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IT Outsourcing and the Local Market

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Proximity and software programming: IT Outsourcing and the local market

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Abstract

Prior interviews conducted by the Software Industry Center with service providers in the Indian software industry suggested the need for some face-to-face communication in coordination-intensive activities. That is, despite improvements in communication capabilities due to information technology (IT), some IT services may still be inherently nontradable. This observation motivates the present paper. We examine the question of which services are tradable within a concrete setting: the outsourcing of IT services across a broad cross-section of establishments in the US. If markets for IT services are local, then we should expect the entry decisions of IT services firms will depend upon the size of the local market and conversely, increases in local supply should increase the likelihood of outsourcing by lowering cost of outsourcing. If markets are not local, then the composition of local demand should matter little to the entry decisions of suppliers, and local supply will not affect outsourcing. We analyze outsourcing decisions from 52,191 establishments with over 100 employees at the end of 2002, for two types of IT services: *programming and design* and *hosting*. Programming and design projects require communication of detailed user requirements whereas hosting requires less coordination between client and service provider than programming and design. Our empirical results bear out this intuition: Supply of programming and design services are more sensitive to increases in local market demand than are providers of hosting services, and the probability of outsourcing programming and design is increasing the local supply of outsourcing, but the outsourcing of hosting is not. This suggests that hosting services are more tradable than programming and design, and there is some irreducible non-tradable or "local" component to programming and design services.

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1. Introduction

The outsourcing and offshoring of services in the US is an important and growing phenomenon that has recently attracted widespread attention. Concerns have been expressed about a “hollowing out” of the American information technology sector, and about the potential loss of American technological leadership. Despite a recent increase in research on outsourcing and offshoring and extensive public discussion in this area, there remains relatively little understanding of which jobs are at risk to be outsourced or offshored. At present, widely varying projections of the number of jobs “at risk” have been presented, mostly by consulting firms (e.g., McCarthy 2002). Ultimately, these estimates turn on the question of which services are tradable.

There have been two prevailing views on which services are tradable. One view emphasizes the role of information technology in reducing the costs of performing services at a distance. Under this view, IT reduces the costs of coordinating economic activity over long distances. Proponents of this view argue that all services are potentially tradable (e.g., Roach 2005). A second view argues that humans work best in physical proximity to one another, and that face-to-face interaction is required for the execution of many types of services. Proponents of this view argue that offshoring is fraught with hidden costs arising from inexperienced personnel in the services company, differences in language and culture, and time differences between vendor and client site (Matloff 2005). Though a great deal of case study work has examined offshore project decisions and governance in a variety of situations (e.g., Robinson and Kalakota 2004; Robinson et. al. 2005), this is ultimately a question not of what is possible but rather what is predominant.

In this paper, we examine the question of which services are tradable within a concrete setting: the outsourcing of IT services across a broad cross-section of firm in the US. We perform two separate sets of analyses. First, we begin by examining the cross-sectional variation in suppliers of IT services across the US. If markets for IT services are local, then we should expect the entry decisions of IT services firms will depend in part upon the size of the local market. Market size will depend both upon aggregate employment in downstream industries as well as the composition of firms in the local market and their propensity to purchase IT services. If markets are not local, then the composition of local demand should matter little to the entry decisions of suppliers. We examine the extent to which the local supply of IT services firms varies with the characteristics of demand in local markets.

Second, we examine the IT outsourcing decisions of a large cross-section of establishments in the US. We investigate the extent to which the outsourcing decision depends upon the local supply of outsourcing firms. Our major hypothesis is that if markets for IT services are local, then increases in local supply should increase the likelihood of outsourcing by lowering cost of outsourcing.

We focus on the largest investors in IT in the United States. Specifically, we analyze a survey (conducted by Harte Hanks) of adoption of advanced Internet technologies at 52,191 establishments that have over 100 employees at the end of 2002. This sample consists of established firms rather than start-ups. Approximately two-thirds of the U.S. workforce is employed in the type of establishments studied.

We examine the decisions of firms to outsourcing two types of IT services: *programming and design* and *hosting*. Programming and design refers to the decision to outsource programming tasks or planning and designing information systems that involve the integration of computer hardware, software, and communication technologies. These outsourcing projects by necessity require communication of detailed user requirements to be carried out successfully. Hosting involves management and operation of computer and data processing services for the client. After an initial set-up period, the requirements of such hosting services will be relatively static and will require less coordination between client and service provider than programming and design.

As a preview to our results, we show that:

1. Supply of outsourcing services is greater, the greater is local market demand. In particular, outsourcing supply is increasing in local employment, the IT intensity of firms in the industry, and in other characteristics of local firms that make them more likely to outsource. However, providers of programming and design services are more sensitive to increases in local market demand than are providers of hosting services.

2. On the demand side, the probability of outsourcing programming and design is increasing the local supply of outsourcing, but the outsourcing of hosting is not. This suggests that hosting services are more tradable than programming and design, and there is some irreducible non-tradable or "local" component to programming and design services.
3. The sensitivity to local conditions is greater in smaller markets: The decision to outsource is less sensitive at the margin to increases in local supply in large urban areas than in smaller areas.

We view our research as building upon recent attempts to understand which services are tradable across a broad cross-section of the economy. Jensen and Kletzer (2005) examine which services are tradable by examining geographic concentration in economic activity. The idea there is that tradable industries will be geographically concentrated to take advantage of economies of scale and favorable location factors. By contrast, non-tradable industries must locate where demand is and thus be geographically distributed similarly to economic activity in general. Our approach is complementary: If a service is tradable, demand decisions will not be sensitive to whether the service is locally available (or the extent of its availability), and similarly, local supply will not depend on local demand. Thus, we examine the determinants of local outsourcing supply and the micro-level determinants of outsourcing demand in a particular environment: IT outsourcing. Ono (2001) examines manufacturing firm decisions to outsource white-collar services such as advertising, bookkeeping and accounting, legal services, and software and data processing services. She examines how the outsourcing decision varies with potential demand as proxied by total population and a demand shifter. Like Ono (2001), we examine how the decision to outsource services depends upon local market conditions, however our analysis focuses on identifying which IT services are tradable and we focus on a broader cross-section of industries. We also explicitly model local supply, and treat it as endogenous in the sense of potentially depending upon aggregate local demand.

2. Geographic Variation in the Supply of Outsourcing Services

We begin by examining the factors influencing the cross-sectional variation in the supply of providers of outsourcing services. Firms will continue to enter a local market until the expected profits from operating in that market are equal to zero. If the markets for IT outsourcing services are local, profitability depends upon local market size and thus, all else held constant, entry will be increasing in market size and will be decreasing in the costs of operating in the market. In contrast, if IT outsourcing is a tradable service, then the decision of where to locate will be based primarily on cost considerations.

