Persistent Impacts of Temporary Demand Shocks: How U.S. Servicemen Shaped Thailand's Sex Industry*

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Abstract

This paper documents how the U.S. military presence in Thailand during the Vietnam War led to the subsequent development of the Thai sex industry. We show that the sex industry is currently concentrated in districts near former U.S. bases and provide causal estimates by comparing the surroundings of Thai military bases *used* by the U.S. army (treated group) to districts close to *unused* Thai bases or airfields (control groups). We exploit the distance to active enemy bases in Vietnam as an exogenous factor determining the use of only some Thai bases by the U.S. Army. Our estimates suggest that there are currently between 5 and 9 times more commercial sex workers in treated districts relative to control districts. Surprisingly, the sex industry has become even more concentrated around these red-light districts over the past decades in spite of the departure of U.S. servicemen in 1975 and poor locational fundamentals. We propose a simple theoretical rationale based on information asymmetry in which the U.S. military presence affected the sex market through reputation building from sellers. We then provide evidence that, in treated districts, sex establishments differentiated their services horizontally and vertically, thereby attracting foreigners otherwise held up by information asymmetry.

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I. Introduction

Thailand is well known across the world as one of the largest suppliers of commercial sexual services, and the whole activity is concentrated in a few red-light districts. Since the 1960s, the Thai sex industry has experienced an unparalleled expansion and recent decades have also witnessed an increase in the concentration of sex establishments in major red-light districts. This increasing concentration is puzzling given the poor locational fundamentals of many red-light districts and the fact that the sex industry is a low-skilled service industry where (i) traditional Marshallian agglomeration economies in production are unlikely, and (ii) there are important travel costs for consumers.

In this paper, the explanation to this puzzle we propose is based on temporary demand shocks for sexual services in conjunction with an amplification mechanism. We show that the development of many red-light districts is an unintended consequence of the U.S. military presence in Thailand during the Vietnam War. In spite of the departure of U.S. servicemen in 1975, the sex industry has become even more concentrated around these red-light districts over the past decades. We show that the temporary local demand shocks for sexual services in districts near U.S. bases led to the concentration of sex establishments, and that clustering forces such as information asymmetry and reputation explain the continuous development of the sex industry in those districts, i.e. its concentration and its transformation toward differentiated, high-quality sexual services. In other words, the U.S. military presence led to a formalization of sex establishments, thereby alleviating potential frictions between consumers and sellers.

We first focus on the clustering of sex establishments in districts that formerly housed a U.S. military base. We use a unique census detailing the size of the sex industry at the district level over the past decades to answer this question. In order to identify a causal impact, we create counterfactual locations that could have been used by the U.S. Army. The U.S. government covertly used many Thai military bases during the Vietnam War, but many more were not used. We thus compare bases strategically chosen by the U.S. Air Force versus counterfactual bases, airfields and seaplane anchorages that were unused by the Americans during the war. We find that 3.8% of young women aged 20-30 living in districts that were reachable in less than one hour from a U.S. base (treated districts) were working in the sex industry in the early 1990s in comparison to a national average of 0.8% and 1.4% in districts close to unused Thai bases (control districts).

One concern is that the selection of Thai bases by the U.S. Army was not ran-

dom. We exploit the variation in the distance to active enemy bases in Vietnam as an exogenous factor explaining which Thai bases were used by the U.S. military authorities. Our 2SLS estimates are larger than the OLS estimates and suggest that districts that could be reached by U.S. servicemen in less than one hour using roads as they were before the war have between 2.5 and 8 times more commercial sex workers (CSWs) than districts close to unused Thai bases in the early 1990s. A simple back-of-the-envelope calculation allows us to estimate that at least 40% of the total number of CSWs were located within one hour of former U.S. bases.[1] Importantly, our results suggest a downward bias in OLS estimates indicating that treated districts have poor locational advantages in comparison to control districts.

Strikingly, we find that the sex industry became more concentrated between 1990 and 2012 and that our estimates are larger in 2012 than in 1990. The 2SLS estimates suggest that there are currently 9 times more CSWs in treated districts than in controls. Hence, thirty-five years after the departure of U.S. servicemen, employment in the sex industry in districts within one hour of former U.S. bases was still growing faster than in control districts, suggesting strong agglomeration forces.

The paper then turns to the channels of persistence through which pure, localized, and temporary demand shocks[2] led to the growth and transformation of the sex industry in treated districts.

We propose a simple rationale based on a model with search frictions arising from information asymmetry. In our framework, sexual services can be of different qualities (e.g. the incidence of STIs or diversity of services) and quality-loving consumers cannot perfectly target high-quality services. In the lens of our model, the presence of U.S. servicemen induced sex entrepreneurs to formalize their activity and to offer higher quality, thereby making it easier for future consumers to identify districts with high-quality establishments. After the departure of U.S. servicemen in 1975, treated districts were less subject to information asymmetry and coordination frictions. This facilitated the matching of quality-loving consumers and high-quality sex

[1] Given the richness of our data, we estimate the direct revenue generated by the Thai sex industry. In 1990, we find that customers were paying approximately $435M for sexual services. Note that our calculation does not take into account the indirect revenue such as alcoholic beverages, hotels, and wages of non-CSWs in sex establishments. We compute the direct revenue for all districts (see Appendix G) and show that the direct revenue in treated districts accounted for 48% of all the direct revenue in Thailand.

[2] We verify that the presence of U.S. servicemen was a pure temporary demand shock, i.e. that our results are not driven by the U.S. government assistance to Thailand during the war or direct interventions of U.S. forces to set up sex establishments. U.S. assistance was mainly related to road construction and counter-insurgency activities. We find little evidence that these local income shocks had long-lasting impacts (see Appendix E).

establishments, which attracted quality-loving foreigners and gave incentives to sex establishments to operate their qualitative transformation even further. Our model predicts (i) a higher concentration of formal (i.e. establishments not operating in the "street" market) sex establishments in treated districts, (ii) a higher quality of services, (iii) higher sex act prices, and that (iv) sex tourists consume in treated districts.

We test the predictions of our model. First, we provide empirical evidence that there is a higher concentration of formal sex establishments in treated districts. Second, there is evidence that sex establishments in treated districts differentiate their sexual services *horizontally* and *vertically*. Commercial sex establishments (CSEs) in treated districts offer a large number of different sexual services (*horizontal differentiation*) ranging from massages to erotic dances, baths and escorts. In parallel, we also find evidence that the quality of the service differs between treated and control districts (*vertical differentiation*). In order to show this quality difference, we analyze HIV data and show that the prevalence of HIV among female CSWs is lower in treated districts even when comparing similar types of commercial sex establishments (CSEs). Consistent with this quality premium, we document higher sex act prices for districts near former U.S. bases in comparison to controls. We provide evidence that this sex act price difference is partially explained by the types of sexual services offered across districts, but also that there are price differences across treated and control districts even when comparing similar CSEs. Interestingly, there are very large price differences for sexual services in CSEs where CSWs offer massages and dances, and almost no difference in other CSEs where only sexual services are offered. This suggests that consumers pay a larger premium for sophisticated sexual services than for traditional services offered in brothels. Last, we provide indirect evidence that since the end of the war, the demand for sexual services has been sustained by tourists with a high willingness to purchase sexual services. We find that there are more hotels, particularly 3- 4- and 5-star hotels, in treated districts and that this result is not driven by non-sexual touristic sites. We also uncover evidence that tourists go to different locations depending on their willingness to purchase sexual services. Hotels in provinces that housed U.S. bases offer fewer services to families (e.g. babysitting services) than hotels in other touristic areas.

The main contribution of this study is to show that temporary local demand shocks may lead to the growth of a low-skilled service industry to unparalleled levels. This result highlights the role of non-traditional agglomeration forces/economies of scale in industries that are susceptible to asymmetric information. We relate them

to a very old infant industry literature that analyzes how initial advantages coupled with Marshallian economies of scale may maintain an industry above its foreign competitors (Marshall (1980)). Our findings also relate to the literature on geographic concentration of enterprises in urban economics[3] and path dependence (e.g. Bleakley and Lin (2012)). Relevant papers include Broadberry and Marrison (2002) and Kline and Moretti (2014), who document the role of agglomeration economies in the cotton industry and manufacturing and Stahl (1987) and Wolinsky (1983), who explore retail trade concentration.

We also relate them to recent literature that studies the long-run effects of exogenous shocks (e.g. the division of Germany and Berlin in Ahlfeldt et al. (2014) and Redding et al. (2011)). In Davis and Weinstein (2002) and Miguel and Roland (2011), the authors find very little evidence that bombings affect the long-run development of some regions relative to others. Our conclusions differ from theirs since we do find long-term consequences. Our framework is also different since we analyze an economic push rather than a destruction of existing capital and focus on the specialization in one specific industry rather than estimating an impact on economic growth.[4] Last, our work complements many recent studies that analyze illicit activities. The illicit nature of the sex industry[5] has limited the analysis of this market-based crime, which explains why there is virtually no empirical analysis of supply and demand for sex markets.[6]

The paper is structured as follows. Section II. provides a historical overview of the U.S. military presence in Thailand. Section III. describes the data sets on sex workers and military bases. We present our empirical strategies and our results

[3]See Duranton and Puga (2004), Ellison et al. (2010), Moretti (2011) or Rosenthal and Strange (2004) for a literature review on agglomeration economies. The trade literature on increasing returns to scale and economic geography is also very voluminous (see the seminal work of Krugman (1991a,b)).

[4]There is a large body of literature investigating the impact of military spending or military installations on economic performance. In a seminal paper, Blanchard and Katz (1992) rely on defense spending to examine the impacts of local labor demand shocks. Many papers follow this idea and utilize military spending as an exogenous shock to analyze the effect of local demand booms (Brauer and Marlin (1992); Paloyo et al. (2010); Young (2014)).

[5]Recent economic papers on the sex industry focus on the link between human trafficking and regulating prostitution (Cho et al. (2013); Lee and Persson (2013)), on the costs of sexual services (Arunachalam and Shah (2008); Edlund and Korn (2002); Gertler et al. (2005); Levitt and Venkatesh (2007); Rao et al. (2003); Robinson and Yeh (2011)) and on the economics of sexually transmitted diseases (Canning (2006); Gertler and Shah (2011); Levinsohn et al. (2013); Oster (2005); Oster (2012); Shah (2013)). Some researchers carry out their own surveys (Li (2013); Robinson and Yeh (2012); Wawer et al. (1996)) while others rely on newspapers and online data sets (Cunningham and Kendall (2011); Seib et al. (2009)).

[6]One exception is Levitt and Venkatesh (2007). In their paper, they rely on survey data, but also on a police data set in Chicago. They provide evidence that the sex industry is more geographically concentrated than other crimes and that there is a large price increase on the 4th of July.

in section IV. We document how the demand persisted through sex tourism and analyze the channels of persistence in section V. The last section provides a brief conclusion.

II. Historical Background

A. U.S. Presence During the Vietnam War

The presence of United States servicemen in Thailand was a direct consequence of the Vietnam conflict. The start of the American air war against North Vietnam and other communist regimes in Cambodia and Laos resulted in an increased demand for air bases and military facilities in Southeast Asia. The United States needed a safe haven from which units could transit to the front and from which aerial raids could be launched. Thailand was the unique country close to Vietnam with pro-American authorities. The increasing presence of Communist rebels and guerrillas linked to the *Pathet Lao* who threatened the borders of Thailand fostered the U.S.-Thailand collaboration. The Northeastern part of the country offered a well-located region for air bases.[7] The proximity of the front would lower flight distances and fuel costs for air missions, and the U.S. army would provide protection against insurgency in an unstable region (Baral (1973); Randolph (1979)). To sum up, the proximity to the front was the main factor determining the locations of United States Air Force (U.S.A.F.) bases in Northeast Thailand.

The U.S. Army began to use Thai bases in 1961 for the air defense of Thailand and to fly reconnaissance flights over Laos. Thai bases used by the U.S.A.F. were geographically closer to the war front and Laos than other Thai bases. The U.S.A.F. deployed combat aircraft to Thailand from 1961 to 1975. By the end of 1966, there were already over 25,000 U.S.A.F. personnel and 400 U.S. combat aircraft. The number of bases and aircraft would increase during the conflict. At the peak of the Vietnam War, there were approximately 50,000 men stationed in Thailand, and it is estimated that around 700,000 U.S. servicemen visited Thailand between 1962 and 1976 (Clift and Carter (2000)). Most of the U.S.A.F. air strikes over North Vietnam during this period originated from those U.S. military bases. According to historical documents, about 80% of all U.S.A.F. air strikes over North Vietnam originated from air bases in Thailand.

[7]The idea of using Thai military bases had already been considered by the Truman administration. Baral (1973) explains that the "Joint Chiefs of Staff had recommended in April 1950 that *a programme of special covert operations* be launched from Thailand."

The U.S. Army did not help but did not prevent servicemen permanently stationed in Thailand from visiting brothels. In addition, the U.S. authorities organized Rest & Recreation (R&R) leave for U.S. servicemen (mostly in Bangkok and Pattaya). Around 11 to 16% of total visitors during 1966-7 were R&R military personnel from Vietnam, and they spent between 6.8 and 10.8 million U.S. dollars annually. Ouyyanont (2001) writes that "In 1966, for example, there were at least 652 night clubs, bars, and massage parlors in the whole country of which 336 were in Bangkok, 126 were in the five provinces housing US bases in the northeast, and 190 in the other provinces particularly close to the two bases in provinces in the central region." Many authors report that it was quite common for troops to go to shanty towns of brothels surrounding U.S. bases (Enloe (1989)). This practice was referred to as going to the "dogpatch." Kislenko (2004) writes that "A cluster of shanty towns sprang up around the base [U-Tapao], offering servicemen everything from souvenirs to prostitutes." Thompson (2003) echoes Kislenko and explains that "Club bars provided a ready release from the tension of combat or the boredom of desk duty. Just off base, Thai prostitutes did not want for customers, and the dispensary at each base was handling about a thousand venereal disease cases a year."

Entertainment establishments grew around the bases, attracting more and more entrepreneurs to organize prostitution. The U.S. military also had a practice of hiring *hooch maids* for enlisted men. *Hooch maids* were supposed to offer massages and other non-sexual services requested by U.S. servicemen. Lyttleton (1994) explains that "American bases in the Northeast established a large range of accompanying entertainment locales and the practice of *renting wives*. [...] After the war, foreign tourism increased, sustaining the demand for Isan [Northeast] CSWs to provide sex."

While the U.S. or Thai authorities never invested directly in the development of the sex industry,[8] they did help it through the adoption of several laws that facilitated the development of a new form of "entertainment." Created in 1959, it is thought that the Tourist Organization of Thailand and the 1966 Service Establishment Act helped to control the explosion of the sex industry. While prostitution remained legally suppressed at the time, the 1966 Act permitted entertainment establishments throughout the country to employ women who would offer "special services." Massage parlors, bars and tea-houses where clients could request "special services" were thus legalized under a license.[9] Only non-sexual services such as mas-

[8]U.S. expenditures in Thailand over the years 1968-9 was equivalent to approximately 5% of Thailand's GNP. U.S. authorities invested mainly in the maintenance of military installments and the construction of adequate infrastructure. We discuss later the potential implications of the American economic aid program, and show that it had limited long-term impact.

[9]Tax evasion is considerable in the sex industry since customers do not request receipts for

sages were supposed to be offered but in practice sexual services were provided. This was followed by the 1967 Rest & Recreation Treaty, which formalized the agreement of Thai authorities to provide entertainment services for U.S. servicemen. While prostitution is illegal in Thailand, it is still nowadays practiced openly throughout the country.

B. End of the War and Aftermath

With the collapse in Laos and the fall of both Cambodia and South Vietnam in the spring of 1975, the political climate between Washington and Bangkok began to sour, and the Thai government demanded that the U.S. Army remove the bulk of its forces from Thailand by the end of the year. Under operation Palace Lightning, the U.S.A.F. began to withdraw its aircraft and personnel from Thailand. On April 17, the U.S.A.F. flew its last mission over Laos, working a handful of targets requested by the Laotian government.

Before the Vietnam conflict, approximately 80% of the Thai working population were farmers and the entertainment industry was almost non-existent. There were only 200,000 international and domestic tourists visiting Thailand in 1960. This number increased to 800,000 in 1970 and 2 million in 1980. The American presence drastically changed the international travel image of Thailand. Despite the departure of American soldiers in 1975, their legacy in the form of R&R areas and military bases changed the commercial sex industry.[10]

The Thai government monitored the growth of the entertainment industry through various policies following the U.S. military presence. In 1971, a delegation of the World Bank met with Thai officials and advocated for the development of the Thai entertainment industry, which could foster economic growth.[11] The Thai government then adopted a National Plan of Tourist Development in 1975 (Li (1995)).

Since 1970, when there were slightly more than 600,000 tourist arrivals in Thailand (excluding Thais), the number of visitors has increased more than 35 times to

sexual services. Following the 1966 Act, most establishments obtained a license that facilitated the work of the Ministry of Health and increased local tax revenues.

[10]It is important to point out that the willingness to purchase sexual services among Thais has been on the rise since the Vietnam War.Cohen (1988) explains that "Thais visit the bars [...] and the massage parlors on the main avenues, which were originally established to serve the needs and preferences of the American G.I.s on R&R from Vietnam." This means that the demand for sexual services is not only sustained by foreigners but also by locals or domestic tourists. Most provinces do not have a red-light district, and Edlund and Korn (2002) point out that men in transit are more likely to consume sexual services.

[11]Robert McNamara, President of the World Bank in the 1970s, was a member of this delegation. Interestingly, he was also the U.S. Secretary of Defense during the signing of the 1967 Rest & Recreation Treaty.

reach 20 million in 2012. In the early 1990s, it was estimated that approximately 70% of travelers visiting Thailand were male (Leheny (1995)), but this has changed substantially in recent years with an increase in the number of women travelers. We document the evolution of the number of tourist arrivals by gender and nationality in the Online Appendix (Brodeur et al. (2014)).

III. Data

A. Military Base Data

We rely on two types of data to construct our indicator of U.S. military presence in Thailand. For the exact locations and characteristics of U.S. military bases, the data come from Fact Sheets and Histories of the United States Air Force at Royal Thai Air Force Bases, dated August 12, 1976, and published by the 13th Air Force Office of History. We also collected information on U.S. military bases from reports of the Thailand Laos Cambodia (TLC) Brotherhood's website.[12] The second source of military data is the National Archives and Records Administration (NARA), which reports on air combat missions flown in Southeast Asia by the U.S. Air Force during the Vietnam War,[13] deliveries of materials, U.S. direct defense spending and U.S. military receipts in foreign countries. We present a summary of the reports in the Online Appendix.

Table 1 provides descriptive statistics for all U.S. military bases, including the number of air combat missions flown in Southeast Asia,[14] the exact location of the bases, the distance to enemy bases (for 1969) and the evacuation date. We also indicate whether the U.S. installment was a major base or a camp.[15]

Historical roads, railways, airfields and seaplane anchorages are reported from different sources in the Online Appendix. We report the exhaustive list of active enemy bases in Southeast Asia and Thai military bases with their coordinates in the Online Appendix tables. There were 136 active enemy bases in 1969, 112 of which were in Vietnam according to current borders. There were 33 Thai military bases not used by the U.S.A.F. in 1970 and many more were built over the period from

[12] $http://www.tlc-brotherhood.net$

[13] Also by the U.S. Army, Navy, Marine Corps, South Vietnam Air Force, Royal Laotian Air Force, South Korean Air Force and Royal Australian Air Force.

[14] Using this data set, Miguel and Roland (2011) found no evidence that U.S. bombing had a persistent impact on local poverty rates or other economic outcomes in Vietnam.

[15] One could rely on air combat missions or unit transfers during the war to categorize bases as major or minor installments. However, these variables do not give an accurate indication of the size of the base.

1971-2013.

B. Sex Worker Data

In this research we rely on an annual nation-wide survey conducted in Thailand by the Venereal Disease Section of the Ministry of Public Health in collaboration with the Department of Public Welfare of the Ministry of Social Development and Human Society. This is the most reliable source of data on the commercial sex industry in Thailand. Thai authorities collect this data as valuable information for venereal disease control and policies, in particular HIV. This data collection began in the early 1970s and continued on a yearly basis. However, in this study, we rely on sex worker data from 1990 to 2012. This is mainly because in these years the data are reported at the district level, instead of national and province levels, which is essential for our analysis.

The survey methods are very similar to those of a census. The data collection is conducted during the whole month of January.[16] The field conductors go to each detailed locality believed to have commercial sex establishments. All the areas of all provinces are covered annually. The survey is conducted in the evening or at night, the time believed to be the active time of the sex industry. Detailed locality maps provided by the Thailand National Statistical Office are used to conduct the field survey. It is crucial that at least one of the surveyors is familiar with the locality and the commercial sex environment. Surveyors count and record only the establishments where there is firm evidence suggesting that there are commercial sex transactions. They also count the number of people working in the establishment but exclude anyone who is not a CSW (e.g. cleaners, security guards or waitresses). Additionally, the surveyor may estimate the number of CSWs not present on the day of the survey by talking to the owner or manager and by linking the information received from patients of sexually transmitted infection (STI) clinics. The nature of the sex industry facilitates the work of the surveyors since CSWs need local customers and tourists to be able to find them (Levitt and Venkatesh (2007)).

Over the years, a large amount of knowledge has been accumulated that helps surveyors. A database with all the locations in the country is maintained and updated when receiving information from clients or sex workers. A classic example is when a male customer or a CSW of an establishment goes to an STI clinic for a venereal disease test. The location of the establishment will be recorded and added

[16]The data were previously collected in September (1971), October (1972-1981) and April (1982). The survey has been conducted in January since 1983. The sex industry is seasonal and Thailand's peak tourist season is from November to March.

to the database. Health officials very often facilitate health checks for CSWs. Surveyors talk to managers in each establishment surveyed, and then classify them in one of the 25 different categories of establishments. Surveyors count only CSWs who work in a "permanent" location. CSWs who frequent streets, public parks or stand around non-suspicious entertainment locations are thus excluded. Anecdotal evidence suggests that very few CSWs work in non-permanent locations in Thailand. Nationality and age of CSWs are not recorded but both Thais and non-Thais are counted. Note that we may underestimate the number of minor CSWs since managers of sex establishments may hide them or pretend they are not working in their establishment.[17]

While the estimates from the Ministry of Public Health are potentially underestimating[18] the number of CSWs in Thailand, this should not bias our findings if this underestimation is not related to the U.S. military presence. We discuss in more detail non-traditional measurement error and the possible biases in the Online Appendix. The 1990s data can be argued to be more reliable as it was conducted during the AIDS epidemic, when ties between officials and CSWs were very strong. Recall that the survey method relies on the willingness of the managers or sex workers to cooperate, therefore a closer relationship would facilitate better data collection. The HIV outbreak during the late 1980s and early 1990s scared many tourists at the time; however, the impact was not long-lasting. In fact, the commercial sex industry became heavily regulated by the official authorities. It is quite usual nowadays for CSWs to have regular check-ups and identification cards indicating whether they are disease-free. Instead of the disappearing of the industry, the number of CSWs is almost the same in 1990 and 2012, with a drop during the HIV epidemic (Online Appendix Figure A.6 shows the evolution of CSWs per 1,000 inhabitants over this time period).

