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The Push-Pull Effects of the Information Technology Boom and Bust: Insight from Matched Employer-Employee Data

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Working Paper 2006-1
February 2006

WORKING PAPER SERIES

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Abstract: This paper examines the inflow and outflow of workers to different industries in Georgia during the information technology (IT) boom of the 1990s and the subsequent bust. Workers in the software and computer services industry were much more likely to have been absent from the Georgia workforce prior to the boom but were no more likely than workers from other industries to have exited the workforce during the bust. Consequently, the Georgia workforce likely experienced a net gain in worker human capital as a result of being an area of concentration of IT-producing activity during the IT boom.

JEL classification: J61, R23, R58

Key words: push-pull, migration, information technology, administrative data, profit analysis

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The authors thank Chris Cunningham, Sabrina Pabilonia, Kathryn Shaw, and Dan Wilson for their insightful suggestions as well as participants at seminars presented at the University of Colorado-Denver and the University of North Carolina-Greensboro. The views expressed here are the authors' and not necessarily those of the Federal Reserve Bank of Atlanta or the Federal Reserve System. Any remaining errors are the authors' responsibility.

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I. Introduction

The information technology (IT) sector played a remarkable role in the growth of the U.S. economy during the late 1990s. Between 1996 and 2000 the IT-producing sector was responsible for an estimated 1.4 percentage points of the nation's average annual real GDP growth of 4.6 percent, largely driven by business investment in IT products. Since 2000, however, the IT sector has been struggling. In particular, the level of IT Manufacturing output declined rapidly as business investment spending on IT declined sharply during the 2001 recession. In 2002 it is estimated that IT-producing industries contributed only 0.1 percentage points to the economy's 2 percent annual growth (Economics and Statistics Administration 2003).

The IT boom of the 1990s led to a dramatic rise in employment in IT-producing industries, and the subsequent IT retrenchment resulted in a large decline in employment in the early 2000s. Between 1993 and 2000, the average number of workers in IT-producing industries in the U.S. grew by approximately 50 percent, which is almost two and a half times as fast as employment in private sector non-IT industries.[1] From 2000 to 2003, average employment in IT-producing industries declined by 21 percent, compared to a two percent decline in non-IT industries. Such extraordinary movement in the labor market presents unique incentives and opportunities for workers, and could serve as motivation for workers to migrate to take advantage of promising labor market opportunities and/or to escape labor market declines. The pull on workers to

[1] Bureau of Labor Statistics, quarterly Census of Employment and Wages, www.bls.gov/cew.

communities experiencing positive economic opportunities and the push of workers out during economic declines has been referred to as "push-pull" migration, and has been analyzed in a variety of different contexts.[2]

The purpose of this paper is to investigate whether workers migrated into the Georgia workforce to take advantage of the IT boom and whether IT workers (more than workers from other sectors) migrated out of the Georgia workforce after the boom, during the period of dramatic decline in employment opportunities in IT-producing industries. Because the IT-producing sector is concentrated in a few metropolitan areas such as San Francisco, Austin, Boston, Seattle, and Atlanta, the IT boom and bust had a disproportionate impact on these locations (Daly and Valetta 2004). The best chance, therefore, of identifying a migration pull effect of an IT boom would be to investigate worker behavior in these centers of concentration, one of which was Atlanta, Georgia.[3]

Using matched employer-employee data over the period 1993-2003, the analysis in this paper finds that workers in the Software and Computer Services industry in Georgia during the boom period were more likely than workers in other industries to have been absent from the Georgia workforce prior to the boom, but were not any more or less likely to be absent from the Georgia workforce during the IT bust. The implication is that the pull of employment opportunities in the IT-producing sector was much stronger than the push of declining opportunities during the bust. The asymmetry is attributed to the transferability of IT skills to non-IT producing industries during the IT industry bust.

[2] One of the earliest treatments was Thornthwaite (1934). Also see Blevins (1969), Zimmermann (1996), Boyd (2002), and Kyriakoudes (2003).

[3] Another reason for a strong pull into centers of IT concentration is what some have identified as skill complementarity. For instance, Giannetti (2001) finds that high-skill workers, more than low-skill workers, benefit (through rents generated by skill complementarities) from a workforce populated with other workers of their same skill level. This skill complementarity is not identified among workers with lower skill levels.

II. Theoretical and Empirical Framework

Migration decisions are most often modeled as an investment decision; if the return from a move exceeds the cost, one should do it (Mincer and Jovanovic 1981). In a labor market context, the gain from migrating translates into an increase in the return to the value of one's human capital in the labor market. For example, if a worker's skills are more valuable in labor market *B* than in labor market *A*, it might make sense to invest in a move to labor market *B* to reap the higher return to his/her human capital in that market. A labor market experiencing high demand and employment growth, such as that seen during the IT boom in Georgia, is likely to present employment and earnings growth opportunities for workers, thus serve as a "pull" on workers to enter that labor market.[4] As the boom turns into a bust, and demand for workers falls dramatically, there may be an analogous "push" of weak labor market conditions that would drive those workers most likely to be affected by falling demand from the labor market.