Our first test of whether IT outsourcing services are tradable examines the extent to which local supply is correlated with local demand shifters in a cross-section. We examine both the level of the coefficient estimates as well as changes in coefficient estimates across different outsourcing services that we expect ex ante to have varying sensitivity to local demand conditions. Later, we use these variables as instruments in our study of establishment-level outsourcing decisions.

2.1 Data

Our data on local supply of outsourcing and on determinants of local demand (also referred to as demand shifters) is from 2001 County Business Patterns. Our baseline analysis examines establishment-level supply at the county level. While it is common to examine county-level variation in the supply and concentration or industries, it is well known that use of county data is subject to measurement error because of the arbitrary nature of political boundaries.[2] In our study, this problem manifests itself as mismeasurement in the geographic scope of markets. In future work, we will examine the robustness of our results to alternative market definitions.

Next we discuss the dependent and independent variables in our supply side analysis. Descriptive statistics for all variables are presented in Table 1. For dependent variables, we examine the cross-sectional variation in supply of two kinds of outsourcing services. First, we examine the log of programming and design establishments in the county. This is the total number of establishments in North

[2] For an overview of recent work using alternate market definitions, see Holmes and Stevens (2003).

American Industry Classification System (NAICS) codes 541511 and 541512.[3] Programming and design services are those sets of services that involve writing software or designing information systems to meet the needs of clients. It requires vendors to solicit detailed user requirements from the client and involves repeated interaction between the vendor and client throughout the systems design and execution phase to successfully meet client needs (Kendall and Kendall 2004). Second, we examine the log of the total number of establishments involved in hosting services (NAICS 541513).[4] After initial transfer of requirements of system hosting from client to vendor, we expect these services to require less vendor-client interaction than programming and design.

2.1.1 Independent Variables

We first examine how the supply of outsourcing establishments varies with local market size. Our model of outsourcing supply builds on Smith's (1776) classic statement that "the division of labor is limited by the extent of the market." Marshall (1920) and Stigler (1951) use Smith's theorem to provide explanations for the localization of industry and, more broadly, urban agglomeration. As local industries expand, they encourage the growth of complementary subsidiary industries to serve parts of the production process. Similarly, the growth of local markets encourages the growth of "general specialties" that service multiple industries such as transportation infrastructure and professional non-tradable inputs such as IT services firms. We use the log of county employment from CBP to measure the aggregate potential market size in the county. When calculating county employment—as in all of the independent

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[3] According to the Census bureau, NAICS code 541511 "comprises establishments primarily engaged in writing, modifying, testing, and supporting software to meet the needs of a particular customer." NAICS code 541512 "comprises establishments primarily engaged in planning and designing computer systems that integrate computer hardware, software, and communication technologies."

[4] NAICS 541513 "comprises establishments primarily engaged in providing on-site management and operation of clients' computer systems and/or data processing facilities." NAICS 541513 includes "on site" hosting, which may have some sensitivity to local supply conditions. We had some robustness checks using instead NAICS 514210, which comprises establishments primarily engaged in providing electronic data processing services. These establishments may provide complete processing and preparation of reports from data supplied by customers; specialized services, such as automated data entry services; or may make data processing resources available to clients on an hourly or timesharing basis. This variable is somewhat problematic as well, as it comprises services that are outside of what we are considering "hosting." The results are similar to those reported here. The upshot of this discussion is that our measure for hosting is imperfect.

variables in this section—we exclude establishments in the three-digit NAICS industry 541 (Professional, Scientific, and Technical Services).[5]

As is well known, industries differ substantially both in the extent of their IT use and in their geographic dispersion. Since IT-intensive firms may have a greater need for IT outsourcing services, locations with a higher percentage of IT-intensive firms will have greater average demand for IT outsourcing services. We use three sets of measures to capture differences in the IT intensity of firms across counties in our sample.[6]

The IT-intensity index captures how differences in industry mix will affect the demand for outsourcing. It is calculated by first identifying each industry's use of IT services as a fraction of total inputs using BEA Input-Output Benchmark Tables for 1997.[7] To calculate IT intensity for county *l*, these fractions are weighted by industry employment. Thus, for each county *l* and industry *k*,

$$IT-INTENSITY_l = \sum_m \frac{(\text{industry } m \text{ spending on IT services})}{(\text{total industry } m \text{ spending on inputs})} \frac{(\text{total county } l \text{ employment in industry } m)}{(\text{total county } l \text{ employment})}$$

Next we control for the percentage of establishments in the county that are in industries that are involved in the production of IT. We follow the classification developed by the Department of Commerce as described by Cooke (2003), which has been used by prior authors (e.g. Daveri and Moscotto, 2002; Nordhaus, 2001).

Last, we control for the percentage of establishments in different industry groupings: Manufacturing (NAICS 321-339); Wholesale and Retail Trade (NAICS 421-454); Finance, Insurance, and Real Estate (NAICS 521-525); Information Processing (NAICS 511-514 and 551); and Other Services (NAICS 561-814).[8]

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[5] NAICS 541 includes 541511-541513 plus the "other category" 541519. We exclude the entire three-digit category because in our calculation of IT-intensity it was impossible for us to identify the relevant six-digit industry in the BEA input-output tables.

[6] Previous authors have also found that large counties and MSAs will have a higher percentage of IT-intensive firms. For example, Forman, Goldfarb, and Greenstein (2005) show that IT-intensive industries are concentrated in urban areas. These additional measures will also help us to separate the market scale effect from the effects of increasing IT intensity that are correlated with market scale.

[7] IT services are identified using IO code 5415, computer systems design and related services.

[8] The excluded category includes Mining (211-213), Utilities (221), and Construction (233-235, and Transportation and Warehousing (481-493).