According to the survey used in this research, there were over 80,000 CSWs in Thailand in 2012. We calculate, using this data set and data presented in the Online Appendix, that around 4.3-11.4% of women born during the years 1970-1975 (and still alive in 2000) have worked in the Thai sex industry at one point in their life. Our methodology for estimating this number is quite simple and is related to the fact that the estimates from the Ministry of Health are snapshots (in January) of

[17]While prostitution is practiced openly in Thailand, there may be some pressure from NGOs and local officials to close sex establishments employing minor sex workers.

[18]Boonchalaksi and Guest (1994) discuss the size of the sex industry and explain why some estimates are larger than others. They also provide evidence that some estimates provided by some sources are too big to be true. Their rationale is that there are simply not enough women aged 15 to 29 in urban areas to match the highest estimates provided by some authors.

the sex industry. Most CSWs are young Thai women and work several months in the sex industry (see Online Appendix). For example, if one considers that former CSWs spent on average a year and a half working in this industry, that 3% of CSWs were male, and that 80% were born in Thailand, then approximately 7% of Thai women born in 1975 (and still alive in 2000) have worked in the Thai sex industry. Our estimates should be viewed with caution. Thai prostitutes working abroad are not included in those statistics. We provide more details in the Online Appendix.

The data set contains various information about the type of establishment and the number of sex workers, each categorized as direct or indirect. Direct establishments are defined as locations having an actual "room" for sexual services whereas indirect establishments are locations where there can be a transaction but there is not a room on site.

Table 2 we report statistics of the commercial sex industry at the district level. There were 85,875 CSWs in Thailand in 1990 compared to 81,559 in 2012. Since most of the CSWs are women aged between 18 and 30 and 12% of the population are women in this age group,[19] this would mean that around 1% of women aged 18 to 30 were working in the sex industry in the early 1990s. The number of indirect CSWs is much lower than the number of direct CSWs in the early 1990s, but this has changed drastically in recent years. Moreover, the number of male sex workers (MCSW) has increased substantially from 2.6% of the total number of CSWs in 1995 to 18% in 2012. There is also a large increase in the number of sex establishments, meaning that the number of CSWs per establishment has decreased during this period. The average number of CSWs per sex establishment is approximately 4 in 2012.

To empirically evaluate the hypothesis that the presence of U.S. military personnel led to the development of the sex industry for districts near U.S. Army installments, we use a variety of different measures. Primarily, we rely on the number of CSWs at the district level in 1990 and 2012, but also on other indicators such as the percentage of young women in the service industry. We will also check whether the results are similar for direct and indirect establishments and by types of sex establishment. It is plausible that some districts are specialized in providing sexual services for tourists in luxurious sex establishments and massage parlors whereas other locations are specialized in a more local sex industry. Appendix Figure A1 illustrates the trends in the number of CSEs by category over the period 1990-2010. The most popular sex establishments are locations with karaoke premises, restaurants, bars and traditional massage parlors. These establishments essentially act as sex establishments while masquerading as normal bars or restaurants.

[19]Estimated using the data from the 1% sample of 1990 and 2000 Censuses.

Figures 1 and 2 illustrate the number of commercial sex workers in each district per 10,000 inhabitants in 1990 and 2012. (See Appendix Figures A3 and A4 for the South of Thailand.) Readers can see that the sex industry is very concentrated. An obvious explanation for the geographic concentration in prostitution is the prevalence of search frictions due to information asymmetry between foreign consumers and sex entrepreneurs (see section V.A). These figures also illustrate the relationship between the number of CSWs per capita and the U.S. military bases during the Vietnam War. As shown in the figures, most of the U.S. military bases were in the Northeast of Thailand with a few more bases close to Pattaya and Bangkok. A relationship between U.S. military installments and the distance to the war front in Vietnam is apparent. The low number of CSWs in the Northwest and the high number in Pattaya and other districts attracting tourists such as Ko Samui and Phuket are consistent with the general view in this literature (Boonchalaksi and Guest (1994); Guest (1995)).

IV. Empirical Evidence

We begin by describing our empirical strategies. We rely on three different specifications in which our unit of observation is the district (i.e. *amphoe*)[20] in order to quantify the empirical relationship between U.S. military presence during the Vietnam War and a variety of sex industry indicators. The first specification consists in constructing the distance to former U.S. bases for each district in Thailand and analyzing the correlation between the size of the sex industry and such distance. In the second specification, we restrict our sample to districts close to Thai military bases, and compare the size of the sex industry around bases used by the U.S.A.F. versus the other unused Thai bases. In our third specification, we use the distance to enemy bases as an instrument explaining which of the Thai bases were used by the U.S. Army. This section sets the stage for the remainder of this study, in which we ask what are the channels of persistence of the sex industry in those areas.

[20]Province and district are respectively analogous to state and county. The number of districts in a province differs greatly. We report the number of districts in the control and treated groups in Table 3.

A. Empirical Strategy

OLS Specification

We classify districts into different categories: we rely on historical network routes and railways of the 1950s to identify districts that U.S. servicemen could reach easily. We calculate how long it would take from each district to reach the nearest U.S. military base, taking into account the different types of roads and train lines[21] available before the U.S.A.F. presence. Similarly, we calculate, for each district, distances to the nearest 1970 Thai bases not used by the U.S.A.F.[22] As a robustness check, we also consider a second set of counterfactual districts: 1950s airfields and seaplane anchorages that were not used by the U.S.A.F.

Our baseline equation is:

$$\ln(1 + CSW_{d,r}) = \alpha + \beta_r + \gamma USB_{d,r} + \lambda THB_{d,r} + \zeta X_d + \varepsilon_{d,r}, \tag{S1}$$

where $CSW_{d,r}$ is the number of commercial sex workers in district d and region r.[23] $USB_{d,r}$, our variable of interest, is equal to one if the district is within a given distance of a former U.S. military base and zero otherwise. Similarly, $THB_{d,r}$ is equal to one if the district is within a given distance of a 1970 Thai military base and zero if it is further away. Region fixed effects (β_r) are included in the model. X_d is a set of control variables at the district level accounting for differences in districts' characteristics. These variables try to control for any features in the location of the U.S. military bases that would bias our estimation. Details on these variables can be found in the Online Appendix. We rely on robust standard errors, clustered at the nearest military base (U.S. or Thai), which yields a total of 47 clusters of districts in the full sample.

We include unused Thai military bases because if omitted factors related to the location of military bases are driving the finding that there are more CSWs in the

[21] We consider six types of roads and two types of railways: hard surface two or more lanes, loose two or more lanes, hard one lane, loose one lane, fair or dry loose lane, trail, railway normal gauge and railway narrow gauge. The distance that we calculate takes into consideration the speed of travel of different means of transportation. See the Online Appendix for the details on the calculation.

[22] We check our main results in the Online Appendix with 1975 Thai bases and 2012 Thai bases as control groups. The sample size is larger and the estimates are very similar. The conclusions of this section do not rest on our choice to rely on 1970 Thai bases. Only some U.S. military bases are currently used by the Thai army. Some were dismantled whereas others are currently used by the Thai Air Force. See the Online Appendix for a detailed description of each U.S. base.

[23] We check that our results are robust to other functions that behave asymptotically as the logarithm but are well defined around 0. For instance, we also rely on the inverse hyperbolic sine in robustness checks not shown (Online Appendix Table A8).

districts close to U.S. bases, then we should find the same pattern for districts close to unused Thai military bases and airfields.

For the second specification, we keep districts that were reachable in less than one hour from a U.S. base or an unused Thai base using roads and railways as they were in the 1950s. More precisely, we restrict the sample to districts for which either $USB_{d,r}$ or $THB_{d,r}$ equal one. For this subsample of districts, we create a new variable, B_d, which is equal to one if the nearest base is U.S. (i.e. $USB_{d,r}$=1) and zero if the nearest base is Thai (i.e. $THB_{d,r}$=1). B_d is thus different than $USB_{d,r}$ since the control group is composed of districts close to unused Thai bases and no longer all the other districts as in specification (S1).[24]

The second specification is the following:

$$\ln(1 + CSW_d) = \alpha + \delta B_d + \zeta X_d + \varepsilon_d, \tag{S2}$$

where CSW_d is the number of CSWs.

2SLS Specification

One concern with the previous specifications is that districts near bases chosen by the U.S. Army may have unobserved characteristics that would have led to the development of the sex industry. For instance, we can imagine that U.S. officials would choose locations for which support and supply would be easier. Conversely, they may prefer isolated locations because they needed to construct additional facilities, and they preferred the activity to be (partly) hidden from the population. Can we exploit exogenous variations in the choice of Thai bases that would become U.S. bases?

As explained previously, the U.S.A.F. used many Thai bases during the war and the locations of the chosen military bases were determined by the distance to active enemy military bases in Vietnam. The U.S.A.F. flew many flights from Thailand from the period 1965-1975, and the desire to diminish fuel costs and air travel time certainly played a major role in determining U.S. base locations. Our strategy relies on military tactics and the fact that it is much easier to supply materials in Vietnam

[24]We restrict the sample to districts near military bases in order to instrument B_d with the distance to enemy bases. Another strategy would be to instrument $USB_{d,r}$ with the same instrument and keep all the sample. We dislike this strategy for two reasons. First, the locations chosen by the U.S.A.F. for most of their bases were among a set of Thai bases. It is thus natural to compare districts near U.S. and Thai military bases. Explaining the locations of U.S. bases with all the districts in Thailand would make less sense from a historical perspective. Second, many districts in the Northeast and near Cambodia did not have Thai bases. The first stage is thus much weaker if we instrument $USB_{d,r}$ with the distance to enemy bases.

and fly over Laos from districts close to Laos and Cambodia than from Northwest or South Thailand. Figures 1 and 2 illustrate that U.S. bases are closer to Vietnam than unused Thai bases. We use the distances from all U.S.A.F. and Thai bases to active enemy military bases in Vietnam as of 1969[25] as an instrument for being a district near a U.S. base relative to an unused Thai base. This identification strategy allows us to tackle the omitted variable bias.

We estimate:

$$\begin{cases} B_d = \rho + \phi \cdot DE_d + \psi X_d + \nu_d \\ \ln(1 + CSW_d) = \alpha + \delta \hat{B}_d + \zeta X_d + \varepsilon_d, \end{cases} \tag{S3}$$

where B_d, the treatment, equals one if the nearest base is U.S. and zero if the nearest base is Thai, and DE_d is the over-the-air distance to the closest (active) enemy bases in Vietnam. In this setting, each district is assigned a distance to enemy bases in Vietnam. This distance is equal to the over-the-air distance between the closest U.S. or Thai military base and the average distance to enemy bases in Vietnam. This means that DE_d is the same for all districts close to the same U.S. or Thai base. We thus rely on robust standard errors clustered at the nearest military base level (U.S. and Thai).

The validity of the instrument relies on the assumption that the distance to enemy bases is only correlated with the subsequent increase in supply of CSWs through the presence of U.S.A.F. installments. Military bases that were used by the U.S.A.F. were closer to enemy bases in Vietnam, which led to the development of the sex industry in those districts and not in districts near unused military bases. We rely on the assumption that (i) before the Vietnam War, there were not more CSWs in districts close to enemy bases in Vietnam than in districts farther away. (Note that only districts within one hour of a U.S. or unused Thai bases are included in specification (S3).) We also assume that (ii) after the arrival of U.S. servicemen, these districts did not experience a boom of the sex industry due to other reasons correlated with the distance to enemy bases. We will come back in what follows on the credibility of this assumption by comparing observable characteristics of districts near U.S. and unused bases.

[25]Note that we rely on distances to the front for the year 1969 in what follows but check the robustness of our results with other years. The point estimates are virtually the same.

B. Sex Industry Around Former U.S. Bases in the Early 1990s

Before discussing the results of specifications (S1), (S2) and (S3), we provide a very simple but insightful mean comparison exercise in Table 3. The first column shows descriptive statistics of districts very close to a U.S. military base (less than one hour). Then the next column repeats this exercise for districts between one hour and two hours from the nearest U.S. base. The third column reports statistics for districts more than two hours from a U.S. base. The fifth column reports statistics for districts very close to a Thai unused military base. Column 4 reports the difference between our treated districts (column 1) and districts more than two hours from a U.S. base (column 3), and column 6 reports the difference between our treated districts and districts very close to a Thai unused military base (column 5).

Strikingly, districts within one hour of a U.S. base have, on average, 5.9 CSWs per 10,000 inhabitants in 2012, which is more than eight times the national average of 0.7 (excluding districts near U.S. installments). The difference between the number of CSWs per 10,000 inhabitants for districts near a U.S. base (less than one hour) and districts farther away (more than two hours) is very large and statistically significant at the 1% level. Furthermore, we calculate the number of young women aged 20-30 from the 1% sample of the 2000 Census and obtain stunning figures. Our estimates suggest that in 1990, approximately 3.8% of young women aged 20-30 living in districts that are within one hour of a former U.S. base were commercial sex workers.[26] This is well above the national average (excluding districts near U.S. installments) of 0.8% and the percentage for districts within one hour of unused Thai bases (1.4%).[27] Note that this number does not take into account non-CSWs working in those establishments nor workers in related industries.

The relationship between the distance to U.S. bases and the size of the sex industry seems to be non-linear since the number of CSWs is very high for districts near U.S. installments (less than one hour) and much lower for districts that are slightly farther away (between one and two hours). We confirm the finding that the sex industry is highly concentrated in districts very close to former U.S. bases with maps. We took Figure 2 and zoomed in on the image. Figures 3 and 4 illustrate

[26] We do not have the number of young women at the district level in 2010. If we rely instead on the 2000 Census, our estimates suggest that approximately 5.9% of young women aged 20-30 living in districts that are within one hour of a former U.S. base were commercial sex workers in 2012.

[27] Only female commercial workers are included in those calculations. Note, however, that these figures are smaller if we add to the denominator women younger than 20 and older than 30 years old.

four zoom-ins on images of unused Thai bases and four zoom-ins on images of U.S. bases. The current road and railway network is also illustrated. It is quite apparent that the sex industry is concentrated in districts near former U.S. bases and less so in districts farther away or hard to reach with major roads or railways.

We also check whether our treated districts differ from others along other characteristics. We find statistical differences with districts more than two hours from a U.S. base for the presence of provincial capitals, a rail line (1950s), a road (1950s) and a temple or spiritual site, as well as the distance to the closest ports of entry by land. Those descriptive statistics indicate that the locations of U.S. bases and camps were not random and that military installments are in districts that are more urbanized. However, when we compare characteristics of treated districts to districts within one hour of unused Thai bases, we find that U.S. officials chose Thai bases that were in slightly less urbanized areas and in districts less likely to have railways (1950s). Unsurprisingly, U.S. bases are significantly closer to active enemy bases in Vietnam. Treated districts are on average 100 kilometers closer to enemy bases than unused Thai bases.

Specification (S1)

Table 4 reports the results of specification (S1) focusing on the number of CSWs in 1990 using a different set of controls. The estimated relationship between the size of the sex industry in 1990 and being a district that could be reached in less than one hour from a U.S. base is robust, positive and statistically significant at the 1% level. The point estimates range from 1.483 to 1.563, suggesting that there were 3.5 times more CSWs in 1990 in districts within one hour of a former U.S. military base.

The first column reports estimates controlling for region fixed effects and population (log) in 1990. In the second column, we include controls to account for transport networks. We include two indicators for whether there was a road and whether there was a train line in the district before the American presence. We also calculate whether it is a coastal district. These variables try to check that our estimates are not only capturing network effects (Townsend (2011)) or beaches. Last, we include a dummy for the district, which is the capital of the province. Column

3 of Table 4 adds two more sets of controls.[28] The second set includes the distance to the closest port of entry by land (log), the presence of a temple or spiritual site and the average annual rain days (log). Only the distance to the port of entry is statistically related to the sex industry in 1990. The coefficients of the third set of controls are not shown for space consideration. The variables included verify that treated districts do not attract visitors because of tourist attractions. We include the following dummies: natural parks, tourist beaches, zoos and safaris, and museums. There are more CSWs in districts with tourist beaches, but the other variables are insignificant. We also include a dummy that equals one if the district is within one hour of an unused Thai base. The point estimate is negative, very small and statistically insignificant. In parallel, the coefficient of interest remains unchanged. This is a first piece of evidence that our results are not biased by unobserved factors and pre-existing conditions.

In column 3, we add the following three dummies: being a district within one and two hours of a U.S. base, within two and three hours of a U.S. base and within three and four hours of a U.S. base. The estimates for these variables are not significant (even jointly) and much smaller than the dummy for districts within one hour of a U.S. base. This specification shows that the influence of U.S. bases is very local and that the sex industry is concentrated in red-light districts.[29]

Finally, in columns 4 and 5, we check that our results are robust using two other waves of data: 1992 and 1995. The point estimates are statistically significant and range from 1.478 to 1.878.

Specifications (S2) and (S3)

We turn to specifications (S2) and (S3) in Table 5, where we directly compare districts within one hour of used and unused Thai bases. We thus restrict the sample to districts for which either $USB_{d,r}$ or $THB_{d,r}$ equal one. In the odd columns, we present OLS estimates of specification (S2). The dependent variables are respectively the natural log of one plus the number of CSWs in 1990 (column 1), 1992 (column

[28] Our set of controls captures a great deal of the variation in economic conditions across districts.We run a regression (S1) where the dependent variable is the share of households in agriculture in 2000 (not shown for space consideration) and the set of controls is identical to Table 4, column 4. The R-squared is 0.65, suggesting that our set of controls explains a great deal of the differences across districts in current urbanization rates. Felkner and Townsend (2011) show that economic activity is very concentrated in Thailand and that concentrations of enterprise within each province are near large towns and major highways.

[29] In principle, the spillovers on districts not very close to U.S. bases may be negative or positive. Those districts may benefit from the higher demand from locals and foreigners. On the other hand, there could also be a decline in the size of the sex industry if sex entrepreneurs prefer districts close to former U.S. bases.

3) and 1995 (column 5). We compare districts within a one-hour range of a former U.S.A.F. base to districts within a one-hour range of an unused Thai base with basic controls (as in Table 4, column 2). In the even columns, we present estimates of specification (S3): we replicate the odd columns but we instrument the treatment in a first stage, i.e. being close to a U.S. base rather than a Thai base, by the average air distance to enemy bases.

Using specification (S2), we find that districts within one hour of a U.S. base have 200% more CSWs in 1990 than districts within one hour of an unused Thai base. The influence of U.S. bases is larger in 1992 and 1995 than in 1990. Districts within one hour of a U.S. base have approximately 5.5 times more CSWs in 1995 than controls.

We now turn to specification (S3). The first stage is reported in the bottom panel. The first stage F-statistics is 14.15 and the centered R-squared of the first stage is 0.502. Consistent with the geographic maps presented before, the first stage suggests that districts near U.S. bases were much closer to enemy bases than districts near unused Thai bases. Interestingly, a few other variables of our first stage seem to predict whether the bases are U.S. or Thai. Districts near U.S. bases were less likely to have a railway, a road and to be a provincial capital. Districts hosting U.S. bases were thus less economically developed and connected to the network than controls.

We find that districts within one hour of a U.S. base compared to one hour of a Thai base have substantially more CSWs. The 2SLS estimates suggest that there were 2.5 to 8 times more CSWs in the early 1990s in districts near U.S. bases than in control districts. As in specification (S2), the estimates are larger in 1995 than in 1990.[30]

Finally, in the last row of this table we report the ratio of CSWs in this sample to the total number of CSWs in Thailand. Strikingly, 47% of CSWs in 1990 were in districts that could be reached from a U.S. base or an unused Thai base in less than one hour. Given the ratio of the number of CSWs in those districts to the total number of CSWs in Thailand, we estimate that 40% of the total number of CSWs in the country were working in districts that were reachable in less than one hour

[30]One potential concern with the 2SLS estimates is that the average distance to enemy bases in Vietnam may be correlated with other locations relevant for the development of the Thai sex industry. We follow the falsification check used by Nunn (2008) and estimate the reduced form relationship between the distance instrument and the sex industry in other Asian countries. We rely on data at the province level for the year 2002 in Cambodia and Indonesia and calculate the average distance to enemy bases for each province. We report the results in the Online Appendix. The average over-the-air distance to enemy bases is positively related to the size of the sex industry in Cambodia. Provinces closer to enemy bases have fewer CSWs. On the other hand, the association between the distance and the number of sex workers is small and statistically insignificant in Indonesia.

from U.S. bases.

C. Sex Industry Around Former U.S. Bases in 2012

In the early 1990s, two decades after the departure of U.S. servicemen, the sex industry was very concentrated in a few red-light districts near former U.S. bases. However, we still do not know whether this result indicates that the effects of the temporary demand shocks are slowly fading away, or instead are amplified over time through agglomeration forces for instance. In order to answer this question, we replicate our previous analysis performed with data from 2012.

Table 6 reports the results of specification (S1) in 2012. There are no clear signs that the impacts of the shocks are fading away. The estimates are significant and very similar to the ones in 1990. Interestingly, there are no signs of propagation across space: the point estimates are not significant for distances farther away (between 1 and 2 hours, 2 and 3 hours, and 3 and 4 hours). In other words, between 1990 and 2012, the sex industry did not propagate and remained similarly concentrated around former U.S. bases.

Columns 4 to 6 of Table 6 report the results of specifications (S2) and (S3) in 2012. In those specifications, we find that the difference between treated and control districts increases over time. The OLS coefficients are between 1.1 and 1.9 in the early 1990s, and 1.7 and 2.1 in 2012. Those differences appear in specifications with or without controls. Note that the OLS estimate in the fifth column is larger than in the fourth column, indicating that adding controls increases the size of the coefficient of interest. The results suggest a downward bias in OLS estimates.

The 2SLS estimate (specification (S3)) is even larger than the ones obtained with the OLS specification (S2). The estimate suggests that there were up to 9 times more CSWs in treated districts in 2012. This is in line with the fact that U.S. bases were located in districts less conducive to the development of the sex industry than military installments not used by the U.S.A.F. Our findings suggest that there were $2.5 - 8$ times more CSWs in treated districts in the early 1990s compared to 9 times more CSWs in treated districts nowadays.

Another way to test whether the sex industry is more concentrated is to relate the size of the sex industry in 1990 to its size in 2012 and instrument the number of CSWs in 1990 with the presence of a U.S. base within one hour (see Online Appendix Table A9). This exercise yields a coefficient very close to 1, and even larger when we restrict the sample to districts with many CSWs in 1990 (e.g. more CSWs than the average number of CSWs in the region). It indicates that red-light

districts are attracting more and more CSEs and that the sex industry is more concentrated in 2012 than in 1990. These results are in line with the existence of strong agglomeration forces.[31]

To sum up, we find that the impacts of the temporary demand shocks are getting amplified over time. We turn to the channels of persistence in the next sections, but first we provide some robustness checks for our previous results.

