in 1986)</td>
<td>0.0211***</td>
<td>0.0075</td>
<td>0.0242***</td>
<td>0.0050</td>
<td>0.0247***</td>
</tr>
<tr>
<td></td>
<td>(0.0063)</td>
<td>(0.0171)</td>
<td>(0.0067)</td>
<td>(0.0151)</td>
<td>(0.0069)</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.0204</td>
<td>0.0107</td>
<td>0.0230</td>
<td>-0.0215</td>
<td>0.0338*</td>
</tr>
<tr>
<td></td>
<td>(0.0167)</td>
<td>(0.0367)</td>
<td>(0.0188)</td>
<td>(0.0329)</td>
<td>(0.0194)</td>
</tr>
<tr>
<td>Observations</td>
<td>8,010</td>
<td>1,372</td>
<td>6,638</td>
<td>1,575</td>
<td>6,435</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.152</td>
<td>0.115</td>
<td>0.162</td>
<td>0.086</td>
<td>0.171</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Change in access to commercial banks over 1986-1996</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>0.0980***</td>
<td>0.1030***</td>
<td>0.0962***</td>
<td>0.1023***</td>
<td>0.0969***</td>
</tr>
<tr>
<td></td>
<td>(0.0045)</td>
<td>(0.0096)</td>
<td>(0.0051)</td>
<td>(0.0098)</td>
<td>(0.0050)</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.1586***</td>
<td>0.1249***</td>
<td>0.1672***</td>
<td>0.1281***</td>
<td>0.1648***</td>
</tr>
<tr>
<td></td>
<td>(0.0105)</td>
<td>(0.0243)</td>
<td>(0.0116)</td>
<td>(0.0279)</td>
<td>(0.0113)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0387***</td>
<td>-0.0416***</td>
<td>-0.0378***</td>
<td>-0.0498***</td>
<td>-0.0358***</td>
</tr>
<tr>
<td></td>
<td>(0.0038)</td>
<td>(0.0086)</td>
<td>(0.0042)</td>
<td>(0.0087)</td>
<td>(0.0042)</td>
</tr>
<tr>
<td>Observations</td>
<td>29,896</td>
<td>6,427</td>
<td>23,469</td>
<td>6,226</td>
<td>23,070</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.101</td>
<td>0.120</td>
<td>0.093</td>
<td>0.088</td>
<td>0.104</td>
</tr>
</tbody>
</table>

Provincial footprint of other FSP
- Any
- High
- Low

Year of footprint measurement
- NA
- 1986
- 1996

Dummy for the financial access to the BAAC in 1986
- Yes
- No

Dummy for the financial access to commercial banks in 1986
- Yes
- No

Province FE
- Yes
- No

Notes: Sample includes all Thai villages in 1996. The dependent variable is the change in access to BAAC (Panel A) commercial banks (Panel B) over 1986-1996. Access to a given FSP is dummy variable indicating whether a given village was serviced by the FSP in a particular year. “Provincial footprint of other FSP in 1986 (columns 2 and 3)/1996(columns 4 and 5)” is percentage of villages in a given province with access to (commercial banks in Panel A, the BAAC in Panel B) in 1996. Sample in columns (2) and (4)/columns (3) and (5) is restricted to observations on villages from provinces where “Provincial footprint of other FSP is “High”/“Low”: above/below the 75th percentile. “ln(distance (minutes) to market place in 1986)” is the log of travel time (in minutes) from a village to the nearest provincial center (market place). ”ln(population in 1986)” is the log of village’s population in 1986. ”Per capita wealth” in a given year is calculated as the first principal component calculated on the basis of assets that a village’s residents own, as described in the data Appendix. “Per capita wealth in 1986 (with 1988 imputation)” is calculated as Per capita wealth in 1986 with 1988 Per capita wealth data imputed whenever 1986 data on wealth were not available. All specifications control for the financial access to both BAAC and commercial banks in 1986. Province fixed effects are included but not reported. Regression equation is estimated by OLS. Standard errors are in parentheses (clustered at the province level). *, **, and * indicate significance at 10%, 5%; and 1% respectively.
Table A2: Financial access provision by a FSP and the amphoe-level footprint of another FSP:

<table>
<thead>
<tr>
<th>Panel A: Change in access to the BAAC over 1986-1996</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>0.0052***</td>
<td>0.0013</td>
<td>0.0069***</td>
<td>0.0012</td>
<td>0.0073***</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.0065</td>
<td>-0.0022</td>
<td>0.0092</td>
<td>-0.0104</td>
<td>0.0123*</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0015</td>
<td>0.0017</td>
<td>-0.0020</td>
<td>0.0096***</td>
<td>-0.0044**</td>
</tr>
<tr>
<td>Observations</td>
<td>41.297</td>
<td>10.506</td>
<td>30.791</td>
<td>10.300</td>
<td>30.797</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.738</td>
<td>0.709</td>
<td>0.732</td>
<td>0.756</td>
<td>0.736</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Panel B: Change in access to commercial banks over 1986-1996</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>0.0964***</td>
<td>0.0848***</td>
<td>0.0992***</td>
<td>0.0889***</td>
<td>0.0987***</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.1492***</td>
<td>0.1270***</td>
<td>0.1535***</td>
<td>0.1171***</td>
<td>0.1641***</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0341***</td>
<td>-0.0282***</td>
<td>-0.0360***</td>
<td>-0.0362***</td>
<td>-0.0337***</td>
</tr>
<tr>
<td>Observations</td>
<td>41.058</td>
<td>10.311</td>
<td>30.747</td>
<td>10.327</td>
<td>30.731</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.391</td>
<td>0.426</td>
<td>0.385</td>
<td>0.417</td>
<td>0.390</td>
</tr>
</tbody>
</table>

| Amphoe-level footprint of other FSP | Any | High | Low | High | Low |
| Year of footprint measurement      | NA  | 1986 | 1986 | 1996 | 1996 |
| Dummy for the financial access to the BAAC in 1986           | Yes | Yes | Yes | Yes | Yes |
| Dummy for the financial access to commercial banks in 1986   | Yes | Yes | Yes | Yes | Yes |
| Province FE                                                   | Yes | Yes | Yes | Yes | Yes |

Notes: Sample includes all Thai villages in 1996. The dependent variable is the change in access to BAAC (Panel A) commercial banks (Panel B) over 1986-1996. Access to a given FSP is dummy variable indicating whether a given village was serviced by the FSP in a particular year. "Amphoe-level footprint of other FSP in 1986 (columns 2 and 3)/1996(columns 4 and 5)” is percentage of villages in a given amphoe with access to (commercial banks in Panel A, the BAAC in Panel B) in 1996. Sample in columns (2) and (4)/columns (3) and (5) is restricted to observations on villages from provinces where "Amphoe-level footprint of other FSP” is “High”/“Low”: above/below the 75th percentile. "ln(distance (minutes) to market place in 1986)” is the log of travel time (in minutes) from a village to the nearest provincial center (market place). "ln(population in 1986)” is the log of village’s population in 1986. "Per capita wealth” in a given year is calculated as the first principal component calculated on the basis of assets that a village’s residents own, as described in the data Appendix. “Per capita wealth in 1986 (with 1988 imputation)” is calculated as Per capita wealth in 1986 with 1988 Per capita wealth data imputed whenever 1986 data on wealth were not available. All specifications control for the financial access to both BAAC and commercial banks in 1986. Province fixed effects are included but not reported. Regression equation is estimated by OLS. Standard errors are in parentheses (clustered at the province level). *, **, And * indicate significance at 10%, 5%; and 1% respectively.
C Data description

We combine three different datasets.

First, the village data is extracted from the Thai Community Development Department (CDD) survey, conducted biannually from 1986 to 1996. Despite the CDD data focus on villages rather than urban centers, there is a significant correlation between population in urban centers and population in surrounding villages. Table A5 depicts summary statistics for the complete sample and for the 10 selected provinces used in the estimation exercise. There are binary variables indicating financial access to financial providers (the BAAC and commercial banks). These variables equal to 1 when the village has at least one loan contract with the respective provider in the survey year as per the headman/headwoman report. We also have information on population, distance to marketplace and a wealth index built as the first factor of a principal component analysis comprising the number of motorcycles, pick-up trucks and flush toilets per 1000 villagers.