We next examine how the size of establishments in a location affects the entry of suppliers. As noted above, the Smith-Marshall-Stigler theorem argues that increasing local market size will lead to greater vertical disintegration. However, the intensity of vertical disintegration will depend on the source of market growth. As noted by earlier studies (e.g., Ang and Staub 1998), large firms may achieve economies of scale without the use of IT services firms. If market growth arises primarily as a result of increases in the size of large firms, then entry by IT services firms will be limited. If, however, market growth arises through increasing numbers of small firms who are individually unable to achieve sufficient market scale, then entry by IT services firms will greater. This idea was formalized by Bresnahan and Gambardella (1998). Thus, controlling for market size, the supply of IT services firms will decrease as the size of establishments increase relative to the industry average. To measure how variation in the establishment size distribution affects industry employment, we construct the following index of establishment size:

$$ESTSIZE_l = \sum_m \frac{\dfrac{\text{(total employment in county } l \text{ and industry m)}}{\text{(total establishments in county } l \text{ and industry m)}}}{\dfrac{\text{(total employment in industry } m \text{ in US)}}{\text{(total establishments in industry } m \text{ in US)}}} \frac{\text{(total county } l \text{ employment in industry } m\text{)}}{\text{(total county } l \text{ employment)}}$$

,

The first term in the index measures the size of county-industry establishments relative to the average size of similar establishments in the same industry across the US. It controls for the fact that average establishment size varies across industries. Values of the index past 1 indicate that the average size of establishments in the industry-county is smaller relative to establishments in the same industry across the US. The second term then weights this county-industry index by the fraction of employment from that industry in the county.[9]

Entry of outsourcing firms may also be influenced by cost differences across locations. One thing that may influence the costs of outsourcing firms may be the availability of highly skilled workers. To

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[9] We have also examined alternative measures of establishment size, for example the percentage of establishments that exceed some size threshold. Our results are robust to these alternate measures of the size distribution of firms.

proxy for this, we also include the log of total enrollment from post-secondary colleges and universities in the county, obtain from Barron's.

2.2 Results

To estimate how these potential demand and cost shifters influence outsourcing supply, we estimate the following regression using ordinary least squares. Coefficient estimates and robust standard errors are reported in table 2. Column (1)-(3) are estimated over all counties in the US, while columns (4) through (6) are estimated over the set of counties for which we have demand information. As the qualitative results are similar, we focus our discussion on the results in columns (1) through (3).

$$\begin{aligned}\log(LOCAL-SUPPLY_l) = \beta_0 + \beta_1 \log(CNTY-EMPLOYMENT_l) + \beta_2 IT-INTENSITY_l + \\ \beta_3 ESTABLISHMENT-SIZE_l + \beta_4 PCT-ITPRODUCING_l + \\ \beta_5 \log(UNIV-ENROLL_l) + \sum_i \gamma_i PCT-IND(i)_l + \varepsilon_l\end{aligned}$$

Increases in population and potential demand significantly increase the supply of programming and design services to a region. Column 2 shows that elasticity of programming/design supply with respect to population is 0.806. This supports the conclusion that local market factors have a significant effect on the entry decisions of programming and design firms. It provides evidence to support the view that vertical specialization is increasing in the scale of the market (Stigler 1951), at least for this set of services.

As expected, the sensitivity of hosting to local demand is weaker than that of programming/design; the elasticity of hosting supply with respect to population is 0.1899. However, it is still significant. This may be because locations with larger population and larger potential demand may have lower operating costs. For example, large counties may have better local IT and communications infrastructure, which may lower the costs of hosting.

Table 2 also shows that entry of programming and design firms will be decreasing in average firm size, other things equal. The coefficient estimate for the establishment size index in column 2 is -0.012, which suggests that a one standard deviation increase in the establishment size index will decrease the expected number of programming and design firms by 8.2%. Column 3 suggests that changes in average establishment size have little effect on the entry decisions of hosting firms; the coefficient estimate of -0.0013 is not statistically significant.

As expected, entry of IT services firms will be increasing in the intensity with which firms use IT as well as increasing in the percentage of firms involved in the production of IT. However, once again the supply of programming and design services is more sensitive than the supply of hosting to increases in local IT intensity. The coefficient estimate of the IT intensity index is 57.688 for programming and design (column 2) and 35.106 for hosting, while the coefficient estimate for percent IT producing industries is 2.852 for programming and design and 1.061 for hosting.

Surprisingly, entry of both programming and design and hosting firms is decreasing in local university enrollment. It is likely that the variable is picking up unobservable cross-sectional factors that are negatively correlated with the supply of IT services.

Overall, these results suggest that the supply of programming and design services is more sensitive to local market conditions than is the supply of hosting services. However, as noted above, these results may also be capturing unobservable cross-sectional differences that may be correlated with the supply of outsourcing. To say something more conclusive, we need a more explicit model characterizing the demand for outsourcing services. We turn to this analysis in the next section.

3. Theory and Hypotheses for the Decision to Outsource

To understand how the local supply of outsourcing firms influences the IT outsourcing decision, we build a simple model of an establishment's decision to staff IT projects with internal or external IT staff. Establishments face the following maximization problem:

$$\max_{x_1, x_2} \pi(x_1, x_2, z) - w_1 x_1 - w_2 x_2$$

where x_1 and x_2 represent the decision to hire external or internal IT employees (respectively), and w_1 and w_2 represent the wage of hiring and additional internal external or internal worker. The function $\pi(\cdot)$ represents the value of IT projects and the vector z represent establishment-specific and industry-specific variables that will shift the value of new IT projects. To decide upon the optimal level of outsourcing and IT employment, we take first order conditions:

$$\frac{d\pi(x_1, x_2, z)}{dx_1} - w_1 = 0$$
$$\frac{d\pi(x_1, x_2, z)}{dx_2} - w_2 = 0$$

leading to the following optimal levels of outsourcing and internal IT employment:

$$x_1 = f(w_1, x_2, z)$$
$$x_2 = f(w_2, x_1, z)$$

The focus of our analysis will be on the optimal level of outsourcing x_1. To econometrically estimate the outsourcing decision embedded in these first order conditions, we must make a number of additional assumptions. First, we assume that if outsourcing markets are local, then the price of outsourcing employees will be a function of local supply, $w_1 = g(os) + \eta$. Further, as noted below, we do not observe the true quantity of employees outsourced, only a binary variable indicating whether outsourcing had been used. Thus, the number of outsourcing employees hired will be a latent variable x_1^*. Further, the decision to outsource will also be a function of unobservables ν that are not captured in the vector z. Thus, the decision we observe for establishment i will be

$$x_{1i}^* = f(os_i + \eta_i, x_{2i}, z_i, \nu_i).$$

Assuming that x_{1i}^* is linear in parameters gives us

$$x_{1i}^* = \alpha os_i + \beta x_{2i} + \gamma z_i + \eta_i + \nu_i \qquad (1)$$

If we assume that $\eta_i + \nu_i$ is iid normal, then equation (1) is a probit model. Our major interest is in testing whether $\alpha > 0$, that is, whether the decision to outsource is increasing in local supply.