D. Robustness Checks

Our results are robust to many sensitivity checks. We report some of them in the paper and present additional robustness checks in the Online Appendix. We make sure that the findings presented above are robust to the inclusion of Thai bases built after 1970 (Online Appendix Table A5), to the exclusion of any of the U.S. bases (Online Appendix Table A6) and to the exclusion of the whole region of Bangkok (Online Appendix Table A7). We also check whether our empirical strategy yields similar results using other measures of the size of the sex industry and administrative data on the size of the service industry (Online Appendix tables A12 and A13).[32]

Second Comparison Group: Airfields and Seaplane Anchorages

We now check if our results are sensitive to the use of another control group, i.e. 1950s airfields and seaplane anchorages not used by the U.S. Army. The U.S.A.F. needed large airfields that would enable takeoffs and landings of many aircraft. In our empirical analysis, we use all the airfields and seaplane anchorages that were not used by the Americans to create an additional set of counterfactual districts (see Appendix Figure A2). These districts offer a credible control group because they were likely to become major tourist destinations.[33] We illustrate 1950s airfields and seaplane anchorages in Appendix Figure A2.

Our methodology is similar to the one used for the variable B_d. We calculate for each district the distance to the nearest 1950s airfield or seaplane anchorage using historical roads and railways. We create a dummy that equals one if the district is

[31] We focus on treated and control districts but document in the Online Appendix an increase in the concentration of CSEs for the whole country. This result is also illustrated in Figures 1 and 2.

[32] Our 2SLS results suggest that districts within one hour of a U.S. base have 5 times more women aged 20-30 working in the service industry than in control districts. This suggests that measurement error is not driving our results. For the remainder of the analysis, we rely on commercial sex workers for space consideration. Nonetheless, as these findings illustrate, the results of the article do not rest on this choice.

[33] See Online Appendix Table A15 for a comparison of economic and geographical features between this second control group and treated districts. Note that controls are more likely to be coastal districts and were closer to ports of entry.

within one hour of a U.S. military base and zero of the district is within one hour of an unused airfield, seaplane anchorage or a Thai military base. In other words, the control group now includes more districts.

Table 7 reports our OLS estimates (specifications (S1) and (S2)), controlling for our usual sets of control variables. The dependent variables are respectively the natural log of one plus the number of CSWs in 1990 and 2012. Robust standard errors corrected for clustering at the nearest U.S. base and unused Thai base, airfield and seaplane anchorage are presented. The number of clusters and the sample size are larger than with our first comparison group.

Comparisons of U.S. districts against our second control group yield results that are quantitatively very similar to those in Tables 4, 5 and 6. The difference between U.S. bases and the second control group is economically very large. The point estimates for this second comparison group fall in the same range as those of the first control group: 1.537 (1990) to 1.601 (2012) for the second specification. We believe that it is unlikely that our two sets of comparison groups would suffer from identical selection biases. Note that we do not report 2SLS estimates for this second comparison group since the first stage is much weaker than for the first comparison group, with F-statistics around 1. This is expected since the U.S. Army did not use civil airfields. Many airfields and seaplane anchorages are located in districts closer to enemy bases than unused Thai military bases.

To summarize, we find that the U.S. military presence led to the development of the sex industry in districts close to the former locations of U.S. bases. By contrast, sex entrepreneurs did not locate their establishments in districts close to Thai military bases and airfields not used by the U.S.A.F. Interestingly, we do not find evidence for a convergence process in the sex industry with treated districts returning to the national average. The sex industry is extremely concentrated in several red-light districts, and at least as much as in 1990. It is not clear who sustains the demand for sexual services in treated districts and what are the sources of agglomeration in the sex industry. We turn to these issues in the next section.

V. Channels of Persistence

The persistent clustering of the sex industry in districts close to former U.S. bases is puzzling. Our results are not consistent with theoretical models in which long-term differences in the size of an industry are driven by locational fundamentals. Most coastal districts and tourist beaches are in the South of Thailand, and treated districts are less urbanized than control districts. Second, traditional sources of

economies of scale (i.e. faster supply of intermediate goods, better quality of worker-firm matches and knowledge spillovers) are unlikely in our settings.[34] The sex industry is labor intensive, with very mobile workers and very few innovations.

In order to better understand the persistence of the demand shocks, we first offer a theoretical rationale in a model with coordination frictions and information asymmetry between consumers and producers. In the lens of our model, the U.S. military presence gave incentives to sex entrepreneurs to invest in higher quality standards and build a reputation, thereby alleviating the frictions and information asymmetry. In spite of the departure of U.S. servicemen, these lower frictions attracted foreigners interested in buying high-quality sexual services (e.g. diversity of services or healthier standards). In parallel, lower information asymmetry also benefited sex entrepreneurs, who could invest even further in quality given the higher likelihood of finding a consumer interested in such services. We then empirically test the main predictions of the model: (i) sex establishments, and in particular high-quality sex establishments, are concentrated in districts near U.S. bases during and after the war, (ii) the quality offered is higher in districts near former U.S. bases (particularly so after the war), which yields (iii) higher sex act prices on average, and (iv) tourists consume sexual services after the war only in treated districts. We find strong empirical support for these predictions. In addition, we show that the higher quality standards reflect both a vertical and horizontal differentiation of services.

A. Model

The sex industry can be seen as a lemon market, and (quality-loving) consumers are only willing to purchase sexual services when quality is higher than a minimum level (Akerlof (1970)). The model draws on information asymmetry[35] to explain the persistence of prostitution in districts near former U.S. bases.

We set out a simple model with search frictions à la Diamond-Mortensen-Pissarides

[34]Many recent papers develop spatial equilibrium models with agglomeration economies. See for instance Kline and Moretti (2014), Gaubert (2014) and Severnini (2014).

[35]Bagwell and Staiger (1989), Grossman and Horn (1988) and Shapiro (1983) develop models with imperfect consumer information. Bagwell and Staiger (1989) study the role of export subsidies when foreign goods are initially of unknown quality. Grossman and Horn (1988) analyze the consequence that infant industry protection may have in the presence of informational barriers to entry whereas Shapiro (1983) investigate the implications of reputation in a perfectly competitive environment. O'Flaherty and Sethi (2010) and Galenianos et al. (2012) also develop theoretical models to study illicit markets. Galenianos et al. (2012) develops a search model with repeated trade between dealers and addicts. O'Flaherty and Sethi (2010) develop a model of illegal commercial transactions where the seller and the buyer need to be close to each other to trade. A relevant empirical study is Couture (2014), who estimates the gains from concentration in the restaurant industry using individuals' willingness to incur extra travel costs to reach their preferred locations.

and information asymmetry. Our model relies on three main assumptions. First, we assume, as is standard in random matching environment, that buyers cannot target a specific seller's type when looking for a match in a particular market. We assume that there are two types of sellers – street sellers and regular sellers – with different production technologies. Street sellers (e.g. direct sex establishments) only offer low-quality services. In contrast, a regular seller can adjust the quality of services that he offers in a regular establishment (e.g. indirect sex establishment). Second, there are two markets in each region: a regular market and a street market. In each period, buyers and sellers may only search for a match in one, and only one, market. We assume that street sellers only operate in the street market while regular sellers need to transit through the street market. But after one period in the street market, regular sellers acquire a reputation and are able to operate in the regular sex market. Third, we assume heterogeneity in how buyers value quality.

Our modeling choices are supported by anecdotal evidence. First, we assume information asymmetry between buyers and sellers at the matching stage, i.e. buyers are randomly matched with a seller irrespectively of their types. However, before matching, buyers rationally form beliefs on the structure of markets (reputation) in each region. Readers can imagine that foreign customers acquire the information about quality through the Internet or that the information is known through sex magazines. There were many articles on the Thai sex industry in the 1970s and 1980s in well-known magazines such as *Time Magazine*, *Parade Magazine* (Thanh-Dam (1983)) and *The New York Times*. Many travel guidebooks also describe red-light districts. The *2012 Rough Guide to Thailand* (Gray and Ridout (2012)) provides the following description of Pattaya: "The city swarms with male and female prostitutes, spiced up by Thailand's largest population of transvestites (*katoey*), and plane-loads of Westerners men flock here to enjoy their services in the rash of hostess bar-beers, go-go clubs and massage parlours."

Second, we assume that there are two segmented markets, one in which the type of seller is not observed, and one in which it is (only one type of sellers operate in the regular market). The rationale is that the street market is one market in which sellers pull customers in through procuresses, for instance, and buyers cannot verify whether the seller will bring them to a regular establishment. In contrast, in the regular market, establishments have been identified such that customers can skip the street market and directly look for the establishment. In this regard, the two markets benefit from matching technologies differing in their capacity to certify the type of sellers, which, *de facto*, excludes street sellers from the regular market. For simplicity, we assume that a regular establishment has access to the regular

market after one period with certainty, i.e. they are identified by potential consumers irrespectively of the quality that they offer. We could assume, without modifying the results, that such information transmission is imperfect.

Third, the model considers that there are different types of buyers, heterogeneous in how they value quality. We assume that U.S. servicemen have preferences for high-quality sexual services. There is anecdotal evidence supporting the idea that sex entrepreneurs adapted their services to foreigners' demand. Leheny (1995) writes that "during the Vietnam War, the sex industry both grew and diversified, moving beyond the rudimentary structure of simple brothels, which had largely catered to local men, to massage parlours, dance halls, and other, more complex environments for the marketing of sex."

Environment

The economy lasts for two periods. The economy is divided into 3 regions: a *treated* Thai district indexed by $i = t$, a *control* Thai district indexed by $i = c$ and the rest of the world indexed by $i = *$.

There are two goods, a numeraire and a final good (which is a sexual service and must be consumed where it is produced), whose production will be detailed later on. The final good can differ in its *quality* q.

There are two types of agents in the economy: buyers (or consumers) and sellers (or CSEs). Buyers live for only one period and are endowed with a unit of numeraire. Buyers derive utility from the consumption of (at most) one unit of final good and the remaining numeraire n at the end of the period:

$$u(q) + n.$$

Buyers can be of two types: quality-neutral (QN thereafter) and quality-loving buyers (QL thereafter). For QN buyers, $u(q) = \bar{u}$ is constant and represents also the maximum price that they are willing to pay for one unit of final good. For QL buyers, $u'(q) > 0$ such that they are prepared to pay a higher price for a high-quality final good.

There is a very large mass of potential sellers. Potential sellers live for two periods and are endowed at each period with one unit of labor and a technology to produce the final good from this labor. They maximize their profits and do not value the final good *per se*. Finally, the final good depreciates fully after one period such that the outside option of keeping the good at the end of the period is 0 for a seller.

At each period, sellers decide to enter the market or not and whether to be a

regular seller or a street seller. Street sellers produce a final good of the lowest quality 0 at a cost $c(0)$. Regular sellers have to pay a fixed cost $\bar{c}$ in order to set up an establishment which give them the possibility of producing a good of quality $q \geq 0$ at cost $c(q)$.

We assume that sellers operate in two distinct sex markets and buyers can direct their search specifically toward one of the two markets. First, there is a street market in which street sellers and newly established regular sellers operate. Second, there is a regular market constituted of sellers having been regular sellers in the first period. In other words, regular sellers need one period to convey information about their type. After this initial period, regular sellers can distinguish themselves from street sellers and their establishments can be identified. There are reputation returns, but not from offering a high-quality final good in the current period because quality is unobserved *ex-ante* and can be modified between periods without costs. The reputation returns come from being identified by buyers as a regular seller, thereby operating in the regular market. Appendix A5 illustrates the environment.

The timing of actions is as follows. At the beginning of each period, a number $\bar{b}_j^i$ of type-j buyers are born in region i. Each buyer decides whether to move to another region. We assume a transport cost t between the 2 Thai districts and a transport cost T between the rest of the world and any of the two Thai districts. Buyers then choose a sex market in which they search for a seller. In parallel, sellers decide to become regular or street sellers and are allocated to their respective sex market. Street sellers and newly established regular sellers are in the street market and regular sellers who transited in the street market in the previous period are now in the regular market. Regular sellers then simultaneously choose quality. In each market, sellers and buyers are then (randomly) matched following a process that we describe below. Buyers observe the quality upon matching while sellers observe the buyer's type. A price negotiation follows (see below). Last, buyers consume and die.

In each market, sellers cannot coordinate which buyers to meet, leading to coordination frictions. We assume that each seller must settle on one market and meet exactly one buyer. In other words, each seller can make only one offer per period. In contrast, some buyers get multiple offers from sellers, while others receive none. With sellers sending a random offer in a market with many sellers and buyers, the probability for a buyer to be matched with exactly a sellers follows a binomial distribution that can be approximated by a Poisson distribution:

$$P(a) = \frac{\theta^a}{a!} e^{-\theta},$$

where θ is the seller to buyer ratio. The probability that a buyer has exactly one offer is then $P(a=1)=\theta e^{-\theta}$ and the probability that a seller finds a buyer with no other offer is $e^{-\theta}$. Since there are two types of buyers, the probability for a buyer to be matched with exactly $\{a_1, a_2\}$ sellers follows a multinomial distribution.

Once they have received propositions from sellers, buyers observe the quality of goods offered by sellers and sellers observe the buyer's type. The decision to purchase the final good or not and the price of the final good is determined through a bargaining game between the buyer and the sellers. We assume that the buyer and the preferred seller share the surplus generated by the match over a match between the buyer and the second-preferred seller, an outcome that can be formalized as follows: with probability $1-\beta$, sellers issue simultaneous take-it-or-leave-it offers (prices) to the buyer. With probability β, the buyer issues simultaneous take-it-or-leave-it offers (prices) to the sellers. When sellers issue offers, the price is such that the preferred seller gets all the surplus above the second-preferred one. When buyers issue offers, the price is such that the buyer gets all the surplus, i.e. $p=0$.

There are then two cases that determine the negotiated price:

1. The buyer has only one offer of quality q. On average, the buyer expects to receive a share β of the surplus $\beta u(q)$ and the seller receives $E[p]=(1-\beta)u(q)$.

2. The buyer has more than one offer. Let $q^{'}$ be the preferred offer and q be the second-preferred offer. The buyer expects to receive $\beta(u(q)-u(q^{'}))+u(q^{'})$ and the preferred seller receives $E[p]=(1-\beta)(u(q)-u(q^{'}))$. A particular case is when there are two preferred sellers q, in which case the buyer expects to receive $u(q)$ and the preferred seller receives $E[p]=0$.

The next subsections present the buyers' and sellers' decision problems.

Buyers' Decision Problem

Before describing the buyer's expected gains from searching in a particular market, we need to derive the probability for all the different matching cases. In what follows, we drop region, period and market indices.

Consider a market in which there are s_r regular sellers, s_s street sellers, b_n quality-neutral buyers and b_l quality-loving buyers. For each buyer, the probability that he faces a_r regular sellers and a_s street sellers is given by:

$$P(a_r, a_s) = \frac{\theta_r^{a_r}}{a_r!}e^{-\theta_r}\frac{\theta_s^{a_s}}{a_s!}e^{-\theta_s},$$

where $\theta_r = \frac{s_r}{b_n+b_l}$ and $\theta_s = \frac{s_s}{b_n+b_l}$.

Reciprocally, sellers make one and only one offer. The probability to meet a QL buyer is $\frac{b_l}{b_n+b_l}$ and a QN buyer is $\frac{b_n}{b_n+b_l}$. One important determinant of a seller's problem is the competition that he faces. The probability that a seller, having made an offer, faces a_r other regular sellers and a_s other street sellers is the same for all buyers and is the same as the probability for a buyer to meet a_r regular sellers and a_s street sellers, i.e., $P(a_r, a_s)$ described above.

Consider as given the number of street and regular sellers in a sex market, the number of buyers and also the choice of quality q. The expected gains of a QL buyer searching in this market is:

$$U_{ql}(\theta_r, \theta_s) = (1 - e^{-\theta_r} - \theta_r e^{-\theta_r} + \beta\theta_r e^{-\theta_r-\theta_s})u(q) + ((2-\beta)e^{-\theta_r}(1 - e^{-\theta_s}) - (1-\beta)\theta_s e^{-\theta_r-\theta_s})u(0). \quad (1)$$

The expected gains of a QN buyer searching in this market is:

$$U_{qn}(\theta_r, \theta_s) = (1 - e^{-\theta_r-\theta_s} - (1-\beta)(\theta_r + \theta_s)e^{-\theta_r-\theta_s})u(0). \quad (2)$$

The buyer's decision consists in searching in the market which provides the highest expected gains once potential transport costs t or T are accounted for.

As shown in equation (2), QN buyers only care about the congestion in each market irrespectively of sellers' type shares. In contrast, QL buyers value more the presence of regular sellers, especially so when the quality of services is high (see equation (1)). Finally, buyers of both types are better off in markets with a lot of competition between sellers because it allows them to extract a larger share of the surplus.

We first assume that t and T are sufficiently high that QN buyers never travel. Second, we assume that the cost $\bar{c}$ is such that the regular market is never more congested than street markets. In other words, because the ratio $\theta_r + \theta_s$ is higher in street markets, the QN buyer always prefers the street markets. Coupled with the previous observation, it pins down the behavior of QN buyers who search in their own street market.

Sellers' Decision Problem

Consider as given the number of street and regular sellers in a market, the number of buyers and the choice of quality q. And let $\pi_i^j(t)$ denote the profit in one period of a seller of type i in a market of type j in period t. The expected profit for a regular

seller can be written as follows:

$$\pi_r(b_n, b_l, \theta_r, \theta_s) = \frac{b_l}{b_n + b_l}[e^{-\theta_r}(1-\beta)u(q) - e^{-\theta_r}(1-e^{-\theta_s})(1-\beta)u(0)] + \frac{b_n}{b_n + b_l}e^{-\theta_r-\theta_s}(1-\beta)u(0) - c(q) - \bar{c}.$$

Similarly, the expected profit for a street seller entering this market is given by:

$$\pi_s(b_n, b_l, \theta_r, \theta_s) = e^{-\theta_r-\theta_s}(1-\beta)u(0) - c(0).$$

Note that regular sellers gain only when they are not in competition with another regular seller. Street sellers gain only when they are not in competition with anyone.

We now deduce the behavior of sellers using backward induction. Once all sellers and buyers have entered a market (i.e. given b_n, b_l, θ_r and θ_s), regular sellers need to invest in quality q. What is the best response of a regular seller given that the other participants have chosen q? Offering quality $q + \varepsilon$ instead of q costs $c^{'}(q)$ and triggers the following marginal gain:

$$\frac{b_l}{b_n + b_l}(1-\beta)u^{'}(q).$$

Consequently, the only symmetric equilibrium for quality needs to verify:

$$\frac{b_l}{b_n + b_l}(1-\beta)u^{'}(q) = c'(q). \tag{3}$$

Quality is independent of congestion and only depends on the share of QL buyers. The higher this share, the higher the quality. In the end, quality depends on other regular sellers in the market only through the share of buyers that they attract.

We now study the entry decision of street sellers. Given that there are no dynamic gains for street sellers, the free-entry condition imposes that they enter as long as their instantaneous profit is positive, i.e. in each period t:

$$\pi_s^s(t) = 0, \quad t = 1, 2. \tag{4}$$

The entry decision of regular sellers is more difficult to analyze. In the second period, regular sellers having operated first in the street market enter the regular market. What about entry in the street market? Regular sellers enter in the first period as long as $\pi_r^s(1) + \pi_r^r(2) \geq 0$. Thus, the free-entry condition is:

$$\pi_r^s(1) + \pi_r^r(2) = 0 \tag{5}$$

This condition determines both how many regular sellers enter the street market in period 1, and how many regular sellers end up in the regular market in period 2. Because our model lasts only two periods, there is no entry of regular sellers in period 2 since (i) they would not benefit from reputation gains in the next period, (ii) and they have no relative advantage compared to street sellers given that QL buyers now target the regular market and there are mostly QN buyers in the street market.[36]

We can see from the analysis of equations (4) and (5) that the number of street sellers only depends on the number of buyers, irrespectively of their type. In contrast, the number of regular sellers depends crucially on the number of QL buyers. What is the advantage of being in the regular market? One can see from equation (1) that quality-loving buyers lose from the search frictions implied by the presence of street sellers. In the regular market, there are only regular sellers and quality-loving buyers, which allow regular sellers to offer higher quality and foster their entry. In the end, the regular market allows buyers and sellers to sort themselves and alleviate search frictions.

To sum up, let $s_i^j(t)$ denote the number of sellers of type i in market j in period t, we have:

- $s_r^r(1) = 0$: there is no regular market in the first period;
- $s_r^r(2) = s_r^s(1)$: the regular market in the second period is composed of first-period regular sellers in the street market; and
- $s_r^s(2) = 0$: there is no entry of regular sellers in the street market in the second period.

The remaining quantities $s_s^s(1)$, $s_s^s(2)$ and $s_r^s(1)$ are determined by the two equations (4) and equation (5).

Equilibrium

Definition 1. *An equilibrium is a set of tightness in each market j, region i, and period t, $(\theta_r^{i,j}(t), \theta_s^{i,j}(t))$, of buyer's presence $(b_n^{i,j}(t), b_l^{i,j}(t))$, of quality $q^{i,j}(t)$ verifying:*

[36] The condition is simply that regular sellers would not enter a street market without the future expected gains from operating in the regular market, i.e., that $\bar{c}$ is large enough:

$$\frac{\bar{b}_l}{\bar{b}_n + \bar{b}_l}(1-\beta)u(q) \leq c(q) + \bar{c}, \quad \forall q$$

.

- *the buyer's maximization program (see equations (1) and (2)) in each period;*
- *the profit maximization (see equation (3)) in each period; and*
- *the free entry conditions (see equations (4) and (5)).*

Given our previous observations, QN buyers never move and always search in the street market of their region of residence, i.e. $b_n^{i,r}(t) = 0$ and $b_n^{i,s}(t) = \bar{b}_n^i$. In the first period, the structure of supply in each region is the same, such that we assume that QL buyers coordinate and search in their region of residence, i.e. $b_l^{i,r}(1) = 0$ and $b_l^{i,s}(1) = \bar{b}^i$.

These observations, coupled with the ones on entry, allow us to simplify the equilibrium characterization. $(b_l^{i,r}(2), b_l^{i,s}(2))$, $(q^{i,s}(1), q^{i,r}(2))$ and $s_s^{i,s}(1), s_s^{i,s}(2), s_r^{i,s}(1)$ are determined by the 3 equations (4), one for each region, for the two periods, equation (5), equation (1) in period 2, and equation (3) in each period.

Predictions

In this subsection, we adapt our model to interpret our temporary demand shocks around former U.S. bases in Thailand. The first period is the war period, i.e. between 1965 and 1975, and U.S. servicemen are present in Thailand. The second period is the aftermath, i.e. after the departure of U.S. servicemen.

In order to simplify the exposition, we first assume that the *treated* and *control* district are both populated by $\bar{b}_n$ QN residents in both periods, and the rest of the world is populated by $\bar{b}_n^*$ QN residents in both periods.