Second, the information on bank branch location comes the Bank of Thailand, the Bank of Agricultural and Agricultural Cooperative, Telephone Authority of Thailand, Community Development Center and several non-traditional financial institutes. Combining these data, we get, for each bank branch, the date of opening, closing date (if ever closed), bank name and branch name. We geo-located the branches with the support of the Google Map API. For those branches matched at village level, we assign the village location as the branch location. Branches which can only be matched to tambon or municipal districts were assigned to the nearest road network intersections. In places where there are more than one intersection in the tambon or municipal district, we assign the earliest branches to the intersections with the largest number of segments and then follow the ranking for the next branches in the same tambon/municipal district. During the branch location assignment, we ensure that branches opened by the same bank are at least 500 meters apart from each other.

Third, we get the information on the road network from the Thailand Environment Institute. The data provides spatial geometries of national wide roads and intersections. In total, 59238 junctures are connected by 7 road types. We estimate the average vehicle speed for each type of road based on real time information. The type and length of road segment connecting any two
junctures are obtained through a GIS platform. The car travel time between any two junctures is computed as the length of the connecting road segment divided by the average speed.

The average speed considered in each one of the road types is considered as follows:

<table>
<thead>
<tr>
<th>Road type</th>
<th>Average speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 All weather: hard surface, two or more lanes wide</td>
<td>45</td>
</tr>
<tr>
<td>2 All weather: loose or light surface, two or more lanes wide</td>
<td>38</td>
</tr>
<tr>
<td>3 All weather: hard surface, one lane wide</td>
<td>38</td>
</tr>
<tr>
<td>4 All weather: loose or light surface, one lane wide</td>
<td>30</td>
</tr>
<tr>
<td>5 Fair or dry weather: loose surface</td>
<td>25</td>
</tr>
<tr>
<td>6 Cart track</td>
<td>20</td>
</tr>
<tr>
<td>7 Footpath, trail</td>
<td>15</td>
</tr>
</tbody>
</table>

Branch locations, villages and the road network are depicted in Figures 9-13. There is a wide variety of spatial configurations.

C.1 Flexible functional form for financial outreach technology.

In the main text we considered a particular functional form for the financial outreach technology and conducted estimation on the sample of 10 provinces. We selected those provinces on the basis of number of new office branch opening being less than 6, which is required for analytical tractability of our two-step estimation procedure. However, one can estimate financial outreach technology using data on financial access from all provinces. This is what we do in the current section. We also investigate whether the functional form with exponential distance discounting represented in equation (6) is too restrictive.

Table A3 and Figure 7 present parametric and non-parametric estimation of equation (6). Figure 7 shows that equation (6) is a good approximation for the relationship between financial access and the distance to the branches.
Table A3: Estimation of the outreach technology function (all provinces) 
\[ Υ_k \exp(-τ_k D_{ij}) \]

<table>
<thead>
<tr>
<th>Access to</th>
<th>Heterogeneous outreach technologies</th>
<th>Homogeneous outreach technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to BAAC (B)</td>
<td>Access to commercial bank (C)</td>
<td>Access to BAAC or commercial bank</td>
</tr>
<tr>
<td>Υ_k</td>
<td>0.940*** (0.0021)</td>
<td>0.534*** (0.0060)</td>
</tr>
<tr>
<td>τ_k</td>
<td>-0.00073*** (0.000081)</td>
<td>0.00665*** (0.00043)</td>
</tr>
<tr>
<td>Observations</td>
<td>35686</td>
<td>34365</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.96</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The equation \( r_{i,j}^k = Υ_k \exp(-τ_k D_{ij}) \) is estimated through non-linear least squares, considering the 1996 data.