Of course, as (1) is a cross-sectional regression, one may be concerned that os_i may be correlated with unobserved location-specific factors η_i that increase the likelihood of outsourcing. For example, outsourcing firms may prefer to locate in places with a more highly skilled workforce, which may also lower the costs of outsourcing. In this case, estimates of α will be inconsistent. Further, x_2 may be correlated with unobservables that increase the value of outsourcing at an establishment. For example, management at the establishment may have a propensity for investing in IT that is inadequately controlled for in the vector z_i. To address this issue, we use nonlinear instrumental variable (IV) techniques. Following Maddala (1983, p. 247–52), we used Amemiya Generalized Least Squares.[10] Our instruments for os_i will be the variables used in our supply equation: log of county employment, IT intensity index, index of average establishment size, log of university employment, percent IT-producing industries, as well as industry controls. Our instruments for x_{2i} will be equal to the change in $x_{2i'}$ for establishments $i' \neq i$ from other firms in other locations in which the firm has establishments. We describe these instruments in further detail below.

4. Data

The data we use for this part of the analysis come from the Harte Hanks Market Intelligence CI Technology database (hereafter CI database). The CI database contains establishment-level data on (1) establishment characteristics, such as number of employees, industry and location; (2) use of technology hardware and software, such as computers, networking equipment, printers and other office equipment; and (3) use of outsourcing. Harte Hanks collects this information to resell as a tool for the marketing divisions at technology companies. Interview teams survey establishments throughout the calendar year; our sample contains the most current information as of December 2002.

We focus on establishments rather than firms as the unit of analysis because establishment-level data will enable us to more precisely measure the impact of changes in local supply on the costs of outsourcing. Moreover, most software investment decisions in our data are made at the establishment level. For instance, 80% of the establishments that responded to the question stated that decisions on adoption of Internet technologies were made at the establishment rather than the firm level. Our sample from the CI database contains all commercial establishments with over 100 employees, 91,129 establishments in all. We use the 52,191 observations with complete data.

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[10] In the first stage, the endogenous variables are treated as a linear function of the instruments and the exogenous variables. The second stage probit uses the predicted values for the endogenous variables from the first stage.

4.1 Identifying Decisions to Outsource

Our endogenous variable will be x_{1i}, the extent of outsourcing by establishment *i*. This variable x_{1i} is latent. We observe only discrete choices: whether or not the establishment chooses to outsource a particular service or not, with the observed decision takes on a value of either one or zero, respectively.

Establishments in our sample can contract with outside firms for a range of services. Harte Hanks tracks 20 separate binary measures of outsourcing services that an establishment may use. We aggregate these 20 different outsourcing services into two categories that have similar production technologies. These two categories will comprise the endogenous variables for our baseline model. We explore other classification of outsourcing services for our robustness checks discussed later.

The first endogenous variable measures an establishment's decision to outsource programming or network design services. An establishment is considered to have outsourced programming and design if it answers yes to outsourcing any of the following services: application design; contract programming; outsourced application development; package software implementation; or Internet/web application development.

The second variable measures an establishment's decision to outsource the hosting or maintenance of a firm's hardware or network facilities to a third party. An establishment is considered to have outsourced hosting services if it answers yes to outsourcing any of the following services: LAN client/server; LAN network management; or LAN maintenance. One category of hosting services that we have omitted is the outsourcing of Internet/web servers; web site management; the provision of routers; and the provision of firewalls. There are two reasons for this omission. First, these services are often provided by Internet service providers (ISPs) as well as by dedicated hosting firms. However, prior work (Greenstein 2000) has shown that there is considerable heterogeneity in the extent to which ISPs provide these additional services. Because we are unable to determine which services ISPs provide, including ISPs in our measure of supply would add noise to this measure. Moreover, the costs (to the client) of hosting Internet services at a collocation facility may be increasing in the distance of the collocation facility from the client. In particular, clients may need to visit the collocation facility if there is a security intrusion. In general, holding all else equal, the link between the quality of service provision and proximity to the client is ambiguous for hosting of Internet/web services. Because of this, we exclude it from our analysis. Including this increases the sensitivity to local conditions for both supply of such services and the decision to outsource, but not markedly so, and the substantial differences between programming and design and hosting remain.

4.2 Independent Variables

Summary statistics on the independent variables are included in Table 5. As before, measures of local supply and supply instruments are calculated from County Business Patterns data. All other variables are calculated using the CI database.

We use two different measures of the change in internal IT services (x_{2i}), depending upon the measure of outsourcing that we consider. When x_{1i} measures outsourcing of programming and design, then x_{2i} measures changes in the number of programmers at the establishment between 2000 and 2002.[11] When x_{1i} measures outsourcing of hosting services, then x_{2i} measures changes in the number of non-PC servers at the establishment between 2000 and 2002.

As noted above, x_{2i} is likely to be correlated with establishment-specific unobservables that influence the likelihood of outsourcing. As an instrument for changes in the number of programmers, we calculate the change in programmers in other firms in the same 2-digit NAICS industry in other locations that the firm has an establishment. The instruments pick up factor changes in industry specific demand (but not location specific demand) and should be correlated with an establishment's change in programmers but not with the propensity of the establishment to outsource, conditional on its industry.[12] We instrument for changes in the number of servers using this variable plus changes in the number of servers in other firms in the same 2-digit NAICS industry in other locations that the firm has an

[11] In fact, number of programmers is measured as a categorical variable with the following ranges: 1-4; 5-9; 10-24; 25-49; 50-99; 100-249; 250-499; 500-999; and 1000 or more. We use the midpoint of each interval and then calculate the change between 2000 and 2002.

[12] In an OLS regression of change in programmers on this instrument and other exogenous variables in our baseline regression (not reported), this instrument had a coefficient estimate of -0.0658 and was significant at the one percent level.

establishment. We include both variables as instruments because the instrument using servers alone is weak.[13]

We include as additional controls in our regressions three-digit NAICS dummies, the log of establishment employment, a dummy indicating that the establishment comes from a multi-establishment firm, the number of PCs per employee and the number of non-PCs per employee.

4.3 Descriptive Statistics

Table 3a shows how outsourcing of programming and design and hosting has changed over two year intervals from 1998-2004 within a sample of 26,708 establishments that have remained in the CI database for the entire sample period. Incidence of outsourcing of both programming and design and hosting jumped sharply between 1998 and 2000. Outsourcing of programming and design rose from 18.6% in 1998 to 30.1% in 2000, while outsourcing of hosting rose from 8.2% in 1998 to 17.2% in 2000. Outsourcing of both programming and design and hosting subsequently declined, possibly reflecting an overall decline in real IT spending. However, by 2004 outsourcing of programming retreated to 20.7%, close to its 1998 levels. In contrast, 2004 outsourcing of hosting was 14.7%, still well above its 1998 levels. Though not fully representative of the US economy, these data suggest that while outsourcing of programming is not following any obvious trend, outsourcing of hosting services may be trending upward.