Second, we assume that there are no QL residents in the *control* district in both periods, and there are no QL residents in the *treated* district in period 2. The only difference between the two districts – the treatment – is the presence of $\bar{b}_l^t$ QL buyers (i.e. U.S. servicemen) in period 1.

Finally, and only to simplify the exposition,[37] we assume that Thailand is small relatively to the rest of the world, and the presence of U.S. servicemen in the treated district implies a much higher share of QL residents than in the rest of the world (in the first period only). Accordingly, the presence of servicemen is sufficient to (substantially) affect the ratio of QL buyers in the treated district, but does not change the ratio of QL buyers in the rest of the world.

Let $\bar{b}^t = \bar{b}_l^t + \bar{b}_n$ denote the number of residents and $r^t = \bar{b}_l^t/(\bar{b}_l^t + \bar{b}_n)$ the ratio of QL buyers in the treated district period 1. Remark that there is a (constant) ratio

[37]The only important condition is that the share of QL residents in period 1 is higher in the treated district.

$r^c = 0$ in the control district and, because of the previous assumption, there is a (constant) number of residents $\bar{b}^* = \bar{b}_l^* + \bar{b}_n^*$ and (constant) ratio $r^* \approx 0$ of QL buyers in the rest of the world.

Let us start with the control district. In periods 1 and 2, there is no entry of regular sellers in the control district, and no buyers visit the district: $\theta_s = \ln((1-\beta)u(0)) - \ln(c(0))$ determines the number of street sellers in both periods, quality is 0 in both periods and prices are low. There is only a street market and the average price is

$$E[p_s(t)] = \frac{c(0)}{1 - \frac{c(0)}{(1-\beta)u(0)}} \ln\left[\frac{(1-\beta)u(0)}{c(0)}\right].$$

Given our assumption that QL buyers are negligible compared to QN buyers in the rest of the world, the rest of the world behaves approximately like the control district and the size of the regular market is negligible. The only difference lies in the existence of QL movers in period 2, which, from the perspective of sellers in the treated district, is not negligible.

We now focus on the treated district. We assume that there are no movements of QL buyers in period 1 (and establish under which condition it is verified later). There are six quantities that need to be determined: the number of regular sellers s_r^t, the quality $q^t(1)$ and $q^t(2)$ chosen by regular sellers in the street market ($t = 1$) and regular market ($t = 2$), the number of street sellers in both periods $s_s^t(1)$ and $s_s^t(2)$ and the number of QL buyers visiting the regular market in period 2 from the rest of the world.

In the first period, the number of street sellers is $s_s^t(1) = \bar{b}^t \ln\left[\frac{(1-\beta)u(0)}{c(0)}\right] - s_r^t$. In the second period, the number of street sellers is $s_s^t(2) = \bar{b}_n \ln\left[\frac{(1-\beta)u(0)}{c(0)}\right]$.

As regard investments in quality $q^t(1)$ in period 1 and $q^t(2)$ in period 2, they should verify:

$$\begin{cases} (1-\beta) r^t u'(q^t(1)) = c'(q^t(1)) \\ (1-\beta) u'(q^t(2)) = c'(q^t(2)). \end{cases}$$

As regards the number of regular sellers, we combine the free entry conditions and find an expression of regular sellers as a function of future QL buyers b_l^t and quality:

$$r^t e^{-\frac{s_r^t}{\bar{b}}}(1 - \beta(u(q^t(1)) - u(0))) + c(0) + (1-\beta) e^{-\frac{s_r^t}{b_l^t}} u(q^t(2)) = c(q^t(1)) + c(q^t(2)) + 2\bar{c}. \tag{6}$$

The previous equations give $(s_s^t(t), s_r^t(t), q^t(t))$ as a function of future QL buyers b_l^t and exogenous region-specific parameters $(r^t, \bar{b})$.

We need to determine the behavior of QL buyers, knowing that they all reside in the rest of the world in period 2. QL residents from the rest of the world will move to the treated district up to the point where they are indifferent given that the regular market is negligible in the rest of the world. Letting b_l^t denote the number of QL movers,

$$u(0)-\frac{c(0)}{1-\beta}-c(0)\ln(\frac{(1-\beta)u(0)}{c(0)}) = (1-e^{-\frac{s_r^t}{b_l^t}}-(1-\beta)\frac{s_r^t}{b_l^t}e^{-\frac{s_r^t}{b_l^t}})u(q^t(2))-T-c(q^t(2)). \tag{7}$$

Equation (7) determines the congestion $\frac{s_r^t}{b_l^t}$ in the regular market in period 2, and the equation is independent of r^t. The ratio regular sellers/QL buyers in the treated district is independent of the size of the initial flow of U.S. servicemen.

What pins down the size of the regular market, s_r^t (and thus indirectly b_l^t) is the no-profit condition (6). Regular sellers enter the sex market knowing that (i) in period 1, the number of potential buyers is fixed, while (ii) in period 2, QL residents respond to maintain congestion fixed at the level determined by equation (7). Equation (6) shows that, given congestion $\frac{s_r^t}{b_l^t}$ which is independent of r^t, s_r^t increases with r^t.

Following these remarks, we can summarize our results in the following proposition:

Proposition 1. *Across regions (treated t, control c, the rest of the world $*$) characterized by different initial allocation of residents $r^t > r^* \approx r^c = 0$ in period 1, we have that*

- *the quality offered by regular sellers verify $q^t > q^* \approx q^c = 0$ in both periods,*
- *the ratio of regular sellers over residents is higher in the treated district, i.e. $\frac{s_r^t}{\bar{b}_n^t+\bar{b}_l^t} > \frac{s_r^*}{\bar{b}_n^*+\bar{b}_l^*} \approx s_r^c = 0$ in both periods.*
- *Given that the quality offered by regular sellers and the share of regular sellers are both higher in the treated district than in the rest of the world or the control district, the <u>average</u> quality is also higher. Using a similar reasoning, the average quality increases over time in the treated district.*
- *As long as*

$$u(0)-\frac{c(0)}{1-\beta}-c(0)\ln(\frac{(1-\beta)u(0)}{c(0)}) = u(q^t(2))-T-c(q^t(2)) \tag{8}$$

is verified, there is an outflow of QL buyers from the rest of the world to the treated district whose size positively depends upon the size of r^t.

Finally, across time, we have that:

- $q^t(2) > q^t(1)$, *quality improves over time.*
- $Ep^t(2) > Ep^t(1)$, *prices increase over time.*

How can we interpret these results? In period 1, some QL buyers (i.e. U.S. servicemen) from the rest of the world purchase sexual services in the treated district. This demand shock in the treated district gives incentives for regular sellers to enter the sex market and to offer a final good of a quality higher than the lowest quality 0. However, in period 1, regular sellers operate in the street market and cannot differentiate themselves from street sellers. The quality offered is thus higher than in districts without U.S. servicemen, but not as high as it would be with a regular market. In the second period, regular sellers operate in the regular market which allows them to increase the quality offered. In the rest of the world, there exists a regular market with the same high quality, but the market is negligible as a share of the demand. Consequently, QL buyers in the rest of the world move to the treated district in order to benefit from the high congestion of regular sellers.

We now reformulate the proposition and obtain four testable implications:

1. **Concentration**: there is a higher concentration of regular sellers in treated districts during and after the war.
2. **Quality**: quality is higher in treated districts than in control districts and the gap increases over time.
3. **Prices**: sex act prices are higher in treated districts than in control districts and the gap increases over time.
4. **Flows**: there are flows of QL buyers from the rest of the world to treated districts after the war.

Empirically, we proxy regular sellers by indirect establishments and street sellers by direct establishments. As regards quality, we use two distinct dimensions. First, we look at the variety of sexual services offered in treated and control districts. Second, we test the prediction of higher quality by analyzing HIV data. Importantly, in the empirical application, we do not observe the first period, i.e. the war period. Instead, we use many observations during the aftermath, assuming that changes have been gradual. All predictions requiring time comparisons are tested using the differences between 1990 and 2010s data.

B. Stylized Facts

In this subsection, we document the concentration of regular establishments, the horizontal and vertical differentiation of services, prices and tourist demand.

Concentration of Regular Establishments

The size of the sex industry varies enormously across districts and provinces.[38] Figures 1 and 2 illustrate that the sex industry is very concentrated. In 1990, approximately 50% of commercial sex workers were working in 21 red-light districts. Looking at the figures, readers can see that this concentration has increased over the past decades. In 2012, more than half of the CSWs were working in solely 13 districts.

In 1990, we find evidence that there were fewer direct (i.e. brothels, tea houses, hotels, bungalows or guesthouses) and "archaic" sex establishments and more sophisticated sex establishments in treated districts. There were 3.25 brothels or tea houses and 1.92 hotels, bungalows or guesthouses on average in treated districts in comparison to 8.48 brothels or tea houses and 1.5 hotels, bungalows or guesthouses in controls. In contrast and in line with our theoretical framework, there were much more indirect sex establishments in treated districts than in controls.[39] For instance, there were 11 times more beer bars, pubs and lounges on average in treated districts than in controls. We confirm these results using specification (S2). We find that there were 115% more indirect sex establishments in treated districts than in controls in 1990 (not shown for space consideration).

The number of regular sex establishments remained much larger in treated districts than in controls in recent years. In 2010, there were 790 CSWs working in indirect sex establishments on average in districts within an hour of a former U.S. base against 71 on average in districts within an hour of an unused Thai base. Our estimate of specification (S2) with the natural log of one plus the number of CSWs working in indirect CSEs as the dependent variable suggests that there are ten times more sex workers in indirect sex establishments in treated than in control districts (not shown for space consideration). Hence, we confirm that there is a concentration of regular sex establishments in treated districts.

[38] Felkner and Townsend (2011) report that there are high concentrations of enterprise in Thailand and that economic concentrations are increasing over time, although the patterns for most industries in Thailand are not as extreme as for the sex industry.

[39] Note that traditional massage parlors are often categorized as a direct CSE while modern massage parlors are categorized as indirect sex establishment. The results presented in this section are robust to the categorization of massage parlors as direct or indirect CSEs.

Quality: Horizontal and Vertical Differentiation

The theoretical model predicts that sex establishments in districts that housed U.S. bases offer high-quality sexual services. In particular, sex entrepreneurs will attempt to attract sex tourists by differentiating their sexual services after the war. In our framework, foreign consumers may gain from concentration of regular CSEs through better access to a variety of sexual services and healthier standards, for instance. We find empirical evidence that CSEs in treated districts offer a greater range of sexual services than controls. For instance, there are currently eighteen times more male CSWs in treated districts than in controls and the majority of ladyboy cabaret shows are in major red-light districts. Moreover, most of the "sophisticated" sex establishments are in red-light districts. In 1990, almost half of the sex establishments classified as discotheque, nightclub or gogo bar were in the five biggest red-light districts.

We show empirical evidence of horizontal differentiation in Appendix Table A1. We classify CSEs into eight categories and show the differential composition of establishments across districts in 1990 and 2010 (2012 data not available). The categories are as follows: (i) brothel and tea house (ii) hotel, guesthouse and bungalow (iii) restaurant and coffee shop (iv) karaoke (v) massage parlor (vi) beer bar, pub, lounge and cafe (vii) discotheque, nightclub and gogo bar (viii) other CSEs. Comparing columns 1 (treated group) and 2 (control group), we see that there are relatively more bars and nightclubs in the treated districts: for the year 1990, they represent 32% of sex establishments against 4% in the control group. In contrast, the share of brothels was less important. CSEs in treated districts were also more likely to be bars and discotheques in 2010. To sum up, sex entrepreneurs offer a broader range of luxurious sexual services in treated districts.

We confirm this compositional difference in Table 8. We estimate specification (S2) with the share of each type of establishment as the dependent variable. The dependent variable is on a scale of 0 to 1. A value of 1 means that all the sex establishments in the district are of this type. The results confirm the idea that bars and nightclubs have substituted direct CSEs in treated districts. The share of beer bars and discotheques is economically and significantly larger in treated districts than in controls in both years.

We now check whether high-quality services are offered in treated districts. It is usually believed that consumer's willingness to pay is negatively related to the local disease prevalence. We thus test the prediction of vertical differentiation by analyzing HIV data. Approximately 600,000 Thais have died from AIDS since the

late 1980s and many more are living with HIV. The decision to purchase sexual services is clearly related to the HIV prevalence among CSWs. Online Appendix Figure A.6 reports that the number of CSWs in Thailand decreased by more than a third during the HIV outbreak (early 1990s).

Figure A6 illustrates the HIV prevalence among direct female CSWs, indirect female CSWs, female CSWs outside urban areas and Thai conscripts aged 21 years old from 1990-2010. The data are from examinations of female CSWs (sentinel surveillance system) conducted by the Ministry of Public Health. The prevalence reached 25% among direct female CSWs in the early 1990s and fell steadily to less than 5% in recent years. HIV rates among indirect female CSWs never reached 10% and have stabilized around 3% since the mid-2000s. HIV prevalence for the third group, female CSWs outside urban areas, is between the prevalence among direct and indirect female CSWs over the whole period.

Unfortunately, the sentinel surveillance system data are available solely at the province level and we cannot directly compare our treated districts against the control districts. We thus classify provinces as treated if at least one district is within one hour of a former U.S. base. Control provinces have at least one district within one hour of an unused Thai base and no district within one hour of a U.S. base. Figure 6 shows the HIV prevalence among direct and indirect female CSWs for the treated and control provinces over the past two decades. The HIV data confirm our hypothesis of vertical differentiation. The prevalence among direct female sex workers is around 11% in treated provinces and over 15% in control provinces over all these years. The gap between treated and control provinces is smaller for indirect female CSWs, with a prevalence smaller than 5% for treated provinces and over 6% for the controls. Note that HIV rates are decreasing over the period studied. This is mainly due to the implementation of various programs to prevent and control the HIV epidemic.[40] These results suggest that sex entrepreneurs have offered higher quality services in order to attract sex tourists after the departure of U.S. servicemen and during the HIV outbreak.[41]

To sum up, we uncovered empirical evidence that the sex industry in treated

[40]Rojanapithayakorn and Hanenberg (1996) describe how HIV spread in the late 1980s and how Thai authorities implemented prevention programs. One of the most well-known programs is the 100% Condom Campaign whose goals included targeting condom usage among CSWs and their clients. The program worked effectively and it led to a substantial decline in the number of major STIs in the next few years.

[41]Many authors have pointed out that large firms tend to differentiate their products more. We uncover evidence that the size of firms, measured by the number of CSWs per CSE, is much larger for treated districts than in controls. We present 1990 and 2012 OLS estimates in Online Appendix Table A17. The estimates suggest that sex establishments in treated districts have economically and significantly more sex workers than in control districts.

districts does not only differ by its size but also by the range and quality of services that are offered. The sex industry in the comparison group is composed of rudimentary CSEs whereas red-light districts formerly housing U.S. bases offer a greater range of higher-quality sexual services.

Sex Act Prices

We now analyze price differences across Thailand, and show that sex act prices are higher in treated districts than in controls and that the price differences are explained by both horizontal and vertical differentiation of sexual services.[42] Unfortunately, we cannot test whether the gap increases over time since we only have 1990 sex act prices.

The price data are collected when the surveyors visit the CSEs for the annual national survey in January. The information is self-reported and is sometimes provided as a range of prices (e.g. from 800 to 1,000). We use the mean in those instances. The price data do not include the price of drinks and food but it is possible that this is inclusive of a dance or a massage before the intercourse service. We take the average price of an intercourse service reported by all sex establishments in each district.

Figure 5 shows the distribution of sex act prices in 1990. Figure 5(a) and 5(b) present respectively the distribution of sex act prices for treated districts ($USB_{d,r}$=1) and districts in the first control group ($THB_{d,r}$=1). The distribution in treated districts presents a two-humped camel pattern with a local minimum around 500 bahts ($20) and a local maximum around 650 bahts ($25). The distribution in controls presents a maximum around 100 bahts ($5). Very few sex establishments in controls reported sex act prices over 400 bahts ($15). These results suggest that sex act prices are higher in treated districts than in controls and that treated districts offer both low and high-quality sexual services. We verify our intuition in what follows.

We check if there are sex act price differences between U.S. districts and our comparison group in Table 9 (specifications (S1) and S2)). We find that the average price of a sex act is approximately 50% higher in districts near the locations of former U.S. bases compared to control districts.[43]

[42]The sex industry is highly competitive, and any price differences are unlikely to be explained by different mark-ups. If anything, there is probably higher competition with the geographical concentration of CSEs, and mark-ups would be lower in treated districts.

[43]Note that the sex act price differences between treated and control districts are not driven by cost-of-living differences. We checked that prices of well-known commodities are similar between the two groups of districts using data at the province level from the Thai Bureau of Trade and

Do the price differences come from horizontal differentiation? Horizontal differentiation indeed explains a large share of the across-district differences in sex act prices; however, even when we consider the average sex act prices of similar CSEs, we still uncover significant differences. In Table 10, we verify if there are price differences for sexual services in similar CSEs across treated and control districts (specifications (S1) and (S2)). We aggregate the different establishments into three groups. The first group is composed of brothels, tea houses, hotels, bungalows and guesthouses. Sex acts are relatively inexpensive in these establishments and CSWs generally offer sexual services on the premises. The second group includes beer bars, pubs, lounges, alcohol-sale cafes, restaurants and coffee shops. The price of intercourse is higher than in the first group for those indirect CSEs. The last group is composed of CSEs in which CSWs very often provide a massage or a dance in addition to sexual services. We include massage parlors, discotheques, nightclubs, gogo bars and the few remaining establishments in this category. The coefficients in columns 1 and 2 are positive, but smaller than the estimate for all CSEs. Strikingly, columns 3 and 4 show that the price differences for sex acts are not statistically significant for the second group. In contrast, the price of sex acts for the third group, columns 5 and 6, is much larger in treated districts than in controls. The coefficient is almost three times larger than the estimate for all CSEs and larger than the mean of the control group.

We found that there are relatively more sophisticated sex establishments in treated districts than in controls. Moreover, there are large price differences in sophisticated establishments across the treatment, which could indicate that better quality sexual services are offered in treated districts. In order to test this quality hypothesis, we provide evidence that sex act prices are on average lower when local HIV rates are higher. We rely on the prevalence of HIV among Thai military conscripts aged 21 years old, direct female CSWs and indirect female CSWs at the province level. HIV indicators are on a scale from 0 to 100, and the means are respectively 3.2, 11.9 and 3.3. We present the estimates for Thai military conscripts in Table 9, column 3. We do not include region fixed effects since the HIV data is at the province level and there is not enough variation across provinces in a given region. The estimates are significant and suggest that an increase of 1% in HIV prevalence among Thai conscripts decreases sex act prices by 4.6%. The relationship between prices and HIV among direct female CSWs is also statistically significant (see On-

Economic Indices. For instance, we find very small differences in prices for rice and chicken in specification (S2). Chicken is 4% less expensive in treated districts than in controls while rice is 8% more expensive. Results available upon request.

line Appendix Table A16). The estimates suggest that an increase of 1% in HIV prevalence among direct female CSWs decreases sex act prices by 1.1%. Last, HIV prevalence among indirect CSWs at the province level is not related to sex act prices. This may be due to the fact that the perceived risk of HIV transmission in indirect sex establishments is low.

These results, along with the price differences across treated and control districts for similar CSEs, lead us to the conclusion that the quality offered in treated districts is higher than in controls. We now turn to the prediction on the number of QL buyers from the rest of the world consuming in treated districts.

Flows of Tourists

We cannot directly test whether tourists are purchasing sexual services in treated districts. Instead, we undertake the following exercises. First, we check whether tourists visit treated districts and verify that this relationship is not related to non-sexual tourist attractions. Second, we look at whether tourists with a low willingness to purchase sexual services visit districts that housed U.S. bases. Arguably, families are less likely to visit sex establishments than bachelors. The third exercise consists in documenting whether sex act prices are higher in tourist destinations.

Sex tourism in Thailand is well known internationally, with red-light districts being recommended in several travel guidebooks and sex magazines (Nuttavuthisit (2007)). However, there are no reliable estimates on the number of tourists buying sexual services. Thanh-Dam (1983) mentions that approximately 60% of tourists visiting Thailand in the early 1980s were drawn to this country because of the sex industry. Brinkmann (1992) proposed that around 10% of tourists visiting Thailand were paying for sexual services in the early 1990s. He calculated that if 500,000 tourists were having sex with CSWs on average 10 times, this would imply approximately 5 million sexual acts per year. While we cannot verify those numbers and assumptions, we document whether tourists are visiting districts where U.S. servicemen were formerly stationed.

Unfortunately, data on tourist arrivals from the Tourism Authority of Thailand (TAT) are only available at the province level. In order to verify whether tourists are visiting districts near the former locations of U.S. military bases, we rely on a list of hotels in Thailand on the internet-based travel website Expedia (see the Online Appendix for details concerning the data construction and data sources). In Appendix E, we also rely on the number of persons employed in this industry. We construct the following three tourism variables from this website: the number of 1- and 2-star hotels, the number of 3-star hotels and the number of 4- and 5-star

hotels. These measures of tourism are highly correlated with a range of data from the TAT, which is reassuring. For instance, the correlation between the number of foreign visitors in 2011 and the total number of hotels at the province level is 0.74.

We analyze whether there are currently more hotels in districts that were close to U.S. and unused bases in Table 11. We report OLS estimates of equations (S1) and (S2) with our usual set of controls. Note that our specification takes into account the fact that many tourists visit Thailand because of temples, ruins, beaches and other non-sexual tourist attractions. Column 1 suggests that the U.S. military presence is weakly positively correlated with the current number of 1- or 2-star hotels in districts within one hour of a U.S. base compared to unused districts.[44] The most striking impact is for luxurious hotels. Columns 3 and 4 show a positive impact of U.S. military presence for 3-star hotels. Columns 5 and 6 estimate that the U.S. presence increased by approximately 100% the number of 4- and 5-star hotels for districts within one hour of a former U.S. installment. The effect is large and economically significant. Note that the mean of the dependent variable for the reduced sample is 3.2 (column 6). This result is quite remarkable since our specifications include a large number of non-sexual tourist attractions. Around a quarter of all 4- and 5-star hotels in Thailand are nowadays in districts that could be reached by U.S. servicemen in less than one hour. This is consistent with anecdotal evidence that sex establishments and luxurious hotels are located near each other.

A related observation is that hotels in provinces that housed U.S. bases offer fewer services to families than hotels in other tourist areas. We present in Appendix Table A2 the percentage of hotels offering babysitting services. Among the 15 provinces with the highest number of hotels, Chon Buri and Nakhon Ratchasima, two provinces that housed U.S. bases, have the lowest percentage of hotels offering services to families. On the other hand, hotels located in Southern provinces such as Phang Nga and Phuket are more likely to offer babysitting services. We find that only 18% of the hotels in treated districts offer babysitting services compared to 27% in the second comparison group (control group including airfields) and a national average of 26%. This finding simply indicates that families and bachelors might not visit the same destinations in Thailand.