Table A4: Estimation of the outreach technology function depending on intensity of service of other provider: \( Υ_k \exp(-τ_k D_{ij}) \)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Υ_k</td>
<td>0.934*** (0.0093)</td>
<td>0.949*** (0.00689)</td>
<td>0.949*** (0.00688)</td>
<td>0.486*** (0.0279)</td>
<td>0.561*** (0.0188)</td>
<td>0.561*** (0.0188)</td>
</tr>
<tr>
<td>τ_k</td>
<td>-0.000742** (0.000318)</td>
<td>-0.000720*** (0.000196)</td>
<td>-0.000720*** (0.000196)</td>
<td>0.00674*** (0.000011)</td>
<td>0.00710*** (0.000105)</td>
<td>0.00710*** (0.000105)</td>
</tr>
<tr>
<td>Υ' k</td>
<td>-0.0150</td>
<td>-0.0749** (0.0121)</td>
<td>-2.17e-05 (0.0336)</td>
<td>-0.00359</td>
<td>-0.00359 (0.00235)</td>
<td></td>
</tr>
<tr>
<td>Presence of other FSP</td>
<td>Low</td>
<td>High</td>
<td>Any</td>
<td>Low</td>
<td>High</td>
<td>Any</td>
</tr>
<tr>
<td>Observations</td>
<td>18.649</td>
<td>17.037</td>
<td>35.686</td>
<td>10.057</td>
<td>24.308</td>
<td>34.365</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.950</td>
<td>0.965</td>
<td>0.958</td>
<td>0.421</td>
<td>0.474</td>
<td>0.460</td>
</tr>
</tbody>
</table>

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Specifications (1), (2), (4),(5) contain estimation for the equation \( r_{i,j}^k = Υ_k \exp(-τ_k D_{ij}) \), which is estimated through non-linear least squares, considering the 1996 data. "Low"("High") presence of other FSP indicate subsamples of villages in amphoes below(above) the mean level of presence of the other provider, where amphoe-level presence of an FSP provider is calculated as the mean number of villages in the amphoe with access to services of that provider. Specifications (3) and (6) show estimates of the equation \( r_{i,j}^k = (Υ_k + Υ'_ k * 1(Low other presence)) \exp(-τ_k + τ'_ k 1(Low other presence)) D_{ij} \) for the whole sample of villages, considering 1996 data, where 1(Low other presence) is a dummy variable which for a given FSP indicates that presence of another FSP in the area(amphoe) is below the mean presence.
Notes: The figure plots the non-parametric and the parametric estimations of the outreach equation. The parametric version considers the model specification $r_{i,j}^k = \Upsilon_k \exp(-\tau_k D_{ij})$, as presented in Table A3. The non-parametric estimation is based on the Nadaraya-Watson regression with Epanechnikov kernel and bandwidth 15.
The outreach technology of the BAAC and commercial banks differs in two ways. First, the baseline probability of being served by the BAAC is higher - 94% instead of 53%. Second, while the probability of getting services of commercial banks decreases in the distance from the commercial bank branch, it is pretty flat for the BAAC, if anything it increases slightly with distance. It seems that conditionally on being present in the area the BAAC perceives travel time/distance as less of a hurdle in providing its services to customers in remote locations. Thus, outreach is an important dimension through which the behavior of the BAAC and commercial banks might differ, with implications for the spatial distribution of financial access.

In the last column of Table A3 we also estimate the outreach technology under the assumption of homogeneity across financial providers. In this case, we pooled all of the observations and estimate equation (6) assuming all the information on access is associated with a single bank. In this case, the estimated technology is closer to that of a commercial bank.

When we compare the estimates presented in Table A3 to the ones presented in Table 5 obtained using bootstrap for the 10 selected provinces, then for the most part estimated parameters \( \tau \)'s and \( \Upsilon \)'s are quite close across specifications qualitatively and quantitatively.

One could also be concerned that financial outreach parameters might be not constant and depend on the presence of a competing FSP in the area. For example, there could be a “selection” issue, with BAAC serving the primarily agricultural areas where it could be hypothesized it might have a competitive advantage and losing ground to commercial banks in more lucrative markets where it has to compete head-to-head with them. This could then potentially bias our structural parameter estimates (\( \Upsilon \) and \( \tau \)) and antipreemption patterns, which we find and explain with our model, might be affected by such selection.\(^\text{62}\)