Table 3b shows how the propensity to outsource varies with the change in programmers at an establishment. This variable provides a crude measure of how outsourcing varies with internal employment flows. The table shows that outsourcing of programming and design services is greater when establishments add programmers (29.4%) then when establishments lose programmers (24.0%). In contrast, outsourcing of hosting is greater when establishments lose programmers (17.1%) than when they add programmers (13.7%). Though we are unable to draw formal conclusions from these aggregate statistics, they are suggestive that internal and contract programmers may be used as complements to one

[13] In an OLS regression of change in servers on these two instruments and other exogenous variables in our baseline regression (not reported), the programmers instrument had a coefficient estimate of -0.0521 and had a p-value of 0.334.

another, while hosting services may be used as a substitute to internal IT staff, at least at the establishment level.

Table 4 shows how 2002 outsourcing varies by the size of geographic area. Average outsourcing of programming and design is clearly increasing in the size of a location, though the pattern for hosting is less clear. Outsourcing of programming and design increases from an average level of 24.2% in small MSAs and rural areas to 26.1% in medium and large MSAs, and these levels are significantly different from one another at the 1% level. In contrast, outsourcing of hosting declines slightly from an average level of 15.61% in rural areas and small MSAs to 15.60% in medium and large MSAs: these levels are not statistically different from one other. Since Table 2 suggests that the supply of outsourcing establishments is increasing in location size, these results suggest that the decision to outsource programming and design is increasing in the local supply of outsourcing firms. However, as is well firms located in urban and rural areas are systematically different in the way they use IT (Forman, Goldfarb, and Greenstein 2005) and so are likely to be different in their propensity to outsource IT. To identify how local supply influences the decision to outsource, we require a model that controls for industry differences, establishment size, and any potential endogeneity between local supply and the decision to outsource. We turn to this model in the next section.

5. Results

5.1 Baseline Results

Table 6 displays our baseline results for how local supply influences the outsourcing of programming and design services and hosting services. Columns (1) and (2) show probit results without instrumental variables; columns (3) and (4) show the results of instrumenting for local supply but not for changes in internal programmers and servers; and columns (5) and (6) show the full specification with instruments for local supply and changes in internal programmers and servers. All results are reported as marginal effects.

The results show that increases in the local supply of programming and design establishments increases the likelihood of outsourcing those services, while increases in the local supply of hosting establishments does not increase the likelihood of outsourcing hosting. This is true regardless of the extent to which instrumental variables are used. Columns (1), (3), and (5) show that increases in the local supply of programming and design firms have a statistically significant impact (at the 1% level) on the decision to outsource those services. The results in column (5) imply that a one standard deviation increase in the log of local programming and design estasblishments increases the probability of outsourcing programming and design by 0.7 percentage points. In contrast, increases in the local supply of hosting establishments has no statistically significant impact on the decision to outsource hosting services.

While columns (1) and (2) suggest that increases in the number of programmers and servers are significantly positively correlated (at the 1% level) with increases in the outsourcing of programming and design and hosting, these results are not robust to the use of instrumental variables. This may be due in part to the weakness of some of our instruments. Columns (1) and (2) suggest that a one standard deviation increase in programmers and servers increases the probability of outsourcing programming and design and hosting by 0.9 percentage points and 2.1 percentage points respectively, however columns (5) and (6) suggest these variables have no significant impact on the outsourcing decisions.

Columns (5) and (6) also show the impact of other establishment-specific factors on the decision to outsourcing. The positive coefficient on establishment employment in the programming and design regression is somewhat surprising. One common reason for the advantages of IT outsourcing is that third party firms are able to obtain economies of scale that are not possible in smaller firms. Thus, the decision to outsource has previously shown to be negatively correlated with firm size (e.g. Ang and Straub 1998; Loh and Venkatraman 1992). This result likely reflects a larger number of software projects in larger establishments. Other things equal, a larger number of software projects will increase the likelihood that one project will be outsourced. This will in turn increase the likelihood that we observe outsourcing in our measurement framework.

Columns (5) and (6) shows that establishments from multi-establishments firms are 9.7 percentage points less likely to outsource programming and design and 1.1 percentage points more likely to outsource hosting. Both results are significant at the 1% level. Since this variable may capture differences in the costs and benefits of outsourcing for larger firms, this variable may in part capture firm size effects. Moreover, when establishments are part of a larger multi-establishment firm, these results may reflect firm-level choices of where to locate IT projects. In future work, we plan to more carefully investigate this hypothesis.

5.2 Robustness Checks

Table 7 examines the robustness of our results. Columns (1) and (2) show the robustness of our results to the use of employment as our measure of local supply. The results are qualitatively unchanged: increases in programming and design employment have a statistically significant positive affect (at the 1% level) on the adoption of programming and design, while again hosting supply has little affect on the decision to outsource hosting. A one standard deviation in the programming and design employment increases the likelihood of outsourcing by 0.7 percentage points, identical to our results in Table 6.

Columns (3) and (4) examine the robustness of our results to alternative dependent variables. Column (3) examines the relationship between increases in programming establishments and the decision to outsource programming, while column (4) examines the decision to outsource both non-Internet and Internet hosting. As expected, the results are qualitatively similar, though the point estimate of local supply has a weaker effect on programming and design and a stronger effect on hosting.

Table 8 examines how increases in local supply increase the likelihood of outsourcing in large versus small locations. Prior research has demonstrated that the effect of the marginal entrant on a market on increasing competition and decreasing price is declining with number of entrants (Bresnahan and Reiss 1991). If increases in local supply increase the likelihood of outsourcing primarily through lower prices, we should similarly expect the impact of the marginal entrant on outsourcing to be lower in large urban areas than in small areas. To explore this further, we interact our supply variable with a dummy if the establishment is in a medium or large urban area.[14] Columns (5) and (6) show the results using a full set of instrumental variables. Column (5) suggests that increase in local supply will increase the probability of outsourcing programming and design more in small areas than in large urban areas. The direct effect in this model is statistically significant at the 1% level, while the interaction effect is significant at the 10% level. A one standard deviation increase in the log of number of establishments will increase the probability of outsourcing by 1.3 percentage points in small areas but will increase the probability by only 0.8 percentage points in medium and large MSAs. Column (6) shows that a similar pattern exists with hosting services, though the statistical significance is lower. The direct effect is now significant at the 10% level, while the interaction effect is not statistically significant. These coefficient estimates suggest that a one standard deviation increase in hosting increases the probability of hosting by 1.2 percentage points in small areas but by only 0.3 percent in small areas. The reason for the relatively stronger hosting results in small areas is in contrast to our other results, and requires further exploration.