Thus, we find empirical evidence that tourists with a high willingness to purchase sexual services are visiting treated districts. Our interpretation is that the presence of U.S. servicemen gave incentives to sex entrepreneurs to formalize their

[44] Care is required when interpreting this result, as some low-quality hotels may not be registered on Expedia. This should not be an issue for high quality hotels. Measurement error is problematic here if it is related to the treatment.

sex establishments during and after the war. Sex tourists were then attracted to red-light districts near former U.S. bases because of the low search frictions.

VI. Conclusion

We discuss the development of the sex industry after the Vietnam War and study the role that temporary demand shocks for sexual services played in the current concentration of sex establishments. By combining historical documents reporting U.S. military presence in Thailand and data on the commercial sex industry, we analyze the relationship between the presence of U.S. military bases and the size of the local sex industry from 1990-2012. We document that many of the districts that were easily reachable by U.S. servicemen during the war have become red-light districts. We show that our findings are not spurious by exploiting Thai military bases as well as airfields and seaplane anchorages not used by the U.S.A.F. as comparison groups. Our estimates suggest that there are currently five to nine times more commercial sex workers in districts that could be reached by U.S. servicemen in less than one hour and that 40% of the total number of CSWs in Thailand are working in those districts.

While a geographic correlation between prostitution and the presence of military bases would not have been surprising during the war, it is more so 40 years later. We propose a simple model in which the presence of U.S. servicemen allowed sex entrepreneurs to overcome the traditional information asymmetry problem in the sex industry, thereby coordinating high-quality sellers and QL buyers. After the war, sex tourists visited treated districts, sustaining the demand for sexual services. We test the main predictions of our model and find that sophisticated CSEs offering high-quality services are currently located in treated districts.

Our empirical findings are policy relevant. The results suggest that the concentration of CSEs played an important role in attracting sex tourists. This means that dispersing CSEs across Thai provinces or regions could have the opposite impact. It is unclear whether local policymakers want to decrease the sex industry's size. On the one hand, the local development of the sex industry potentially led to drug and alcohol abuse and AIDS deaths. On the other hand, the direct revenue of the sex industry is very high in provinces with a red-light district (see Appendix G). Another policy implication is that local demand shocks may have long-lasting effects even in the absence of natural advantages or agglomeration economies in production. A key question for policy purposes is to assess whether similar results hold for place-based policies on other low-skilled services.

There are many dimensions along which the results of this paper may be of general interest. First, they highlight an unintended consequence of war and show that a disequilibrium in male to female ratio may lead to the development of prostitution.[45] Second, many legal and illegal industries have economic features similar to the Thai sex industry: a service purchased locally by non-local populations with firms highly concentrated. These characteristics are essential for illicit gambling and drug businesses, but also for hotels, restaurants and many other entertainment sectors in which information plays an important role. Our results relate also to the decision of tourists to travel to well-known destinations. For instance, tourists might travel to Las Vegas or Disneyland because of the small informational cost and the large variety of casinos/rides.

[45]The U.S. military presence in the Asia-Pacific region has fostered the commercial sex industry around U.S. bases in South Korea, Philippines and Vietnam (Lim (1998)). Many other historical events have affected male to female ratios. For instance, thousands of men worked on the construction of Hoover Dam and hundreds of thousands of tourists visited Las Vegas in the following years. Anecdotal evidence suggests that the development of the entertainment industry and the liberalization of divorce laws were related to this temporary disequilibrium in the male to female ratio.

References

Ahlfeldt, G. M., Redding, S. J., Sturm, D. M. and Wolf, N.: 2014, The Economics of Density: Evidence from the Berlin Wall, *NBER Working Paper* (20354).

Akerlof, G. A.: 1970, The Market for "Lemons": Quality Uncertainty and the Market Mechanism, *The Quarterly Journal of Economics* **84**(3), 488–500.

Arunachalam, R. and Shah, M.: 2008, Prostitutes and Brides?, *The American Economic Review: Papers and Proceeding* **98**(2), 516–22.

Bagwell, K. and Staiger, R. W.: 1989, The Role of Export Subsidies when Product Quality is Unknown, *Journal of International Economics* **27**(1), 69–89.

Baral, J.: 1973, US Involvement in Thai Security, *China Report* **9**(4), 16–28.

Blanchard, O. J. and Katz, L. F.: 1992, Regional Evolutions, *Brookings Papers on Economic Activity* **23**(1), 1–76.

Bleakley, H. and Lin, J.: 2012, Portage and Path Dependence, *The Quarterly Journal of Economics* **127**(2), 587–644.

Boonchalaksi, W. and Guest, P.: 1994, *Prostitution in Thailand*, number 171, Mahidol University: Institute for Population and Social Research.

Brauer, J. and Marlin, J. T.: 1992, Converting Resources from Military to Nonmilitary Uses, *Journal of Economic Perspectives* **6**(4), 145–164.

Brinkmann, U. K.: 1992, *Features of the AIDS Epidemic in Thailand*, Harvard School of Public Health.

Broadberry, S. and Marrison, A.: 2002, External Economies of Scale in the Lancashire Cotton Industry, 1900-1950, *The Economic History Review* **55**(1), 51–77.

Brodeur, A., Lekfuangfu, W. N. and Zylberberg, Y.: 2014, Online Appendix: Persistent Impacts of Temporary Demand Shocks: How U.S. Servicemen Shaped Thailand's Sex Industry, *Mimeo: https://sites.google.com/site/abelbrodeur/papers* .

Canning, D.: 2006, The Economics of HIV/AIDS in Low-Income Countries: The Case for Prevention, *Journal of Economic Perspectives* **20**(3), 121–142.

Cho, S.-Y., Dreher, A. and Neumayer, E.: 2013, Does Legalized Prostitution Increase Human Trafficking?, *World Development* **41**, 67–82.

Clift, S. and Carter, S.: 2000, *Tourism and Sex: Culture, Commerce and Coercion*, Tourism, Leisure, and Recreation Series, Pinter.

Cohen, E.: 1988, Tourism and AIDS in Thailand, *Annals of Tourism Research* **15**(4), 467–486.

Couture, V.: 2014, Valuing the Consumption Benefits of Urban Density, *Mimeo: University of California, Berkeley* .

Cunningham, S. and Kendall, T. D.: 2011, Prostitution 2.0: The Changing Face of Sex Work, *Journal of Urban Economics* **69**(3), 273–287.

Davis, D. R. and Weinstein, D. E.: 2002, Bones, Bombs, and Break Points: The Geography of Economic Activity, *The American Economic Review* **92**(5), 1269–1289.

Duranton, G. and Puga, D.: 2004, Micro-Foundations of Urban Agglomeration Economies, *Handbook of Regional and Urban Economics* **4**, 2063–2117.

Edlund, L. and Korn, E.: 2002, A Theory of Prostitution, *Journal of Political Economy* **110**(1), 181–214.

Ellison, G., Glaeser, E. L. and Kerr, W. R.: 2010, What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns, *American Economic Review* **100**(3), 1195–1213.

Enloe, C.: 1989, *Bananas, Beaches and Bases: Making Feminist Sense of International Relations*, Berkeley: University of California.

Felkner, J. S. and Townsend, R. M.: 2011, The Geographic Concentration of Enterprise in Developing Countries, *The Quarterly Journal of Economics* **126**(4), 2005–2061.

Galenianos, M., Pacula, R. L. and Persico, N.: 2012, A Search-Theoretic Model of the Retail Market for Illicit Drugs, *Review of Economic Studies* **79**(3), 1239–1269.

Gaubert, C.: 2014, Firm Sorting and Agglomeration, *Mimeo: Princeton University* .

Gertler, P. J. and Shah, M.: 2011, Sex Work and Infection: What's Law Enforcement Got to Do with It?, *Journal of Law and Economics* **54**(4), 811–840.

Gertler, P., Shah, M. and Bertozzi, S. M.: 2005, Risky Business: The Market for Unprotected Commercial Sex, *Journal of Political Economy* **113**(3), 518–550.

Gray, P. and Ridout, L.: 2012, *The Rough Guide to Thailand*, Rough Guides UK.

Grossman, G. and Horn, H.: 1988, Infant-Industry Protection Reconsidered: The Case of Informational Barriers to Entry, *The Quarterly Journal of Economics* **103**(4), 767–87.

Guest, P.: 1995, *Estimating the Inestimable: The Number of Child Prostitutes in Thailand*, Mahidol University: Institute for Population and Social Research.

Kislenko, A.: 2004, A Not So Silent Partner: Thailand's Role in Covert Operations, Counter-Insurgency, and the Wars in Indochina, *Journal of Conflict Studies* **24**(1).

Kline, P. and Moretti, E.: 2014, Local Economic Development, Agglomeration Economies, and the Big Push: 100 Years of Evidence from the Tennessee Valley Authority, *The Quarterly Journal of Economics* **129**(1), 275–331.

Krugman, P.: 1991a, *Geography and Trade*, Cambridge, MA: MIT Press.

Krugman, P.: 1991b, Increasing Returns and Economic Geography, *Journal of Political Economy* **99**(3), 483–99.

Lee, S. and Persson, P.: 2013, Human Trafficking and Regulating Prostitution, *Working Paper Series, Research Institute of Industrial Economics* (996).

Leheny, D.: 1995, A Political Economy of Asian Sex Tourism, *Annals of Tourism Research* **22**(2), 367–384.

Levinsohn, J., McLaren, Z. M., Shisana, O. and Zuma, K.: 2013, HIV Status and Labor Market Participation in South Africa, *Review of Economics and Statistics* **95**(1), 98–108.

Levitt, S. D. and Venkatesh, S. A.: 2007, An Empirical Analysis of Street-Level Prostitution, *Mimeo: Preliminary and Incomplete Version* .

Li, H.: 2013, Does Competition Eliminate Discrimination? Evidence from the Commercial Sex Market in Singapore, *Mimeo: Boston University* .

Li, V. F.: 1995, Child Sex Tourism to Thailand: The Role of the United States as a Consumer Country, *Pacific Rim Law and Policy Journal* **4**(2), 505–542.

Lim, L. L.: 1998, *The Sex Sector: The Economic and Social Bases of Prostitution in Southeast Asia*, International Labour Organization.

Lyttleton, C.: 1994, The Good People of Isan: Commercial Sex in Northeast Thailand, *The Australian Journal of Anthropology* **5**(3), 257–279.

Marshall, A.: 1980, *Principles of Economics*, Macmillan and Co. London.

Miguel, E. and Roland, G.: 2011, The Long-Run Impact of Bombing Vietnam, *Journal of Development Economics* **96**(1), 1–15.

Moretti, E.: 2011, *Local Labor Markets*, Vol. 4 of *Handbook of Labor Economics*, Elsevier, chapter 14, pp. 1237–1313.

Nunn, N.: 2008, The Long-Term Effects of Africa's Slave Trades, *The Quarterly Journal of Economics* **123**(1), 139–176.

Nuttavuthisit, K.: 2007, Branding Thailand: Correcting the Negative Image of Sex Tourism, *Place Branding and Public Diplomacy* **3**(1), 21–30.

O'Flaherty, B. and Sethi, R.: 2010, The racial geography of street vice, *Journal of Urban Economics* **67**(3), 270–286.

Oster, E.: 2005, Sexually Transmitted Infections, Sexual Behavior, and the HIV/AIDS Epidemic, *The Quarterly Journal of Economics* **120**(2), 467–515.

Oster, E.: 2012, Routes of Infection: Exports and HIV Incidence in Sub-Saharan Africa, *Journal of the European Economic Association* **10**(5), 1025–1058.

Ouyyanont, P.: 2001, The Vietnam War and Tourism in Bangkok's Development, 1960-70, *Southeast Asian Studies* **39**(2), 158–187.

Paloyo, A., Vance, C. and Vorell, M.: 2010, The Regional Economic Effects of Military Base Realignments and Closures in Germany, *Defence and Peace Economics* **21**(5-6), 567–579.

Pasuk, P., Piriyarangsan, S. and Treerat, N.: 1998, *Guns, Girls, Gambling, Ganja: Thailand's Illegal Economy and Public Policy*, Chiang Mai: Silkworm Books.

Randolph, R. S.: 1979, The Limits of Influence: American Aid to Thailand, 1965–70, *Asian Affairs: An American Review* **6**(4), 243–266.

Rao, V., Gupta, I., Lokshin, M. and Jana, S.: 2003, Sex Workers and the Cost of Safe Sex: The Compensating Differential for Condom Use Among Calcutta Prostitutes, *Journal of Development Economics* **71**(2), 585–603.

Redding, S. J., Sturm, D. M. and Wolf, N.: 2011, History and Industry Location: Evidence from German Airports, *Review of Economics and Statistics* **93**(3), 814–831.

Robinson, J. and Yeh, E.: 2011, Transactional Sex as a Response to Risk in Western Kenya, *American Economic Journal: Applied Economics* **3**(1), 35–64.

Robinson, J. and Yeh, E.: 2012, Risk-Coping through Sexual Networks: Evidence from Client Transfers in Kenya, *Journal of Human Resources* **47**(1), 107–145.

Rojanapithayakorn, W. and Hanenberg, R.: 1996, The 100% Condom Program in Thailand, *Aids* **10**(1), 1–8.

Rosenthal, S. S. and Strange, W. C.: 2004, Evidence on the Nature and Sources of Agglomeration Economies, *Handbook of Regional and Urban Economics* **4**, 2119–2171.

Seib, C., Fischer, J. and Najman, J. M.: 2009, The Health of Female Sex Workers from Three Industry Sectors in Queensland, Australia, *Social Science & Medicine* **68**(3), 473–478.

Severnini, E. R.: 2014, The Power of Hydroelectric Dams: Agglomeration Spillovers, *Working Paper: IZA discussion papers* (8082).

Shah, M.: 2013, Do Sex Workers Respond to Disease? Evidence from the Male Market for Sex, *The American Economic Review: Papers and Proceeding* **103**(3), 445–450.

Shapiro, C.: 1983, Premiums for High Quality Products as Returns to Reputations, *The Quarterly Journal of Economics* **98**(4), 659–79.

Stahl, K.: 1987, Theories of Urban Business Location, *Handbook of Regional and Urban Economics* **2**, 759–820.

Steinberg, D. I.: 1986, *The Role of External Assistance in the Economic Development and Planning of Thailand: Torques and Tensions in the American Aid Program*, US Agency for International Development.

Thanh-Dam, T.: 1983, The Dynamics of Sex Tourism: the Case of Southeast Asia, *Development and Change* **14**(4), 533–553.

Thompson, W.: 2003, *To Hanoi and Back: The United States Air Force and North Vietnam 1966-1973*, Government Printing Office.

Townsend, R. M.: 2011, *Financial Systems in Developing Economies: Growth, Inequality and Policy Evaluation in Thailand*, number 9780199533237 in *OUP Catalogue*, Oxford University Press.

Viksnins, G. J.: 1973, United States Military Spending and the Economy of Thailand, 1967-1972, *Asian Survey* **13**(5), 441–457.

Wawer, M. J., Podhisita, C., Kanungsukkasem, U., Pramualratana, A. and McNamara, R.: 1996, Origins and Working Conditions of Female Sex Workers in Urban Thailand: Consequences of Social Context for HIV Transmission, *Social Science & Medicine* **42**(3), 453–462.

Wolinsky, A.: 1983, Retail Trade Concentration Due to Consumers' Imperfect Information, *Bell Journal of Economics* **14**(1), 275–282.

Young, A.: 2014, Structural Transformation, the Mismeasurement of Productivity Growth, and the Cost of Disease Services, *American Economic Review* **104**(11), 3635–3667.

A Figures

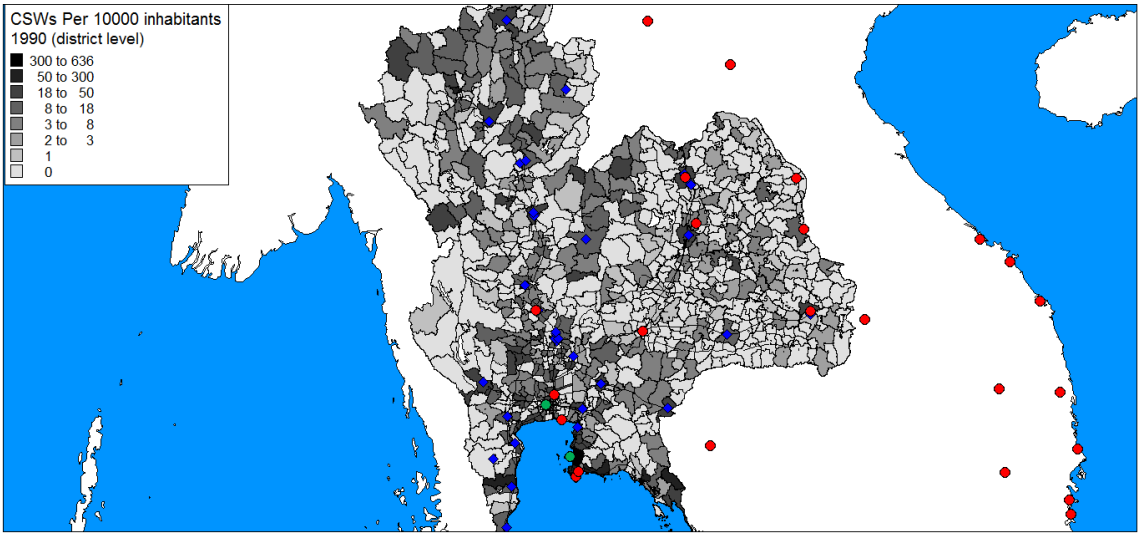


Figure 1: Relationship Between U.S. Military Bases and Sex Industry in 1990. Sex workers in each district per 10,000 inhabitants. Red circles indicate U.S. military bases. Green circles indicate Rest & Recreations areas. Blue diamonds indicate Thai military bases not used by the U.S.A.F.

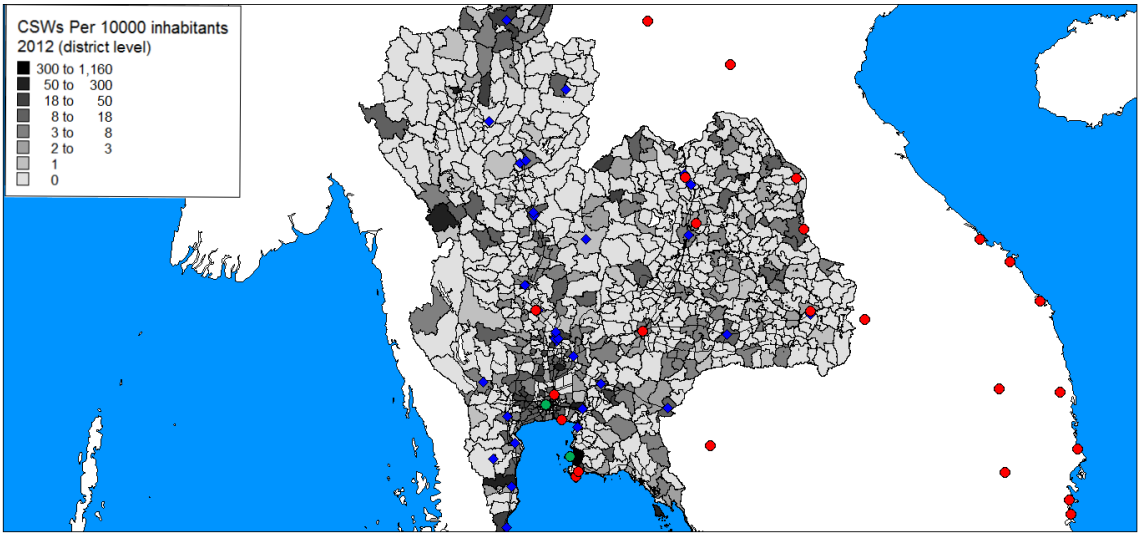
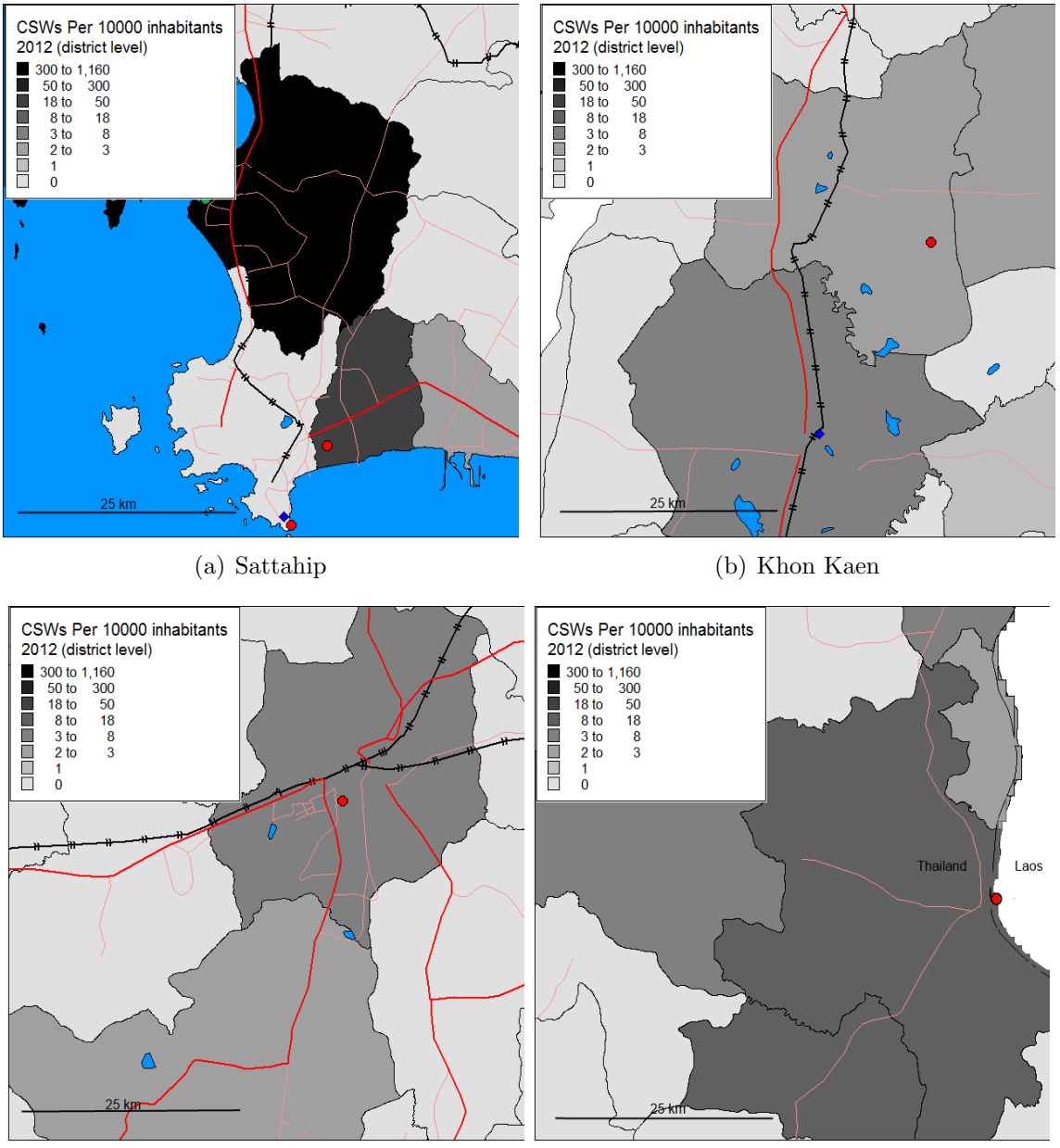


Figure 2: Relationship Between U.S. Military Bases and Sex Industry in 2012. Sex workers in each district per 10,000 inhabitants. Red circles indicate U.S. military bases. Green circles indicate Rest & Recreations areas (not used in the analysis). Blue diamonds indicate Thai military bases not used by the U.S.A.F.