As we mentioned in at the beginning of Section 3 the BAAC and commercial banks are likely to be competing for the same customers. While BAAC indeed started as agricultural bank with lending mission to farmers and farmer cooperative, over time its mission has changed to be a rural bank competing not only in the loan market but also for deposits with commercial banks. Still, to alleviate such "non-common support" concerns we reestimate financial outreach technology separately for villages in amphoes with high vs low presence of the other service provider. To

\(^{62}\)We would like to thank an anonymous referee to raising this issue.
measure the presence of an FSP in an amphoe we calculate the average number of villages in an amphoe with reported services from a given FSP\textsuperscript{63} and for each financial services provider divide our village-level sample into two depending on whether villages are located in amphoes with below or above the mean amphoe-level presence of the other FSP.

Table A4 contains estimation results. We find that, a given FSP outreach technology parameters remain surprisingly stable in terms of economic magnitudes\textsuperscript{64} (particularly for the BAAC) regardless of whether the presence of the other FSP is high or low (above below the mean) in the amphoe. The BAAC seems to be able to extend its financial outreach in the same way in areas which have both high and low presence of the commercial banks. In this regard, we argue that financial outreach technology parameters are unlikely to be affected by the potential selection issues and assuming that those parameters are common for different amphoes is likely to be a sensible approximation.

\textsuperscript{63}We use 1996 year data to measure FSP presence, but the results are similar if we use 1986 data.
\textsuperscript{64}We also performed statistical test of equality coefficients and for the most part coefficients are not statistically distinguishable from each other. Both level and distance discounting ($\Upsilon$ and $\tau$) are similar for the BAAC and only level ($\Upsilon$) might be different in the case of commercial banks.
Table A5: Descriptive Statistics - Village-level Data

<table>
<thead>
<tr>
<th></th>
<th>all provinces</th>
<th>selected provinces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>mean</td>
</tr>
<tr>
<td>ln(population in 1986)</td>
<td>44652</td>
<td>6.21</td>
</tr>
<tr>
<td>per capita wealth in 1986</td>
<td>29235</td>
<td>0.51</td>
</tr>
<tr>
<td>ln(distance to the market place in 1986)</td>
<td>42762</td>
<td>3.28</td>
</tr>
<tr>
<td>BAAC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>financial access - 1986</td>
<td>44515</td>
<td>0.801</td>
</tr>
<tr>
<td>financial access - 1996</td>
<td>44536</td>
<td>0.947</td>
</tr>
<tr>
<td>change in financial access - 1986-96</td>
<td>44393</td>
<td>0.146</td>
</tr>
<tr>
<td>Commercial banks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>financial access - 1986</td>
<td>44175</td>
<td>0.267</td>
</tr>
<tr>
<td>financial access - 1996</td>
<td>44280</td>
<td>0.436</td>
</tr>
<tr>
<td>change in financial access - 1986-96</td>
<td>43802</td>
<td>0.169</td>
</tr>
</tbody>
</table>
Table A6: Financial access provision by a FSP and the province footprint of another FSP

Panel A: Change in access to the BAAC over 1986-1996

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>0.0052***</td>
<td>0.0010</td>
<td>0.0069***</td>
<td>0.0001</td>
<td>0.0067***</td>
</tr>
<tr>
<td></td>
<td>(0.0020)</td>
<td>(0.0040)</td>
<td>(0.0023)</td>
<td>(0.0038)</td>
<td>(0.0024)</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.0065</td>
<td>-0.0038</td>
<td>0.0119**</td>
<td>-0.0161**</td>
<td>0.0175***</td>
</tr>
<tr>
<td></td>
<td>(0.0048)</td>
<td>(0.0089)</td>
<td>(0.0058)</td>
<td>(0.0082)</td>
<td>(0.0059)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0015</td>
<td>0.0079**</td>
<td>-0.0044***</td>
<td>0.0124***</td>
<td>-0.0058***</td>
</tr>
<tr>
<td></td>
<td>(0.0017)</td>
<td>(0.0035)</td>
<td>(0.0019)</td>
<td>(0.0030)</td>
<td>(0.0019)</td>
</tr>
<tr>
<td>Observations</td>
<td>41,297</td>
<td>9,618</td>
<td>31,679</td>
<td>10,375</td>
<td>30,922</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.738</td>
<td>0.697</td>
<td>0.746</td>
<td>0.733</td>
<td>0.739</td>
</tr>
</tbody>
</table>