6. Discussion and Conclusions

In this paper we have examined the geographic variation in supply and the decision to outsource two types of outsourcing services: programming and design and hosting. Differences in the characteristics of these services and the manner in which they are supplied has lead to substantial differences in their geographic dispersion and, in turn, the likelihood that they are potentially tradable.

For one class of services, programming and design, entry decisions into local markets appear to be influenced by the size of the potential market. Total employment, the intensity of IT use of local firms, and the size of local establishments all influence the magnitude of local supply. Further, establishment decisions to outsource are significantly influenced by the magnitude of local supply. These results suggest that markets for programming and design are local, and so these services are not tradable.

In contrast, both supply decisions and micro-level outsourcing decisions for hosting services are much less sensitive to the characteristics of the local market. Hosting services are less sensitive to

[14] We have also estimated the model using a spline for local supply that allows the impact of the marginal entrant to vary across different ranges of supply. The results are qualitatively similar. In future work, we plan to more carefully explore the potential nonlinearity of the relationship between local supply and the decision to outsource.

variations in local demand created by shifts in employment and IT intensity, and are not affected at all by differences in average establishment size across locations. Moreover, the decision to outsource local hosting services does not seem to be shifted by changes in local supply. These results suggest that markets for hosting services may be far more tradable for hosting than for programming and design.

These results have implications for understanding how trends in outsourcing and offshoring will influence US employment growth. While some tasks in programming and design can undoubtedly be conducted at a distance, these results suggest that providers of such services must maintain some local presence. Moreover, our descriptive tables suggest that (unconditionally at least) use of programming and design services is associated with *more* employment growth, at least at the establishment level. Moreover, there is no clear aggregate trend the fraction of firms outsourcing these services.

In contrast, the results suggest that provision of hosting services can more easily be conducted at a distance and potentially performed in offshore locations. Moreover, our descriptive tables suggest that establishments are substituting the hosting services of other companies for internal IT personnel. Last, the there appears to be a trend of increasing use of outsourced hosting over time. Thus, for these sets of services, our results suggest that outsourcing of hosting is clearly a greater concern for US employment growth than the outsourcing of programming and design.

Our focus is on outsourcing rather than offshoring. The two are related but distinct. Offshoring implies that the activity takes place offshore, but may be carried out by the firm itself or its foreign subsidiaries. Outsourcing implies that the activity is carried out by another firm, be it nearby or offshore. It is possible that there are subtle interactions between need for proximity and contracting across firm boundaries so that the potential for offshoring may be greater than that that implied by our results for programming and design services. Nonetheless, the fact is that for software development and maintenance, offshoring is typically through outsourcing to other vendors. Further, the large number of programmers stationed by such vendors near their customers (witness the ongoing uproar about the use of H1-B visas by IT firms) supports our findings that there is a significant need for proximity in some (though not all) aspects of software design and development. It is possible that this need may be satisfied by foreign programmers being moved to be close to the clients; the fact remains that the activity takes place locally. The implications for immigration policy may be less clear; those for our understanding of the boundaries of the firm are not. It is unlikely that the American technological leadership in software design and innovation will face a serious challenge in the near future.

Our paper presents a methodology for identifying tradable and non-tradable services that can be useful outside of an IT setting. Use of this method could be useful in identifying which positions are most at risk for being moved to alternate locations. Moreover, this method could also be useful for identifying whether the set of positions at risk is changing over time, due to improvements in outsourcing practices, technological change in IT that may reduce the coordination costs associated with distance (Forman, Goldfarb, and Greenstein 2005), or some other reason. The major constraint of this methodology is that it requires micro-data on firm usage of outsourcing.

This paper raises several new questions for research. First, as noted above more research is needed on understanding which services are tradable and how this changes over time. Future research could explore more carefully the link between outsourcing and labor demand at the firm level. Future research could also do micro-level studies of outsourcing to determine, for example, what features of services increase or decrease their tradability. Moreover, future research could explore how the selection of governance mechanisms in outsourcing arrangements varies with supplier distance. In short, the outsourcing and offshoring of services is an important research area in need of future work.

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Table 1: Descriptive Statistics

	Mean	Standard Deviation	Minimum	Maximum	Number of Obs
Full Data Set					
Log of programming establishments (NAICS 541511)	0.938542	1.33912	0	7.213032	3185
Log of programming & design establishments (NAICS 541511/2)	1.235442	1.519849	0	7.765145	3185
Log of hosting establishments (NAICS 541513)	0.163525	0.488553	0	3.931826	3185
Log of county employment	8.838296	1.732382	2.302585	15.16671	3185
IT Intensity Index	0.005284	0.002559	0	0.086475	3185
Establishment Size Index	2.586472	8.703245	0.462234	294.8487	3185
Percent of Establishments > 500 Employees	0.003051	0.026824	0	1	3185
Percent of Establishments in Manufacturing	0.208666	0.154059	0	0.956435	3185
Percent of Establishments in Whlse/Retail Trade	0.228801	0.097454	0	1	3185
Percent of Establishments in FIRE	0.061629	0.044081	0	0.666667	3185
Percent of Establishments in Info Processing	0.03303	0.033375	0	0.647482	3185
Percent of Establishments in Other Services	0.397618	0.135809	0	1	3185
Percent of Establishments in IT-Producing Ind	0.027546	0.029937	0	0.470837	3185
Used in Demand Regressions					
Log of programming establishments (NAICS 541511)	1.076381	1.397022	0	7.213032	2721
Log of programming & design establishments (NAICS 541511/2)	1.413147	1.56859	0	7.765145	2721
Log of hosting establishments (NAICS 541513)	0.187079	0.522206	0	3.931826	2721
Log of county employment	9.214482	1.503095	3.496508	15.16671	2721
IT Intensity Index	0.005079	0.002545	0	0.864747	2721
Establishment Size Index	2.137497	2.647978	0.479924	36.02635	2721
Percent of Establishments > 500 Employees	0.001967	0.002496	0	0.520833	2721
Percent of Establishments in Manufacturing	0.22743	0.152093	0	0.9564347	2721
Percent of Establishments in Whlse/Retail Trade	0.212703	0.06183	0.164159	1	2721
Percent of Establishments in FIRE	0.054656	0.026524	0	0.3191489	2721
Percent of Establishments in Info Processing	0.0323	0.027999	0	0.3490919	2721
Percent of Establishments in Other Services	0.377173	0.109128	0.484581	1	2721
Percent of Establishments in IT-Producing Ind	0.028058	0.0295	0	0.4708367	2721