Figure 3: Sex Industry Maps: U.S. Military Bases.



(a) Sattahip

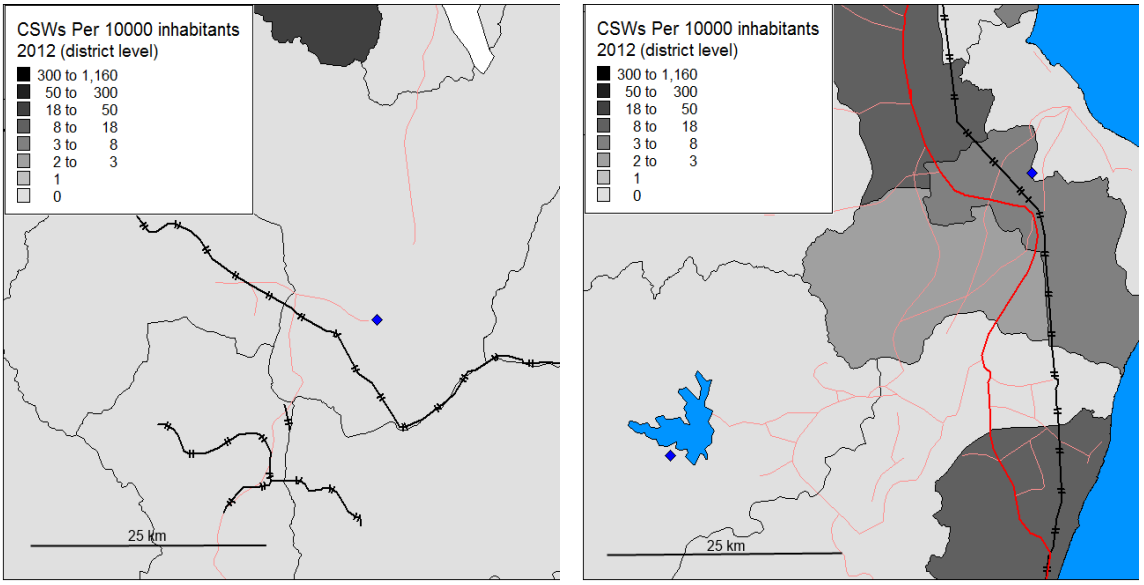
(b) Khon Kaen

(c) Nakhon Ratchasima (Kurat)

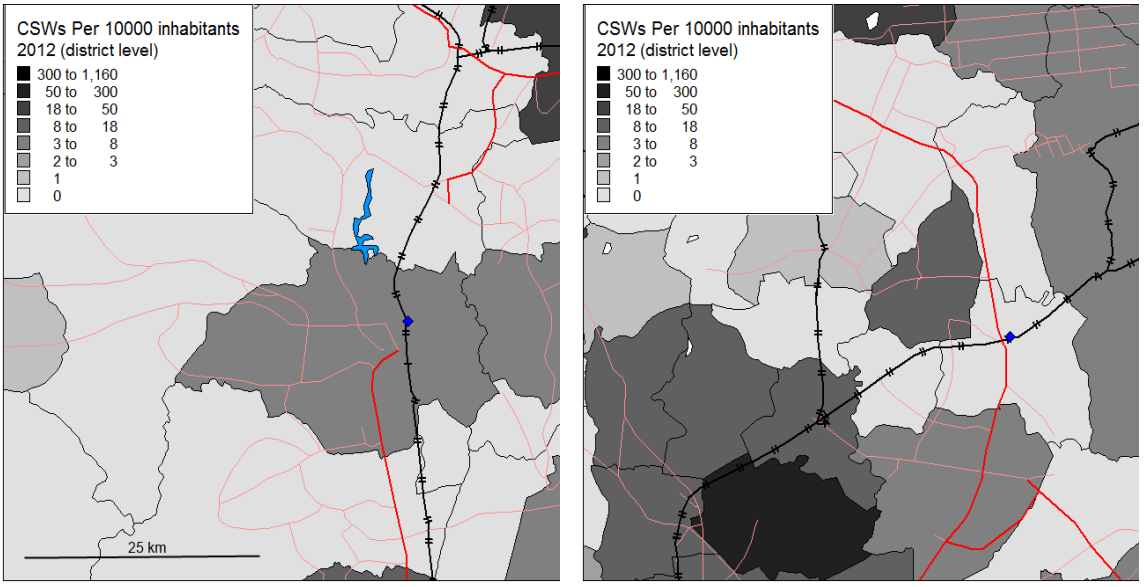
(d) Mukdahan

Note: Sex workers per 1,000 inhabitants at the district level. District boundaries are in black. U.S. military bases are in red (circle) and 1970 Thai active bases are in blue (diamond). Green circles indicate major Rest & Recreations areas (not used in the analysis). Major roads are in red, minor roads in pink and railways in black with two parallel lines.

Figure 4: Sex Industry Maps: Thai Military Bases.



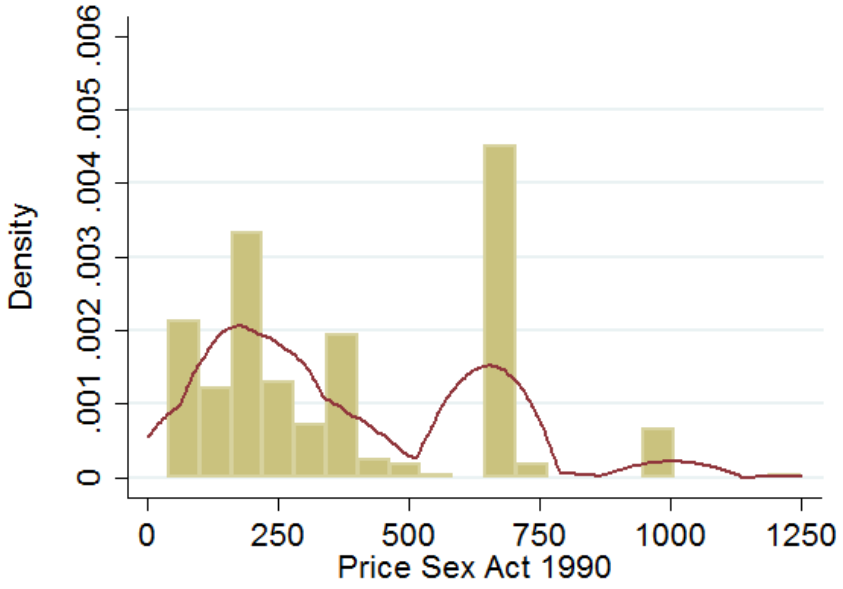
(a) Lampang (b) Phetcha Buri



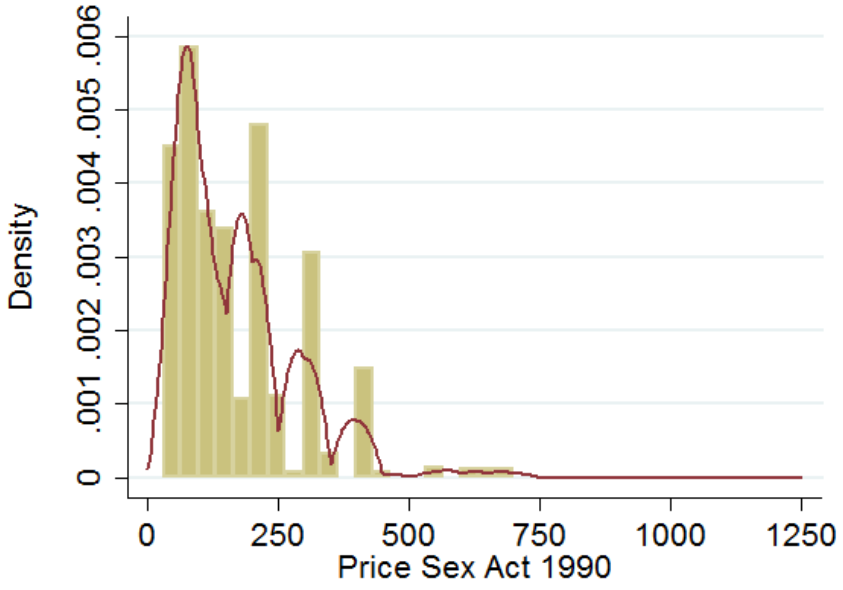
(c) Ratcha Buri (d) Sara Buri

Note: Sex workers per 1,000 inhabitants at the district level. District boundaries are in black. 1970 Thai active bases are in blue (diamond). Major roads are in red, minor roads in pink and railways in black with two parallel lines.

Figure 5: Distribution of Sex Act Prices (1990).



(a) Treated Districts



(b) Control Districts

Note: Raw distribution of sex act prices ($1 = 25.7 bahts). The price data are collected when the surveyors visit the CSEs for the annual national survey in January. There is one sex act price per sex establishment. Figure (a) presents the distribution of sex act prices in treated districts ($USB_{d,r}$=1). Figure (b) presents the distribution of sex act prices in control districts ($THB_{d,r}$=1).

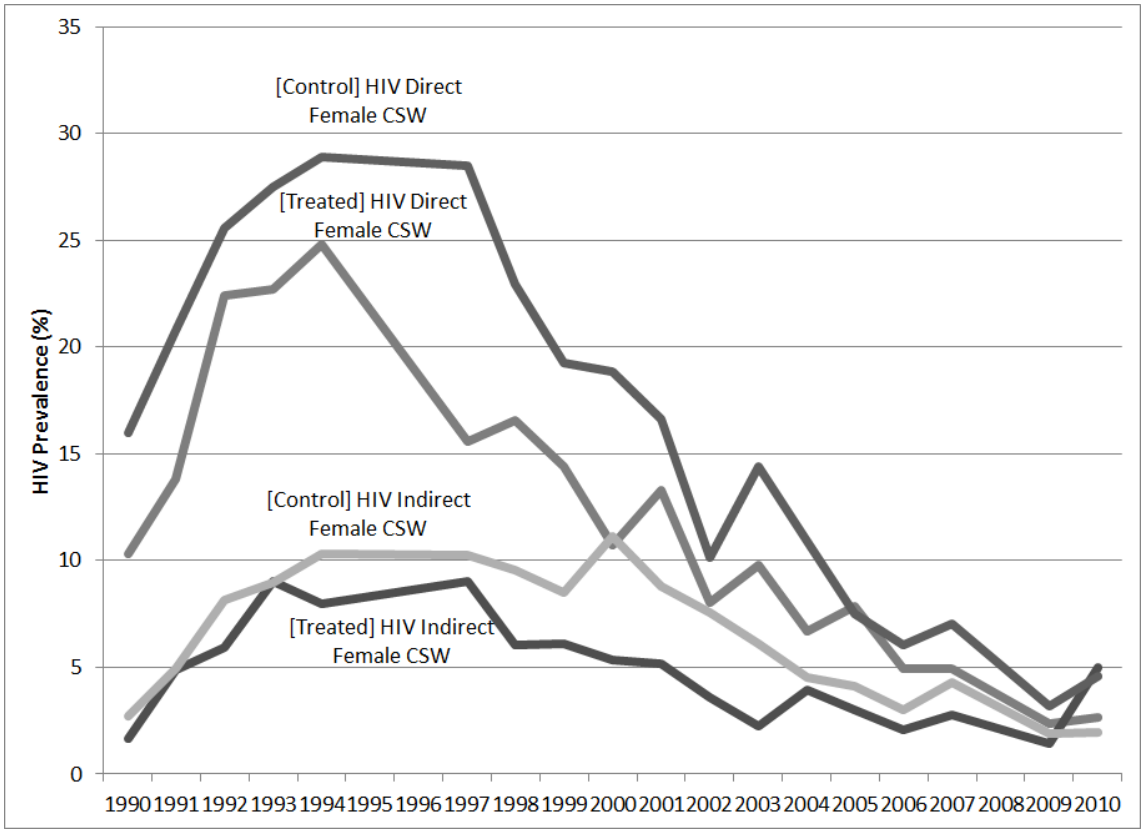


Figure 6: HIV prevalence among direct and indirect female CSWs.
Treated female CSWs are those that work in a district that could be reached in less than 1 hour from a U.S. base. Control female CSWs are those that work in a district that could be reached in less than 1 hour from an unused Thai base.

B Tables

Table 1: Summary Statistics for U.S. Military Bases

Base Name	**Location**	**Evacuation Date**	**Dist. Front 1969**	**Total Mission**
Bang Pla (Camp)	13.302N 100.434E	June 30, 1975	746.3	0
Don Muang	13.544N 100.362E	Jul 6, 1966	610.7	343
Kurat	14.560N 102.044E	Feb 26, 1976	677.1	101,160
Mukdahan/Savanakhet	16.332N 104.453E		604.4	6,495
Nakhon Phanom	17.230N 104.383E	June 30, 1975	772.8	66,736
Nam Phong	16.390N 102.575E	June 30, 1975	719.3	18,325
Ruam Chit Chai (Camp)	17.230N 104.383E	June 30, 1975	684.0	0
Samae San (Camp)	12.360N 100.580E	June 30, 1975	704.3	0
Takhli	15.160N 100.173E	June 30, 1975	852.7	51,774
Ubon Air Force	15.150N 104.521E	June 30, 1975	493.7	215,527
Udorn Air Force	17.231N 102.471E	June 30, 1975	788.5	97,723
U-Tapao	12.404N 101.001E	June 30, 1975	887.9	37,261
Vayama (Camp)	12.404N 101.001E	June 30, 1975	701.5	0
Pakse (Laos)	15.070N 105.470E	Late 1975	437.9	13,017
U.S. Bases Further Away				
Luang Prabang (Laos)	15.070N 105.470E		1042.9	
Long Tieng (Laos)	16.332N 104.453E	Feb 22, 1975	905.9	
Battambang (Cambodia)	13.060N 103.120E		500.1	

Table 2: Summary Statistics for Commercial Sex Workers at the District Level

	Mean	**Min**	**Max**	**Std. Dev.**	**Total**
Total CSWs 1990	93	0	6,152	93	85,875
Establishment 1990	7	0	279	17	6,149
Total CSWs 1995	101	0	6,371	369	80,321
Establishment 1995	8	0	466	23	6,390
Total CSWs 2012	95	0	16,762	635	81,559
Establishment 2012	25	0	1,364	79	21,666
Female CSWs 1995	100	0	5,911	357	79,932
Female CSWs 2012	78	0	14,809	543	66,933
Male CSWs 1995	2.6	0	460	25	2,095
Male CSWs 2012	17	0	1,953	121	14,626
Price Sex Act (baht) 1990 ($1 = 25.7 bahts)	144	30	675	90	

Table 3: Summary Statistics for Districts near U.S. Military Bases

	Less than 1h00 from U.S. Base (1)	**Between 1h-2h from U.S. Base (2)**	**More than 2h00 from U.S. Base (3)**	**Diff. Col. (1-3) (4)**	**Less than 1h00 from Thai Base (5)**	**Diff. Col. (1-5) (6)**
No. CSW (1990) per 1,000 Inhab.	0.59	0.14	0.07	0.52	0.13	0.46
	(1.35)	(0.42)	(0.23)	(0.06)	(0.19)	(0.19)
No. CSW (2012) per 1,000 Inhab.	0.79	0.13	0.06	0.73	0.06	0.73
	(2.53)	(0.23)	(0.18)	(0.11)	(0.11)	(0.34)
Distance Enemy Base	746.5	737.8	813.4	-66.8	841.8	-96.4
	(138.2)	(93.2)	(0.21)	(28.0)	(138.2)	(25.5)
Rails (1954)	0.53	0.40	0.20	0.33	0.70	-0.18
	(0.51)	(0.50)	(0.40)	(0.07)	(0.46)	(0.10)
Roads (1954)	0.75	0.54	0.39	0.36	0.81	-0.06
	(0.44)	(0.51)	(0.49)	(0.08)	(0.39)	(0.09)
Coasts	0.14	0.06	0.12	0.02	0.20	-0.06
	(0.35)	(0.24)	(0.32)	(0.06)	(0.41)	(0.08)
Central District (Capital)	0.19	0.11	0.09	0.11	0.33	-0.14
	(0.40)	(0.32)	(0.28)	(0.05)	(0.48)	(0.10)
Distance Ports Entry (log)	4.74	4.52	4.00	0.73	4.99	0.42
	(0.88)	(0.79)	(1.39)	(0.23)	(1.00)	(0.21)
Temples or Spiritual Sites	0.31	0.09	0.12	0.18	0.28	0.03
	(0.47)	(0.28)	(0.33)	(0.06)	(0.45)	(0.10)
Annual Rain Days (log)	4.70	4.72	4.75	-0.05	4.78	-0.08
	(0.14)	(0.11)	(0.26)	(0.04)	(0.25)	(0.04)
No. Districts	36	35	683	719	54	90

Note: Standard deviations are in parentheses (standard errors for the fourth and sixth columns). Column 1 reports averages for districts near a U.S. military base (less than 1h00). Columns 2 and 3 repeat the exercise for other distances. Column 4 reports the difference between columns 1 and 3. Column 5 reports averages for districts near a Thai military base (less than 1h00). Column 6 reports the difference between columns 1 and 5.

Table 4: Specification (S1) – Relationship Between U.S. Military Bases and Sex Industry (1990s)

log 1 +	CSW 1990 (1)	CSW 1990 (2)	CSW 1990 (3)	CSW 1992 (4)	CSW 1995 (5)
U.S. Base (less 1h)	1.522	1.483	1.563	1.478	1.878
γ	(0.232)	(0.304)	(0.341)	(0.269)	(0.371)
U.S. Base (btw. 1h-2h)			-0.015	0.155	0.431
			(0.399)	(0.516)	(0.669)
U.S. Base (btw. 2h-3h)			-0.171	-0.225	0.006
			(0.244)	(0.222)	(0.259)
U.S. Base (btw. 3h-4)			0.164	0.025	0.178
			(0.373)	(0.339)	(0.363)
Thai Base (less 1h)		-0.059	-0.033	-0.203	-0.323
λ		(0.191)	(0.185)	(0.210)	(0.233)
Population (log)	1.564	1.119	1.119	1.175	1.269
	(0.100)	(0.111)	(0.102)	(0.101)	(0.131)
Rail 1954		0.110	0.167	0.092	0.256
		(0.204)	(0.202)	(0.177)	(0.220)
Road 1954		0.246	0.251	0.106	-0.006
		(0.151)	(0.177)	(0.200)	(0.191)
Coast		0.944	0.606	0.647	0.826
		(0.206)	(0.213)	(0.258)	(0.266)
Province Capital		2.068	1.755	1.834	1.593
		(0.214)	(0.236)	(0.258)	(0.286)
Distance from port			-0.125	-0.148	-0.050
of entry by land (log)			(0.057)	(0.049)	(0.061)
Temple or Spiritual Site			0.118	-0.002	-0.148
			(0.205)	(0.184)	(0.175)
Annual rain days (log)			-0.307	-0.463	-0.209
			(0.355)	(0.327)	(0.406)
Control Variables					
Set of Controls (3)			✓	✓	✓
Region Dummies (6)	✓	✓	✓	✓	✓
Observations	776	776	776	776	723
R-squared	0.364	0.452	0.471	0.499	0.547
$P(\gamma \neq \lambda)$		0.0000	0.0000	0.0000	0.0000

Note: The unit of observation is the district. OLS estimates of (S1) are reported. The dependent variable is the natural log of one plus the number of commercial sex workers in 1990 (1992 in column 4 and 1995 in column 5). The third set of controls include the following dummies: natural parks, tourist beaches, zoos or safaris, and museums. We report standard errors adjusted for clustering at the closest U.S. or Thai base.

Table 5: Specifications (S2)-(S3) – OLS and 2SLS Estimates

log 1+	CSW 1990 (S2) OLS (1)	CSW 1990 (S3) 2SLS (2)	CSW 1992 (S2) OLS (3)	CSW 1992 (S3) 2SLS (4)	CSW 1995 (S2) OLS (5)	CSW 1995 (S3) 2SLS (6)
U.S. Base (B_d)	1.101	1.311	1.375	1.518	1.887	2.228
	(0.598)	(0.842)	(0.416)	(0.872)	(0.597)	(1.065)
First Stage		U.S. Base		U.S. Base		U.S. Base
Distance Enemy Base		-0.0014		-0.0014		-0.0014
		(0.0004)		(0.0004)		(0.0003)
Rails 1954		-0.192		-0.192		-0.221
		(0.073)		(0.073)		(0.073)
Roads 1954		-0.200		-0.200		-0.193
		(0.103)		(0.103)		(0.121)
Coasts		-0.108		-0.108		-0.133
		(0.156)		(0.156)		(0.160)
Province Capital		-0.479		-0.479		-0.505
		(0.096)		(0.096)		(0.100)
Controls						
Set of Controls (1)	✓	✓	✓	✓	✓	✓
Set of Controls (2-3)		✓		✓		✓
Sample Within	1h00	1h00	1h00	1h00	1h00	1h00
Observations	90	90	90	90	87	87
% All CSWs in Sample	47%	47%	45%	45%	53%	53%
F-Statistic		14.15		14.15		17.75
R-squared (1st Stage)		0.502		0.502		0.513
R-squared	0.484	0.539	0.540	0.521	0.569	0.637

Note: The unit of observation is the district. OLS and 2SLS estimates are reported in the top panel (first-stage in the bottom panel). The dependent variable is the natural log of one plus the number of commercial sex workers. "U.S. Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai. Each district is assigned a distance equals to the average over-the-air distance to enemy bases. We report standard errors adjusted for clustering at the closest U.S. or Thai base.