Panel B: Change in access to commercial banks over 1986-1996

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln(population in 1986)</td>
<td>0.0964***</td>
<td>0.0961***</td>
<td>0.0961***</td>
<td>0.1012***</td>
<td>0.0950***</td>
</tr>
<tr>
<td></td>
<td>(0.0039)</td>
<td>(0.0076)</td>
<td>(0.0045)</td>
<td>(0.0080)</td>
<td>(0.0044)</td>
</tr>
<tr>
<td>Per capita wealth 1986 (with 1988 imputation)</td>
<td>0.1492***</td>
<td>0.1034***</td>
<td>0.1638***</td>
<td>0.1034***</td>
<td>0.1604***</td>
</tr>
<tr>
<td></td>
<td>(0.0087)</td>
<td>(0.0178)</td>
<td>(0.0100)</td>
<td>(0.0203)</td>
<td>(0.0096)</td>
</tr>
<tr>
<td>ln(distance (minutes) to market place in 1986)</td>
<td>-0.0341***</td>
<td>-0.0334***</td>
<td>-0.0341***</td>
<td>-0.0411***</td>
<td>-0.0320***</td>
</tr>
<tr>
<td></td>
<td>(0.0033)</td>
<td>(0.0067)</td>
<td>(0.0037)</td>
<td>(0.0069)</td>
<td>(0.0037)</td>
</tr>
<tr>
<td>Observations</td>
<td>41,058</td>
<td>10,145</td>
<td>30,913</td>
<td>9,467</td>
<td>31,591</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.391</td>
<td>0.420</td>
<td>0.381</td>
<td>0.392</td>
<td>0.391</td>
</tr>
</tbody>
</table>

Provincial footprint of other FSP | Any | High | Low | High | Low |
Year of footprint measurement | NA | 1986 | 1986 | 1996 | 1996 |
Dummy for the financial access to the BAAC in 1986 | Yes | Yes | Yes | Yes | Yes |
Dummy for the financial access to commercial banks in 1986 | Yes | Yes | Yes | Yes | Yes |
Province FE | Yes | Yes | Yes | Yes | Yes |

Notes: Sample includes all Thai villages in 1996. The dependent variable is the change in access to BAAC (Panel A) commercial banks (Panel B) over 1986-1996. Access to a given FSP is dummy variable indicating whether a given village was serviced by the FSP in a particular year. “Provincial footprint of other FSP in 1986 (columns 2 and 3)/1996(columns 4 and 5)” is percentage of villages in a given province with access to (commercial banks in Panel A, the BAAC in Panel B) in 1996. Sample in columns (2) and (4)/columns (3) and (5) is restricted to observations on villages from provinces where “Provincial footprint of other FSP” is “High”/“Low”: above/below the 75th percentile. “ln(distance (minutes) to market place in 1986)” is the log of travel time (in minutes) from a village to the nearest provincial center (market place). ”ln(population in 1986)” is the log of village’s population in 1986. “Per capita wealth” in a given year is calculated as the first principal component calculated on the basis of assets that a village’s residents own, as described in the data Appendix. “Per capita wealth in 1986 (with 1988 imputation)” is calculated as Per capita wealth in 1986 with 1988 Per capita wealth data imputed whenever 1986 data on wealth were not available. All specifications control for the financial access to both BAAC and commercial banks in 1986. Province fixed effects are included but not reported. Regression equation is estimated by OLS. Standard errors are in parentheses (clustered at the province level). *, **, And * indicate significance at 10%, 5%; and 1% respectively.
Figure 8: Selected provinces
Figure 9: Selected provinces - Branch locations in 1986 and 1996
Figure 10: Selected provinces - Branch locations in 1986 and 1996
Figure 11: Selected provinces - Branch locations in 1986 and 1996

Province PHATTHALUNG (35)

Province PHETCHABURI (38)
Figure 12: Selected provinces - Branch locations in 1986 and 1996
Figure 13: Selected provinces - Branch locations in 1986 and 1996