Table 2: Supply Regressions

	All Counties			Counties Used in Demand Analysis		
	(1)	(2)	(3)	(4)	(5)	(6)
	Programming	Programming & Design	Hosting	Programming	Programming & Design	Hosting
log of total county employment	0.6918	0.8061	0.1899	0.7829	0.9078	0.2201
	(0.0169)**	(0.0179)**	(0.0101)**	(0.0155)**	(0.0158)**	(0.0110)**
IT Intensity Index	59.2426	57.6884	35.1057	41.2502	37.8881	28.9437
	(21.2208)**	(21.3369)**	(14.0397)*	(15.5397)**	(15.0176)*	(13.2989)*
Average est size relative to US	-0.0086	-0.0117	-0.0013	0.0003	-0.0062	0.0050
	(0.0025)**	(0.0032)**	(0.0008)	(0.0046)	(0.0044)	(0.0020)*
Pct Manufacturing emp	-0.7576	-0.8035	-0.1689	-0.8200	-0.9179	-0.1135
	(0.1317)**	(0.1409)**	(0.0620)**	(0.1510)**	(0.1640)**	(0.0711)
Pct Whsle + Retail trade emp	1.0526	1.1825	0.1900	0.3434	0.3469	-0.0234
	(0.2026)**	(0.2219)**	(0.0859)*	(0.2919)	(0.3243)	(0.1321)
Pct FIRE emp	4.8840	4.9215	1.9030	7.1688	6.3302	3.4818
	(0.4888)**	(0.4991)**	(0.2947)**	(0.6195)**	(0.6216)**	(0.4706)**
Pct Info Prof and Mgmt emp	1.1658	0.9605	0.6870	2.2479	1.8916	1.3026
	(0.6779)+	(0.6625)	(0.4051)+	(0.7353)**	(0.7231)**	(0.4973)**
Pct Oth Services emp	0.3945	0.5172	0.0979	0.1249	0.2657	-0.0164
	(0.1402)**	(0.1566)**	(0.0599)	(0.1647)	(0.1782)	(0.0776)
Log of university enrollment	-0.0076	-0.0051	-0.0048	-0.0237	-0.0240	-0.0089
	(0.0048)	(0.0052)	(0.0023)*	(0.0045)**	(0.0048)**	(0.0024)**
Pct IT-producing industries	2.6715	2.8524	1.0608	2.8299	2.9955	1.1232
	(0.6987)**	(0.6967)**	(0.4132)*	(0.7521)**	(0.7419)**	(0.4603)*
Constant	-6.0956	-6.8699	-1.8980	-6.7345	-7.4949	-2.1918
	(0.1994)**	(0.2124)**	(0.1157)**	(0.2127)**	(0.2265)**	(0.1268)**
Observations	3184	3184	3184	2721	2721	2721
R-squared	0.7499	0.7861	0.4781	0.7816	0.8122	0.5206

Ordinary least squares regression with robust standard errors in parentheses.
+significant at 90% confidence level. *significant at 95% confidence level. **significant at 99% confidence level.

Table 3a: Average Outsourcing by Year

	Programming	Programming & Design	Hosting Ex Internet
1998	15.05%	18.57%	8.15%
	(0.22%)	(0.24%)	(0.17%)
2000	21.77%	30.08%	17.24%
	(0.25%)	(0.28%)	(0.23%)
2002	19.25%	27.22%	17.91%
	(0.24%)	(0.27%)	(0.23%)
2004	12.52%	20.73%	14.70%
	(0.20%)	(0.25%)	(0.22%)

Note: Sample includes only establishments that are in the sample for all four years. Number of observations=26,708. Standard errors in parentheses.

Table 3b: Average Outsourcing by Employment Change in Programmers

	Frequency	Programming	Programming & Design	Hosting Ex Internet
Decline in Programmers	6,236	15.47%	23.97%	17.08%
		(0.46%)	(0.54%)	(0.48%)
No Change	37,312	17.22%	24.19%	16.22%
		(0.20%)	(0.22%)	(0.19%)
Increase in Programmers	17,080	21.87%	29.44%	13.72%
		(0.32%)	(0.35%)	(0.26%)

Note: Calculations for 2002. Standard errors in parentheses. Difference between decline and increase is sig at 5% level for all three types.

Table 4: Average Outsourcing by Size of Metropolitan Statistical Area

	Programming	Programming & Design	Hosting Ex Internet
Rural Area	17.81%	24.30%	15.91%
	(0.38%)	(0.43%)	(0.37%)
Small MSA (< 250,000)	17.87%	23.85%	15.04%
	(0.54%)	(0.60%)	(0.50%)
Medium MSA (250,000 to 1 million)	18.48%	26.30%	16.41%
	(0.35%)	(0.40%)	(0.34%)
Large MSA (> 1 million)	18.54%	26.08%	15.31%
	(0.21%)	(0.24%)	(0.20%)

Note: Calculations for 2002. Standard errors in parentheses. Difference between rural/small and medium/large is sig at 5% level for all three types.