Table 6: Specifications (S1)-(S2)-(S3) – Relationship Between U.S. Military Bases and Sex Industry in 2012

log 1+	CSW 2012 (S1) OLS (1)	CSW 2012 (S1) OLS (2)	CSW 2012 (S1) OLS (3)	CSW 2012 (S2) OLS (4)	CSW 2012 (S2) OLS (5)	CSW 2012 (S3) 2SLS (6)
U.S. Base (less 1h)	1.190	1.134	1.177			
γ	(0.404)	(0.414)	(0.455)			
U.S. Base (btw. 1h-2h)			-0.011			
			(0.495)			
U.S. Base (btw. 2h-3h)			0.507			
			(0.360)			
U.S. Base (btw. 3h-4)			0.127			
			(0.307)			
Thai Base (less 1h)		-0.358	-0.438			
λ		(0.277)	(0.243)			
U.S. Base (B_d)				1.675	2.088	2.374
				(0.583)	(0.749)	(1.312)
Control Variables						
Set of Controls (1-2)		✓	✓	✓	✓	✓
Set of Controls (3)			✓		✓	✓
Region Dummies (6)	✓	✓	✓			
Sample Within	All	All	All	1h00	1h00	1h00
Observations	754	754	754	89	89	89
% All CSWs in Sample	100%	100%	100%	52%	52%	52%
F-Statistic						16.13
R-squared (1st Stage)						0.512
R-squared	0.319	0.387	0.405	0.419	0.552	0.550
$P(\gamma \neq \lambda)$		0.0011	0.0013			

Note: The unit of observation is the district. OLS and 2SLS estimates are reported. The dependent variable is the natural log of one plus the number of commercial sex workers in 2012. The control set is the same as the one used in table 4. Only the natural log of the population in 2010 is included in column 1. "U.S. Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai. Each district is assigned a distance equals to the average over-the-air distance to enemy bases. We report standard errors adjusted for clustering at the closest U.S. or Thai base.

Table 7: Specifications (S1)-(S2) – U.S. Bases and Second Comparison Group

log 1 +	CSW 1990 (S1) OLS (1)	CSW 1990 (S2) OLS (2)	CSW 2012 (S1) OLS (3)	CSW 2012 (S2) OLS (4)
U.S. Base (less 1h)	1.614		1.111	
γ	(0.258)		(0.397)	
Thai Base or Airfield	0.246		-0.115	
(less 1h) η	(0.204)		(0.207)	
U.S. Base (= 1)		1.537		1.601
Thai Base or Airfield (= 0)		(0.525)		(0.706)
Controls				
Set of Controls (1)	✓	✓	✓	✓
Set of Controls (2-3)	✓	✓	✓	✓
Sample Within	All	1h00	All	1h00
Observations	777	125	755	124
% Sex Industry in Sample	100%	59%	100%	63%
R-squared	0.475	0.552	0.404	0.500
$P(\gamma \neq \eta)$	0.0000		0.0018	

Note: The unit of observation is the district. The dependent variable is the natural log of one plus the number of commercial sex workers in 1990 or 2012. "U.S. Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai or an unused airfield or seaplane anchorage. We report standard errors adjusted for clustering at the closest U.S., Thai base, unused airfield or seaplane anchorage.

Table 8: Specification (S2) – Share for Each Type of Establishments

	Share Brothel 1990 OLS (1)	Share Cafe 1990 OLS (2)	Share Massage 1990 OLS (3)	Share Bar 1990 OLS (4)	Share Disco 1990 OLS (5)
U.S. Base (B_d)	-0.229	-0.048	0.019	0.227	0.033
	(0.127)	(0.106)	(0.021)	(0.058)	(0.019)
Observations	74	74	74	74	74
R-squared	0.295	0.205	0.126	0.460	0.107
	2010 (6)	2010 (7)	2010 (8)	2010 (9)	2010 (10)
U.S. Base (B_d)	-0.023	-0.083	-0.038	0.088	0.056
	(0.072)	(0.125)	(0.044)	(0.026)	(0.016)
Observations	90	90	90	90	90
R-squared	0.151	0.242	0.216	0.604	0.530
Controls					
Set of Controls (1)	✓	✓	✓	✓	✓
Set of Controls (2-3)	✓	✓	✓	✓	✓
Sample Within	1h00	1h00	1h00	1h00	1h00

Note: The unit of observation is the district. The dependent variable is the share (0 to 1) of a type of sex establishment in 1990 (top panel) or in 2010 (bottom panel). In columns 1 and 6, the dependent variable is the share of brothel, tea house, hotel, bungalow, and guesthouse (direct CSEs). In columns 2 and 7, the dependent variable is the share of alcohol-sale cafe, karaoke, restaurant and coffee shop. In columns 3 and 8, the dependent variable is the share of massage parlor. In columns 4 and 9, the dependent variable is the share of beer bar, pub and lounge. In columns 5 and 10, the dependent variable is the share of discotheque, nightclub and gogo bar. "U.S. Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai. We report standard errors adjusted for clustering at the closest U.S. or Thai base.

Table 9: Specifications (S1)-(S2) – U.S. Military Bases and Sex Act Prices in 1990

log	Price 1990 (S1) OLS (1)	Price 1990 (S1) OLS (2)	Price 1990 (S1) OLS (3)	Price 1990 (S2) OLS (4)	Price 1990 (S2) OLS (5)
U.S. Base (less 1h)	0.428	0.495	0.521		
γ	(0.097)	(0.106)	(0.127)		
U.S. Base (btw. 1h-2h)		0.208	0.202		
		(0.135)	(0.177)		
U.S. Base (btw. 2h-3h)		0.180	0.148		
		(0.111)	(0.139)		
U.S. Base (btw. 3h-4)		0.160	0.165		
		(0.114)	(0.133)		
Thai Base (less 1h)	-0.081	-0.101	-0.043		
λ	(0.077)	(0.084)	(0.091)		
U.S. Base (B_d)				0.352	0.415
				(0.139)	(0.143)
Population (log)	0.070	0.071	0.019	0.277	0.211
	(0.071)	(0.074)	(0.085)	(0.178)	(0.176)
Rail 1954	-0.031	-0.035	0.032	0.018	0.083
	(0.050)	(0.047)	(0.064)	(0.148)	(0.181)
Road 1954	-0.053	-0.068	-0.055	-0.138	-0.065
	(0.058)	(0.058)	(0.066)	(0.165)	(0.175)
Coast	-0.017	-0.022	0.296	0.448	0.377
	(0.063)	(0.074)	(0.111)	(0.141)	(0.159)
Provincial Capital	0.238	0.198	0.121	-0.108	-0.205
	(0.091)	(0.100)	(0.101)	(0.217)	(0.228)
HIV Rate Conscripts			-0.043		
(21 Years Old)			(0.008)		
Control Variables					
Set of Controls (2-3)		✓	✓		✓
Region Dummies (6)	✓	✓			
Sample Within	All	All	All	1h00	1h00
Observations	400	400	389	67	67
R-squared	0.381	0.431	0.292	0.299	0.365
$P(\gamma \neq \lambda)$	0.0000	0.0000	0.0006		

Note: The unit of observation is the district. OLS estimates are reported. The dependent variable is the natural log of the average price of sexual services in 1990. "U.S. Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai. We report standard errors adjusted for clustering at the closest U.S. or Thai base. We do not report the estimates of the following controls in columns 2, 3 and 5: natural park, museum, zoo or safari, tourist beach, distance from port of entry (log) and annual rain days (log).

Table 10: Specifications (S1)-(S2) – Estimates for Sex Act Prices per Type of Establishments in 1990

log	Price Brothel 1990 (S1) OLS (1)	Price Brothel 1990 (S2) OLS (2)	Price Bar 1990 (S1) OLS (3)	Price Bar 1990 (S2) OLS (4)	Price Massage 1990 (S1) OLS (5)	Price Massage 1990 (S2) OLS (6)
U.S. Base (less 1h)	0.325		0.161		0.749	
γ	(0.096)		(0.102)		(0.273)	
Thai Base (less 1h)	-0.133		-0.013		-0.116	
λ	(0.084)		(0.084)		(0.200)	
U.S. Base		0.333		0.064		0.948
		(0.151)		(0.192)		(0.248)
Controls						
Set of Controls (1)	✓	✓	✓	✓	✓	✓
Set of Controls (2-3)	✓	✓	✓	✓	✓	✓
Sample Within		1h00		1h00		1h00
Observations	286	51	277	53	71	29
R-squared	0.488	0.393	0.237	0.237	0.308	0.655
$P(\gamma \neq \lambda)$	0.0001		0.1762		0.0016	

Note: The unit of observation is the district. The dependent variable is respectively the average price of sex act in brothel, tea house, hotel, bungalow, and guesthouse, the average price of sex act in beer bar, pub, lounge, alcohol-sale cafe, restaurant and coffee shop, and the average price of sex act in massage parlor, discotheque, nightclub, gogo bar and other CSEs. "U.S. Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai. We report standard errors adjusted for clustering at the closest U.S. or Thai base.

Table 11: Specifications (S1)-(S2) – Hotels in 2013

log 1+	Hotel 1-2 Stars 2013 (S1) OLS (1)	Hotel 1-2 Stars 2013 (S2) OLS (2)	Hotel 3 Stars 2013 (S1) OLS (3)	Hotel 3 Stars 2013 (S2) OLS (4)	Hotel 4-5 Stars 2013 (S1) OLS (5)	Hotel 4-5 Stars 2013 (S2) OLS (6)
U.S. Base (less 1h)	0.407		0.922		0.668	
γ	(0.142)		(0.199)		(0.249)	
Thai Base (less 1h)	-0.158		-0.167		-0.179	
λ	(0.074)		(0.110)		(0.088)	
U.S. Base		0.341		0.764		0.607
		(0.200)		(0.329)		(0.296)
Controls						
Set of Controls (1)	✓	✓	✓	✓	✓	✓
Set of Controls (2-3)	✓	✓	✓	✓	✓	✓
Sample Within		1h00		1h00		1h00
Observations	777	90	777	90	777	90
R-squared	0.296	0.320	0.374	0.379	0.339	0.334
$P(\gamma \neq \lambda)$	0.0005		0.0000		0.0019	

Note: The unit of observation is the district. The dependent variable is the log of one plus the number of hotels for each category in 2013. "U.S. Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai. We report standard errors adjusted for clustering at the closest U.S. or Thai base.

APPENDIX

C Appendix Figures

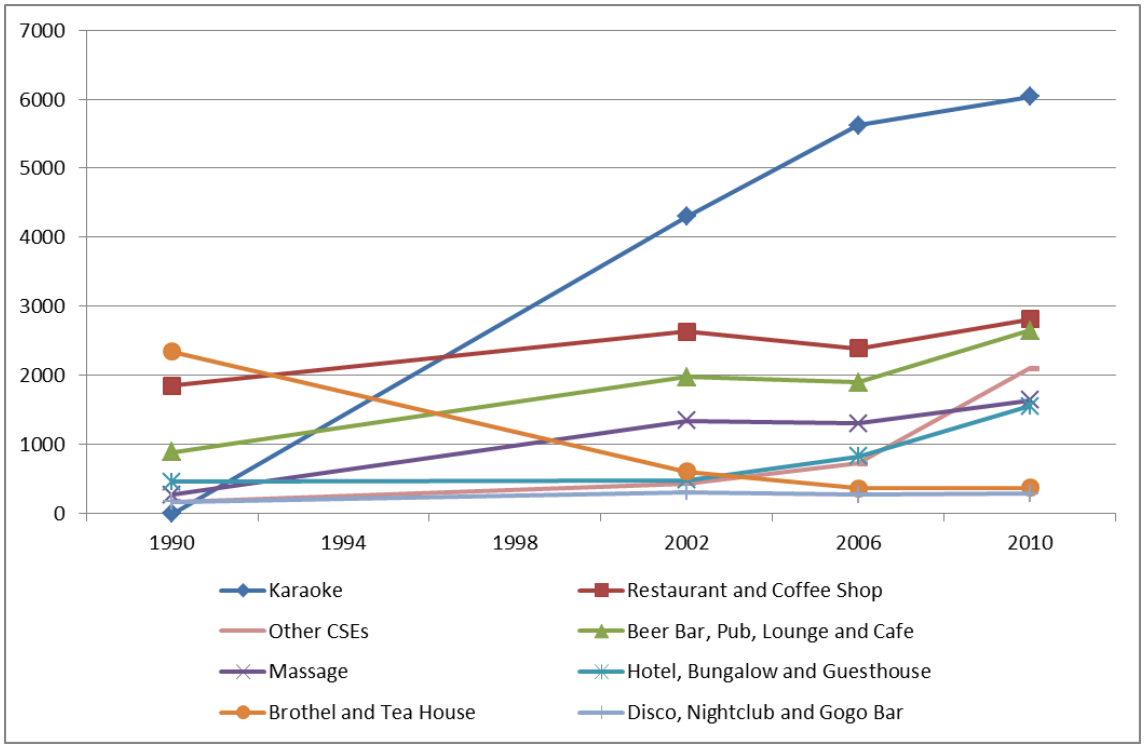


Figure A1: Type of Establishment 1990-2010, Aggregated Categories.

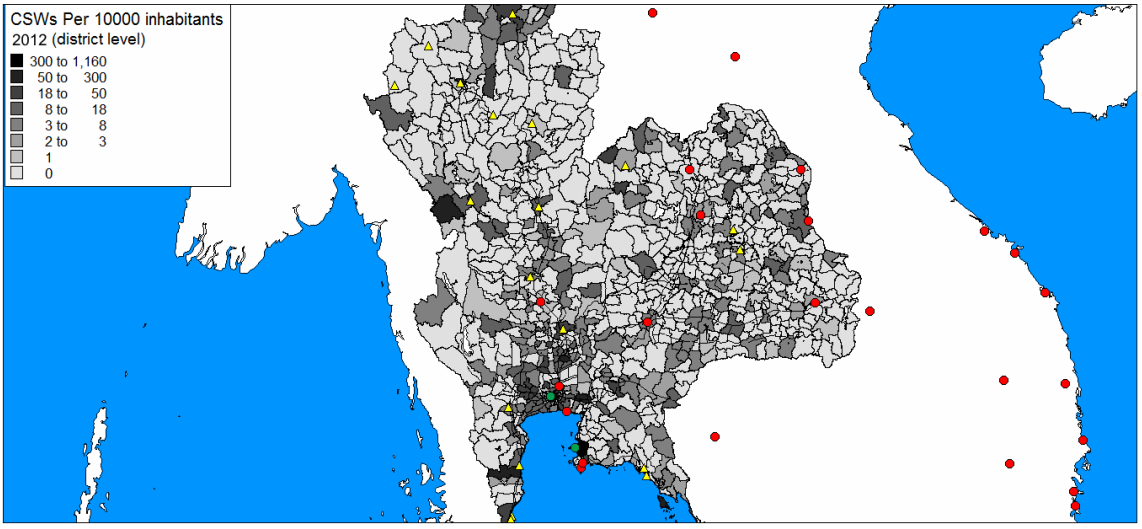


Figure A2: U.S. Military Bases, Airfields and Seaplane Anchorages and Sex Industry in 2012.
Sex workers in each district per 10,000 inhabitants. Red circles indicate U.S. military bases. Green circles indicate Rest & Recreations areas (not used in the analysis). Yellow triangles indicate airfields and seaplane anchorages not used by the U.S.A.F.

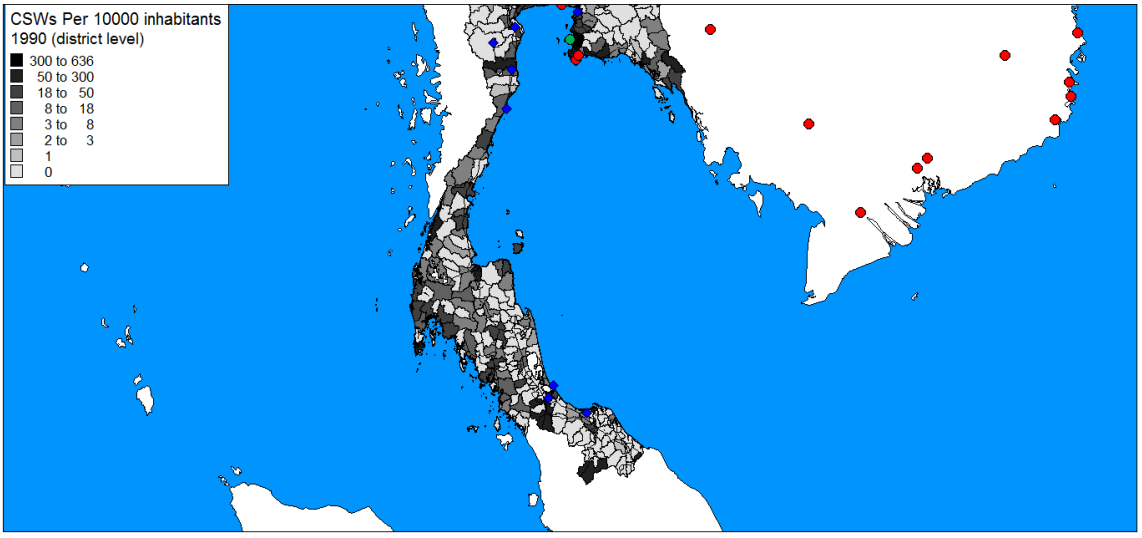


Figure A3: South of Thailand. U.S. Military Bases and Sex Industry in 1990.
Sex workers in each district per 10,000 inhabitants. Red circles indicate U.S. military bases. Green circles indicate Rest & Recreations areas (not used in the analysis). Blue diamonds indicate Thai military bases not used by the U.S.A.F.

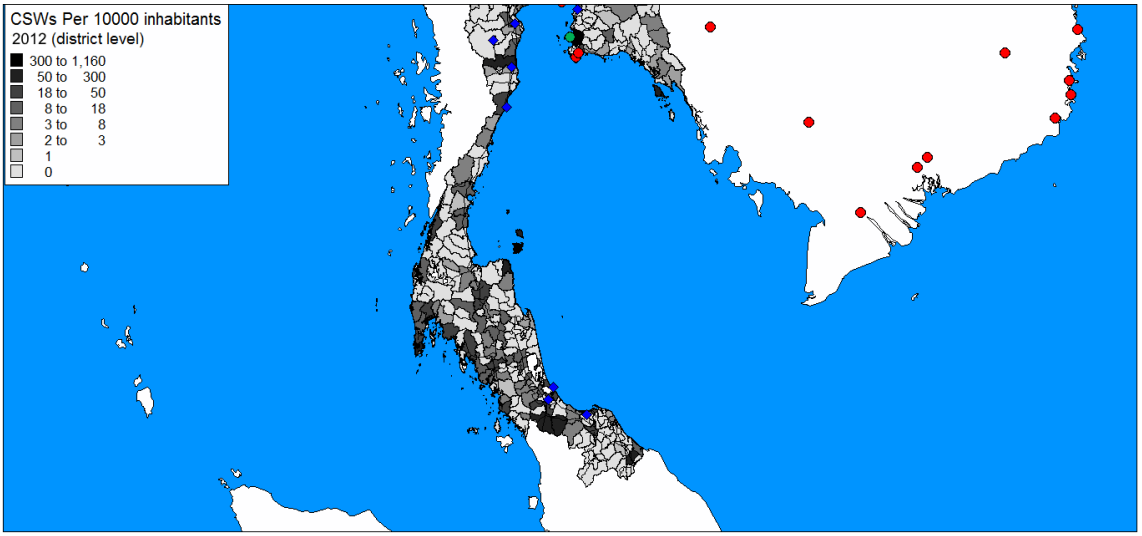


Figure A4: South of Thailand. U.S. Military Bases and Sex Industry in 2012. Sex workers in each district per 10,000 inhabitants. Red circles indicate U.S. military bases. Green circles indicate Rest & Recreations areas (not used in the analysis). Blue diamonds indicate Thai military bases not used by the U.S.A.F.

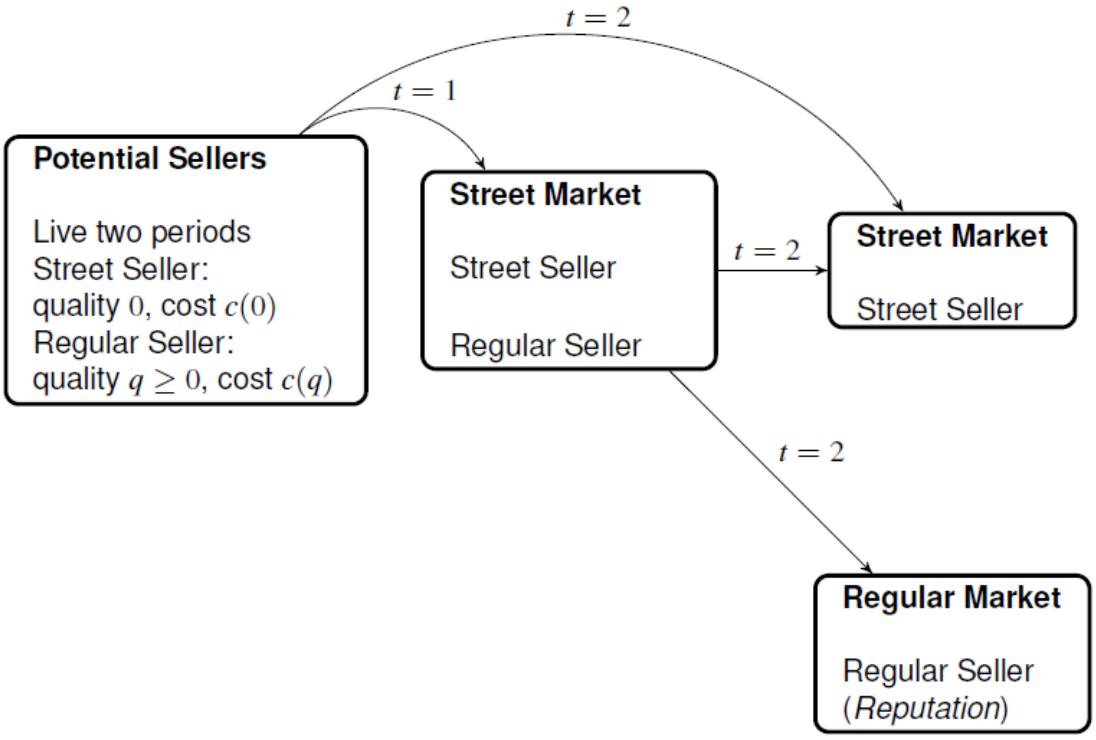


Figure A5: Environment. There is a street market in which street sellers and newly established regular sellers operate. There is also a regular market constituted of sellers having been regular sellers in the first period (reputation returns).