Table 5: Descriptive Statistics for Establishment Outsourcing Analysis

	Mean	Standard Deviation	Minimum	Maximum	Number of Obs
Outsource Programming	0.185952	0.389071	0	1	52191
Outsource Programming & Design	0.260409	0.438862	0	1	52191
Outsourcing Hosting Ex Internet	0.163266	0.369612	0	1	52191
Log(Local Programming Establishments)	3.934071	2.124855	0	7.213032	52191
Log(Local Programming & Design Establishments)	4.5142	2.19376	0	7.765145	52191
Log(Local Hosting Establishments)	1.423794	1.263924	0	3.931826	52191
Change in Programmers	0.837357	28.81435	-500	500	52191
Change in Servers	1.088138	70.45643	-10000	6000	52191
Change in Programmers Instrument	0.314018	5.764956	-346.655	250	52191
Change in Servers Instrument	0.242966	9.864905	-883.463	410.5	52191
Log of County Employment	12.03868	1.729237	3.496508	15.16671	52191
IT Intensity Index	0.007193	0.003516	0	0.086475	52191
Establishment Size Index	1.520034	1.246224	0.479992	36.02635	52191
Log University Enrollment	8.953789	3.53963	0	13.1765	52191
Percent of Establishments in Manufacturing	0.157896	0.107231	0	0.956435	52191
Percent of Establishments in Whlse/Retail Trade	0.183636	0.035955	0.016416	1	52191
Percent of Establishments in FIRE	0.071733	0.034512	0	0.319149	52191
Percent of Establishments in Info Processing	0.057296	0.030596	0	0.347092	52191
Percent of Establishments in Other Services	0.373022	0.067172	0.092736	1	52191
Percent of Establishments in IT-Producing	0.047099	0.033799	0	0.470837	52191
Log Establishment Employment	5.567426	0.808246	4.60517	12.76769	52191
Multi-Establishment Dummy	0.428963	0.494933	0	1	52191
PCs per Employee	0.529886	4.510383	0	1001.05	52191
Non PCS per Employee	0.009858	0.07051	0	8.033334	52191

Table 6: Analysis of Establishment Outsourcing Decision

	No Instruments		Instrument for Local Supply		Instrument for Local Supply & Change in Programmers/Servers	
	(1)	(2)	(3)	(4)	(5)	(6)
	Programming & Design	Hosting	Programming & Design	Hosting	Programming & Design	Hosting
Log(Local Programming & Design Establishments)	0.0036		0.0034		0.0030	
	(0.0010)**		(0.0010)**		(0.0011)**	
Log(Local Hosting Establishments)		0.0007		0.0020		0.0021
		(0.0014)		(0.0016)		(0.0016)
Change in Programmers	0.0003				0.0051	
	(0.0001)**				(0.0032)	
Change in Servers		0.0003				0.0013
		(0.0000)**				(0.0017)
Log Establishment Employment	0.0318	0.0021	0.0325	0.0028	0.0264	0.0018
	(0.0026)**	(0.0022)	(0.0026)**	(0.0022)	(0.0045)**	(0.0022)
Multi-Establishment Dummy	-0.0986	0.0108	-0.0987	0.0107	-0.0970	0.0109
	(0.0041)**	(0.0036)**	(0.0041)**	(0.0036)**	(0.0044)**	(0.0036)**
PCs per Employee	0.0385	-0.0002	0.0396	-0.0001	0.0379	-0.0003
	(0.0015)**	(0.0006)	(0.0015)**	(0.0005)	(0.0015)**	(0.0006)
Non PCS per Employee	0.0912	0.0731	0.0953	0.0847	0.0135	0.0408
	(0.0245)**	(0.0226)**	(0.0244)**	(0.0230)**	(0.0585)	(0.0577)
Observations	52191	52191	52191	52191	52191	52191

Values represent marginal effects. Standard errors are in parentheses. All regressions include dummy variables for three-digits NAICS.
+significant at 90% confidence level.
*significant at 95% confidence level.
**significant at 99% confidence level.

Table 7: Robustness to Alternative Dependent Variables and Measures of Local Supply

	Uses Employment to Measure Local Supply		Alternate Dependent Variables	
	(1)	(2)	(3)	(4)
	Programming & Design	Hosting	Programming	Hosting (Includes Internet)
Local Supply Programming & Design	0.0024			
	(0.0009)**			
Local Supply Programming			0.0016	
			(0.0009)+	
Local Supply Hosting		0.0009		0.0033
		(0.0008)		(0.0021)
Change in Programmers	0.0048		0.0028	
	(0.0032)		(0.0027)	
Change in Servers		0.0012		0.0026
		(0.0017)		(0.0022)
Log Establishment Employment	0.0267	0.0019	0.0149	0.0003
	(0.0045)**	(0.0022)	(0.0039)**	(0.0030)
Multi-Establishment Dummy	-0.0972	0.0109	-0.0806	-0.0812
	(0.0044)**	(0.0036)**	(0.0038)**	(0.0047)**
PCs per Employee	0.0380	-0.0003	0.0006	0.0003
	(0.0015)**	(0.0006)	(0.0004)	(0.0005)
Non PCS per Employee	0.0173	0.0423	0.0569	0.0321
	(0.0586)	(0.0575)	(0.0497)	(0.0766)
Observations	52191	52191	52191	52191

Values represent marginal effects. Standard errors are in parentheses. All regressions include dummy variables for three-digits NAICS.
+significant at 90% confidence level.
*significant at 95% confidence level.
**significant at 99% confidence level.

Table 8: Are Marginal Increases in Local Supply Less Important in Large Urban Areas?

	No Instruments		Instrument for Local Supply		Instrument for Local Supply & Change in Programmers/Servers	
	(1)	(2)	(3)	(4)	(5)	(6)
	Programming & Design	Hosting	Programming & Design	Hosting	Programming & Design	Hosting
Log(Local Programming & Design Establishments)	0.0065		0.0069		0.0059	
	(0.0017)**		(0.0018)**		(0.0020)**	
Log(Local Programming & Design Establishments)*Large MSA Dummy	-0.0024		-0.0027		-0.0024	
	(0.0011)*		(0.0012)*		(0.0013)+	
Log(Local Hosting Establishments)		0.0063		0.0115		0.0094
		(0.0035)+		(0.0051)*		(0.0056)+
Log(Local Hosting Establishments)*Large MSA Dummy		-0.0055		-0.0092		-0.0070
		(0.0032)+		(0.0045)*		(0.0051)
Change in Programmers	0.0003				0.0059	
	(0.0001)**				(0.0026)*	
Change in Servers		0.0003				0.0017
		(0.0000)**				(0.0015)
Log Establishment Employment	0.0317	0.0021	0.0324	0.0028	0.0254	0.0017
	(0.0026)**	(0.0022)	(0.0026)**	(0.0022)	(0.0040)**	(0.0023)
Multi-Establishment Dummy	-0.0985	0.0108	-0.0986	0.0107	-0.0967	0.0110
	(0.0041)**	(0.0036)**	(0.0041)**	(0.0036)**	(0.0045)**	(0.0037)**
PCs per Employee	0.0384	-0.0002	0.0394	-0.0001	0.0377	-0.0003
	(0.0015)**	(0.0006)	(0.0015)**	(0.0005)	(0.0015)**	(0.0006)
Non PCS per Employee	0.0906	0.0728	0.0945	0.0839	-0.0012	0.0262
	(0.0245)**	(0.0227)**	(0.0245)**	(0.0232)**	(0.0495)	(0.0529)
Observations	52191	52191	52191	52191	52191	52191