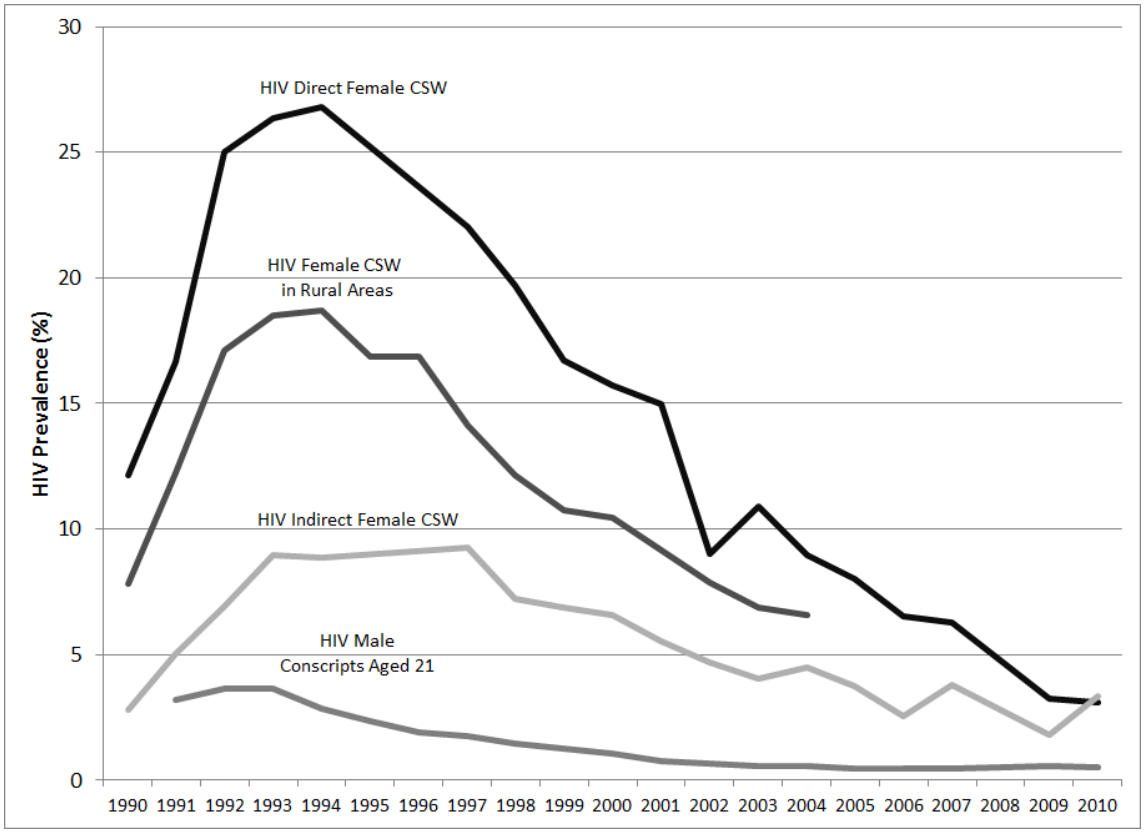


Figure A6: HIV prevalence among direct female CSWs, indirect female CSWs, female CSWs outside urban areas and Thai conscripts aged 21 years old.

D Appendix Tables

Table A1: Type of Sex Establishments, Summary Statistics

	Less than 1h00 from U.S. Base (1)	**Less than 1h00 from Unused Base (2)**	**Difference Col. (1-2)**
1990			
Brothel, Tea House	17%	42%	-25%
Hotel, Guesthouse, Bungalow	5%	6%	-1%
Restaurant, Coffee Shop	40%	43%	-3%
Karaoke	0%	0%	0%
Massage	4%	3%	1%
Beer Bar, Pub, Lounge, Cafe	28%	3%	25%
Discotheque, Nightclub, Gogo	4%	1%	3%
Other CSEs	3%	2%	1%
2010			
Brothel, Tea House	7%	8%	-1%
Hotel, Guesthouse, Bungalow	3%	8%	-5%
Restaurant, Coffee Shop	8%	10%	-2%
Karaoke	32%	42%	-10%
Massage	21%	23%	-2%
Beer Bar, Pub, Lounge, Cafe	17%	6%	11%
Discotheque, Nightclub, Gogo	8%	1%	7%
Other CSEs	3%	2%	1%

Note: Column 1 reports numbers for districts near U.S. base (less than 1h00). Columns 2 repeats the exercise for districts near unused Thai base (less than 1h00). The share of each type of sex establishment is in parentheses (number of each type of establishment over the total number of establishment). The sum of percentages equals 100% in each column. Column 3 reports the difference between columns 1 and 2.

Table A2: Hotels and Babysitting Services

Province	No. Hotels	Baby Service	% Baby Service
Surat Thani	678	198	29%
Bangkok	630	143	23%
Phuket	501	201	40%
Chon Buri	394	58	15%
Krabi	384	71	18%
Chiang Mai	348	66	19%
Prachuap Khiri Khan	181	29	16%
Phang Nga	59	24	41%
Trat	47	12	26%
Chiang Rai	42	11	26%
Phetchaburi	41	10	24%
Rayong	41	7	17%
Kanchanaburi	13	2	15%
Mae Hong Son	11	2	19%
Nakhon Ratchasima	10	1	10%
Treated Districts	159	872	18%
2nd Control Group	323	1204	27%
Thailand (Exclude Treated Districts)	679	2633	26%

Note: Data from the internet-based travel website company Expedia. We report statistics for 15 provinces. The second column indicates the number of hotels by province. The third and fourth columns report respectively the number and the percentage of hotels offering babysitting services. Treated districts include districts within 1 hour of a U.S. base. The 2nd control group includes districts within 1 hour of an unused Thai base, airfield or seaplane anchorage. The last row includes all the districts in Thailand that are not within 1 hour of a U.S. base (i.e. exclude treated districts).

E Appendix: Urbanization and Externalities on Other Industries

E.1 Was the U.S. Presence a Pure Demand Shock?

We now verify whether the influx of foreign direct investment (through road construction and other infrastructures) by the U.S. government during the Vietnam War led to a persistent impact on urbanization.[46] During the Vietnam War, Thailand was the second largest recipient of American aid in Southeast Asia next to Vietnam. Just over the period 1965-1975, total assistance from the U.S. government to Thailand exceeded $US 2 billion in the form of direct military assistance, war expenditures and economic aid (Viksnins (1973); Steinberg (1986); Kislenko (2004)).[47]

[46]See Randolph (1979) for a discussion of the American political and military involvement in Thailand. He argues that the American aid program "was focused predominantly on the economically depressed and politically sensitive Northeast." Ouyyanont (2001) also documents the major burst of construction activity in the 1960-70s.

[47]The estimates are from different sources described in the Online Appendix. Direct military assistance added up to $670 million for the fiscal years 1966-1969 averaging $167 million annually.

The expansion of the American economic aid program to Thailand coincided with the use of military facilities. Overall, the estimates suggest that the U.S. economic aid was mainly targeted towards public safety and road building and other infrastructure projects (see Online Appendix Figures A10 and A11). The concurrent rise of military spending and economic aid in the mid-1960s had potentially large economic impacts on people living near U.S. installments. Thai bases used by the U.S.A.F. were expanded and modernized. The most dramatic example may be the construction of the air base at U-Tapao which required 25,000 American servicemen and 2,000 Thais for an estimated cost of $40 million. This suggests that the U.S. Army were not employing many Thais to build bases and other infrastructure.

As a result of this major influx of foreign direct investments, districts near U.S. bases potentially had better infrastructure and had the investments necessary to develop the entertainment industry. Entrepreneurs may have enjoyed a competitive advantage from the infrastructure construction which probably surpassed maintenance costs. Moreover, the growth of the construction and transportation sectors simultaneously with the entertainment industry could have created income which becomes a source of demand for sexual services.

We check using our road data whether districts near U.S. bases are nowadays more connected to the road network. If treated districts have higher road densities and the sex industry endogenously clustered along roads and urban areas, then the persistent effect that we documented would not be that surprising. It is also plausible that road construction by the American government led to economic growth along roads in treated districts.

Figures in the Online Appendix illustrate the road network of districts near four U.S. military bases (Sattahip, Ubon Ratchathani, Khon Kaen and Nakhon Ratchasima) with the 1954 and 1967 data sets. While the 1954 data clearly show the road network before the American presence, the data compiled in 1967 illustrate railways and roads during the war. An important number of U.S. servicemen were already stationed in Thailand at this point of the Vietnam War, but many more would arrive in the coming years. Readers should thus keep in mind that the 1967 data set shows only a fraction of the new roads built by the U.S. Army. Online Appendix Figures also show four Thai bases for comparison purposes. As shown in the figures, it is quite apparent that many roads were built over the period 1954-1967 in all maps.

We examine this relationship empirically by computing network density for each district by taking the total length of roads in kilometers divided by the surface area in kilometers squared. We first focus on current road network and compute network density for major and minor roads. We do not analyze empirically railways as they did not change much over the past decades. We present estimates in column 1 of

The amounts of war expenditures, measured as net spending in the Thai economy, were even larger. The U.S. government spent few million dollars in operating costs, maintenances and services. Annual expenditures by the U.S. military personnel on leave and stationed in Thailand were around $80 million at the peak of the Vietnam War for a total of more than $400 million over 1967-1972. From 1950-1975, it is estimated that Washington spent as much as $450 million on military installments and logistic of construction. Thailand also received over $300 million in economic aid during the years 1965-1975 which was mainly used for counter-insurgency activities in the Northeast.

Appendix Table A3 suggesting that the U.S. spending does not have a long-term impact on current major roads density. The OLS and 2SLS point estimates are small and statistically insignificant. In contrast, column 2 suggests a positive effect 0.156 kilometers of minor roads for every square kilometer of district surface area (2SLS, panel B). The effect is large in comparison to the average minor road density in treated districts of 0.233.

We further examine road construction for different time period in the remaining columns. Columns 3 and 4 look at the growth in major and minor road density over the period 1967 and 2013 while columns 5 and 6 analyze the period 1954-1967. The dependent variable in column 3 is the difference between the density of major (minor in column 4) roads in 2013 and 1967. Results indicate that the growth in major road density over this time period was not significantly different for U.S. and unused districts and positive and significant for minor road density. Many road construction programs have been implemented during those decades which may affect the interpretation of those results. This exercise is repeated for the period 1954-1967 in columns 5 and 6. The estimates are very small in column 5 and insignificant. The coefficients in column 6 are positive in both specifications but significant solely in panel A.

We find no evidence that treated districts have or had more kilometers of major roads or railways during the time period analyzed. On the other hand, there are differences in minor road density across districts near U.S. and unused bases. Those persistent differences may have led to a comparative advantage for districts within one hour of former U.S. installments which could have enhanced, or not,[48] the development of the sex industry. We thus analyze whether the U.S. presence affected industrialization. We test explicitly this hypothesis by analyzing the growth in the share of household in rural areas over the period 1960-2000. The results are reported in the first column of Appendix Table A4. While the percentage of Thais working in agriculture has been decreasing over this time period, we find no evidence that the rates were different between treated and control districts. The estimates are positive and insignificant suggesting that foreign direct investment and road construction did not lead to a persistent positive effect on urbanization for residents of districts near U.S. installments.

In summary, the influx of foreign direct investment and road construction during the Vietnam War did not have persistent impacts on urbanization, railways and major roads. These results cast doubts on the idea that the development of the sex industry is a result of large income shocks. Consistent with this evidence, we now turn to an investigation of whether other service industries benefited from the development of the sex industry.

E.2 Related Industries

It is interesting to know what happened to other industries in treated and control districts. It is possible that the development of the sex industry in affected districts

[48]To our limited knowledge, no empirical paper has tackle the question of whether the sex industry and income growth are related.

could have positive spillovers on goods and services that sex clients consume.[49] Data limitations prevent us from separately identifying the impacts during and after the war. We rely on data from the 2005 Labour Force Survey on employment in different Thai industries and present OLS and 2SLS estimates in the remaining columns of Appendix Table A4. The dependent variables are the number of employed persons in the top industries: manufacturing (column 2), wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods (column 3), construction and transport (column 4) and hotels and restaurants (column 5). This exercise fails to detect significant effects on manufacturing, the biggest industry in 2005, and construction and transport. But we find evidence that treated districts have more persons employed in wholesale and retail trade and in hotels and restaurants. The coefficients are much smaller than the ones for the sex industry. The estimates suggest that there are approximately 40% more persons employed in those industries in districts that could be reached in less than one hour by U.S. servicemen.

The presence of hotels and other service industries (legal or illegal) may explain why clients and sex entrepreneurs still coordinate in the districts close to former bases. After the Vietnam War, many tourists came to Thailand to purchase sexual services which led to the construction of more hotels and restaurants. Sex entrepreneurs thus decided to establish new CSEs in red-light districts because of the existing infrastructure for tourists and the low search cost incurred by potential customers.

[49]Some readers may think that the consumption of other services by U.S. servicemen during the war could have led to the development of those service industries. While this is possible, we think that the lack of long-term impacts on urbanization and manufacturing makes it unlikely. Note that the development of the sex industry is partly related to the fact that the demand is non-local. Most of the services that servicemen were purchasing are consumed locally. Moreover, most establishments offering services that servicemen were buying (e.g. coffee shops, hair dressers, restaurants and bars) are often disguised as CSEs in those districts.

Table A3: Robustness Checks (Specifications (S1)-(S2)) – Roads

Second Stage	Density of Major Road 2013 (1)	Density of Minor Road 2013 (2)	Density of Major Road (2013-1967) (3)	Density of Minor Road (2013-1967) (4)	Density of Major Road (1967-1954) (5)	Density of Minor Road (1967-1954) (6)
Panel A. (S1)						
U.S. Base (less 1h)	0.020	0.046	0.002	0.009	0.002	0.039
γ	(0.006)	(0.043)	(0.002)	(0.029)	(0.003)	(0.018)
Thai Base (less 1h)	0.005	-0.047	0.002	-0.034	0.002	-0.021
λ	(0.004)	(0.021)	(0.003)	(0.018)	(0.002)	(0.007)
Observations	738	738	738	738	738	738
R-squared	0.072	0.113	0.059	0.092	0.032	0.133
$P(\gamma \neq \lambda)$	0.0694	0.0637	0.9011	0.2403	0.9771	0.0024
Panel B. (S2)	Less 1h00	Less 1h00	Less 1h00	Less 1h00	Less 1h00	Less 1h00
U.S. Military Base	0.008	0.089	-0.001	0.042	0.000	0.055
	(0.010)	(0.033)	(0.005)	(0.032)	(0.006)	(0.013)
Observations	86	86	86	86	86	86
R-squared	0.081	0.151	0.052	0.088	0.054	0.207
Controls						
Set of Controls (1)	✓	✓	✓	✓	✓	✓
Set of Controls (2-3)	✓	✓	✓	✓	✓	✓
Road Network Controls	Excluded	Excluded	Excluded	Excluded	Excluded	Excluded

Note: The unit of observation is the district. OLS estimates of (1) and (2) are reported. The road densities are defined as total length in kilometers in each district divided by the districts' surface in kilometers squared. See the Appendix for the calculations. The dependent variables in the first two columns are the density of major and minor roads in 2013. The dependent variable for column 3 (4) is the difference between the density of major (minor) roads in 2013 and 1967. Columns 5 and 6 repeat this exercise for the difference between 1967 and 1954. "U.S. Military Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai. Each district is assigned a distance equals to the average over-the-air distance to enemy bases. We report standard errors adjusted for clustering at the closest U.S. or Thai base. We do not include our road network control in this table.

Table A4: Robustness Checks (Specifications (S1)-(S2)) – Urbanization and Other Industries

Sample Within:	Share Agriculture (2000-1960) Less 1h00 (1)	Manufacturing 2005 Less 1h00 (2)	Wholesale Retail 2005 Less 1h00 (3)	Construction Transport 2005 Less 1h00 (4)	Hotel Restaurant 2005 Less 1h00 (5)
Panel A. (S1)					
U.S. Base (less 1h)	0.055	-0.099	0.206	0.107	0.401
γ	(0.083)	(0.315)	(0.081)	(0.113)	(0.112)
Thai Base (less 1h)	-0.024	0.150	0.091	0.074	-0.013
λ	(0.026)	(0.147)	(0.080)	(0.083)	(0.087)
Observations	452	746	757	753	728
R-squared	0.207	0.546	0.637	0.586	0.600
$P(\gamma \neq \lambda)$	0.3333	0.4604	0.2984	0.8342	0.0040
Panel B. (S2)	Less 1h00	Less 1h00	Less 1h00	Less 1h00	Less 1h00
U.S. Base	0.080	-0.108	0.201	0.071	0.398
	(0.059)	(0.207)	(0.136)	(0.142)	(0.174)
Observations	79	89	89	89	89
R-squared	0.264	0.526	0.850	0.803	0.779
Controls					
Set of Controls (1)	✓	✓	✓	✓	✓
Set of Controls (2-3)	✓	✓	✓	✓	✓

Note: The unit of observation is the district. OLS estimates of (1) and (2) are reported. Controls are for the year 2000. The dependent variable in the first column is the share of household in agriculture in 2000 minus the share of household in agriculture in 1960. The sample is smaller since many districts were created after 1960. The dependent variables in the remaining columns are the number of employed persons in 2005 in the following industry: (2) manufacturing (3) wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods (4) construction and transport (5) hotels and restaurants. "U.S. Base" equals one if the nearest base is U.S. and zero if the nearest base is Thai. Each district is assigned a distance equals to the average over-the-air distance to enemy bases. We report standard errors adjusted for clustering at the closest U.S. or Thai base.

F Appendix: Model

F.1 Buyers' Decision Problem

Consider as given the number of street and regular sellers in a sex market, the number of buyers and also the choice of quality q. The expected gains of a QL buyer searching in this market is:

$$\begin{aligned} P(a_r \geq 2, a_s \geq 0) \times u(q) + P(a_r = 1, a_s \geq 1) \times [u(0) + \beta(u(q) - u(0))] \\ + P(a_r = 1, a_s = 0) \times \beta u(q) + P(a_r = 0, a_s \geq 2) \times u(0) + P(a_r = 0, a_s = 1) \times \beta u(0) \\ + P(a_r = 0, a_s = 0) \times 0, \end{aligned}$$

which is equal to equation (1).

The expected gains of a QN buyer searching in this market is:

$$P(a_r + a_s \geq 2) \times \bar{u} + P(a_r + a_s = 1) \times \beta \bar{u} + P(a_r + a_s = 0) \times 0,$$

which is equal to equation (2).

F.2 Sellers' Decision Problem

Consider as given the number of street and regular sellers in a market, the number of buyers and the choice of quality q. The expected instantaneous gains for a regular seller entering this market after having invested in quality q is given by:

$$\frac{b_l}{b_n + b_l}[P(a_r = 0, a_s = 0) \times (1 - \beta)u(q) + P(a_r \geq 1, a_s = 0) \times 0$$
$$+ P(a_r = 0, a_s \geq 1) \times (1 - \beta)(u(q) - u(0))] + \frac{b_n}{b_n + b_l} P(a_r = 0, a_s = 0) \times (1 - \beta)u(0).$$

Similarly, the expected profit for a street seller entering this market is given by:

$$\pi_s(b_n, b_l, \theta_r, \theta_s) = P(a_r = 0, a_s = 0) \times (1 - \beta)u(0) - c(0).$$

G Appendix: Direct Revenue of the Sex Industry

In this section, we use our 1990 sex price data and the number of CSWs to conduct a quantitative analysis of the sex industry's direct revenue. Our objective is to assess whether the sex industry represents a large share of total revenue in red-light districts. Note that this is not a welfare analysis. The sex industry is associated with a string of negative externalities and the economic benefits are hard to estimate with tax evasion and corruption (Pasuk et al. (1998)).

Computing the direct revenue of the sex industry in 1990 is straightforward. We use the exchange rate as of January 1990 ($1US equals 25.7 baht) and hypothesize that CSWs have on average 1.5 customers per night. Districts without sex act price data are included in this exercise. We use the average prie at the province level for these districts. Using the price given at the establishment level and the number of CSWs times 1.5, we find that the direct revenue of the sex industry was approximately $1.2M a day in 1990. If one assumes that the number of CSWs and the average number of customers are the same during the whole year, the yearly direct revenue was $435M. The illicit nature of the sex industry makes it unlikely that the direct revenue is completely included in the GDP of Thailand ($84,962M in 1990). Nonetheless, it is interesting to compare the two numbers. The ratio of the direct revenue of the sex industry over the GDP was 0.5% in 1990.

Caution is required when performing this exercise. Measurement error is very likely. Recall that only CSWs in permanent locations are included and that CSWs not present the day of the survey may not be counted (see section III.). On the other hand, a non-trivial fraction of CSWs may be working solely during the tourist season. Readers should also keep in mind that our calculation includes only direct revenue (the sex act) and that indirect revenue should be much greater. Tourists and Thais traveling to red-light districts pay an accommodation and consume many goods. For instance, alcohol beverages are an important share of the revenue of CSEs. It is quite common for clients to pay for drinks and to buy drinks for CSWs. Wages earned by individuals working in CSEs who are not offering sexual services are also excluded from this calculation. One may also include all expenses by foreign tourists who come to Thailand for the sole purpose of buying sexual services. It is thus, in practice, impossible to calculate indirect revenue.

Direct revenue is very high in red-light districts and accounts for a non-trivial share of the local economy. Unsurprisingly, the ratio of direct revenue over the provincial GDP is low for most provinces (data not shown). But 5 provinces have estimates larger than 1%. The highest estimate is for Chon Buri province where this ratio is over 3%. Hence, we find that some areas depend economically on sex industry's revenue. We report direct revenue for all regions in Table A5, column 1. Column 2 shows the region GDP in 1990. Column 3 presents the ratio of the direct revenue of the sex industry over the GDP.

We conclude by computing the direct revenue for districts that could be reached by U.S. servicemen in less than one hour (36 districts). The share of direct revenue in treated districts is expected to be high since sex tourists pay much more for sex act. Strikingly, we find that 1990 direct revenue was approximately $210M in those districts which represents 48% of direct revenue in the whole country. Unfortunately, we do not have GDP data at the district level to benchmark those numbers. But it is quite obvious that red-light districts are highly dependent on sex revenue.

Table A5: Direct Revenue of Sexual Services in 1990

	Direct Revenue ($1M)	GDP ($1M)	Revenue Share GDP
Thailand	435.82	84,962	0.51%
Central (Bangkok)	197.61	52,832	0.37%
Northeast	26.54	10,169	0.26%
East	107.24	6,696	1.60%
North	18.48	4,688	0.39%
West	8.88	3,159	0.28%
South	77.05	7,417	1.03%
Treated Districts	210.45		
Control Districts	47.19		
2nd Control Districts	81.79		

Note: The third column reports the ratio of column 1 over column 2 in percentages. We rely on the assumption that CSWs have 1.5 customers per night in this table. **Central**: Ang Thong, Phra Nakhon Si Ayutthaya, Bangkok, Lop Buri, Nakhon Pathom, Nonthaburi, Pathum Thani, Samut Prakan, Samut Sakhon, Samut Songkhram, Saraburi, Sing Buri and Suphan Buri. **Northeast**: Amnat Charoen, Buri Ram, Chaiyaphum, Kalasin, Khon Kaen, Loei, Maha Sarakham, Mukdahan, Nakhon Phanom, Nakhon Ratchasima, Nong Bua Lamphu, Nong Khai, Roi Et, Sakon Nakhon, Si Sa Ket, Surin, Ubon Ratchathani, Udon Thani and Yasothon. **East**: Chachoengsao, Chanthaburi, Chon Buri, Prachin Buri, Rayong, Sa Kaeo and Trat. **North**: Chiang Mai, Chiang Rai, Lampang, Lamphun, Mae Hong Son, Nan, Phayao, Phrae and Uttaradit. **West**: Kanchanaburi, Phetchaburi, Prachuap Khiri Khan, Ratchaburi and Tak. **South**: Chumphon, Krabi, Nakhon Si Thammarat, Narathiwat, Pattani, Phang Nga, Phatthalung, Phuket, Ranong, Satun, Songkhla, Surat Thani, Trang and Yala. See Appendix for more details.