The goal of the empirical investigation is to determine the extent to which workers in IT industries were influenced by the dramatic swings in IT sector employment opportunities. Specifically, were IT workers more likely to enter the state's workforce during the boom and more likely to exit during the bust relative to workers in other industries? The results of this investigation will contribute to the existing push-pull literature that typically finds pull factors are stronger than push factors in affecting

[4] In addition to workers migrating to the booming labor market from other geographic locations, the earnings opportunities may also raise earnings potential of current resident non-workers beyond their reservation wage, inducing them to enter the labor force. The standard human capital migration theory will be broadly applied in this paper to include physical geographic relocation as well as movement into and out of the labor force.

migration decisions (e.g., see Boyd 2002).[5] The results also have implications for the design of economic development projects that attract workers of different skill levels.

Among workers observed to be working in Georgia during the IT boom, the decision to have entered the workforce during the boom or to exit the workforce during the bust is operationalized by assuming that a person's assessment of the costs and benefits of migrating into or out of a labor market can be represented by a linear function of observable factors affecting the entrance and exit decisions: [6]

$$I_i^* = \beta' X_i + \varepsilon_i = \begin{cases} > 0 \Rightarrow Enter_i = 1 \\ \leq 0 \Rightarrow Enter_i = 0 \end{cases} \quad (1)$$

$$Y_i^* = \alpha' X_i + \upsilon_i = \begin{cases} > 0 \Rightarrow Exit_i = 1 \\ \leq 0 \Rightarrow Exit_i = 0 \end{cases} \quad (2)$$

X_i is a vector of observable characteristics that determine individual *i*'s net return to migrating (either into or out of the Georgia workforce). Information available for inclusion in X_i will be detailed below. ε_i and υ_i are unobserved random components and are assumed to be independent and identically distributed according to a standard normal distribution function. Estimates for β and α are obtained via maximum likelihood probit.

[5] An exception among the rural poor is found in Schafft (2005).

[6] In a sense, equation (1) is using current information to determine a past decision, which may be problematic when trying to make causal inferences. However, it is assumed that a migration decision is in part based on some notion as to the industry in which a worker will be employed and that current characteristics (such as earnings and job stability) are highly correlated with past characteristics. The empirical estimation will determine whether there was a greater probability that workers employed in one industry (IT) during the boom, relative to workers employed in other industries during the boom, had not been in the workforce prior to the boom. It is the unique circumstances of the IT industry during this time period that will allow causal interpretation of the results.

III. The Data and Sample Construction

The data used for the analysis come from two sets of state administrative records compiled by the Georgia Department of Labor for the purposes of administering the state's Unemployment Insurance (UI) program. The program provides almost a complete census of employees on non-farm payrolls, with information available on approximately 97 percent of non-farm employees. The Individual Wage file contains information on a worker's total quarterly earnings from an employer.[7] Regrettably, the wage file contains no additional information about the worker's demographics (e.g., education, gender, race, etc.) or about the worker's job (e.g., hours of work, weeks of work, or occupation). However, the worker's employment experience can be tracked over time using a worker ID number and linked to an employer via a firm ID number.[8] These data are highly confidential and strictly limited in their distribution.

The Employer (ES202) file contains records on all UI-covered firms and includes establishment level information on the number of employees and wage bill, as well as the NAICS classification of each establishment.[9] Because the individual wage file contains a firm identifier, rather than an establishment identifier, a choice of which NAICS code to assign to each worker who was employed by a multi-establishment firm is required.

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[7] Included in wages are pay for vacation and other paid leave, bonuses, stock options, tips, the cash value of meals and lodging, and in some states, contributions to deferred compensation plans (such as 401(k) plans). Covered employer contributions for old-age, survivors, and disability insurance (OASDI), health insurance, unemployment insurance, workers' compensation, and private pension and welfare funds are not reported as wages. Employee contributions for the same purposes, however, as well as money withheld for income taxes, union dues, and so forth, are reported even though they are deducted from the worker's gross pay.

[8] See Haltiwanger et al. (1999) for a collection of studies using these and other employer-employee matched data sets. These state administrative data have also been used to investigate employment and earnings among IT workers in California (Dardia et al. 2005) and North Carolina (Bowles 2004). Also see Perrins (2004).

[9] White et al. (1990) provide an extensive discussion about the use of these employment data, commonly referred to as the ES202 file. These are the UI data being used by the BLS to construct the Business Employment Dynamics data file introduced at a BLS briefing 30 September 2003 (Bureau of Labor Statistics 2003). These data are also now referred to as the Quarterly Census of Employment and Wages by the BLS (see www.bls.gov/cew).

Following the Department of Labor convention, a 6-digit NAICS code is assigned based on the largest share of the firm's total employment.

A. Time Period Definitions

The data are available from the first quarter of 1993 to the fourth quarter of 2003 (44 quarters). The sample is split into three time periods. Using quarterly total IT sector employment data for Georgia it was determined that the peak of employment in the IT-producing sector occurred in the fourth quarter of 2000. This peak is used to define the end of the boom period. The post-boom (bust) period is from the first quarter of 2001 to the fourth quarter of 2003. The beginning of the boom period is less easily identified. In 1995, the growth rate in IT employment began to deviate from the growth in the non-IT sector. Given that the data are available from the first quarter of 1993, the pre-boom period is then defined as all quarters from 1993 through 1995. This definition makes the pre-boom period symmetric with the post-boom period.

B. Industry Definitions

The data are restricted to private sector workers outside of the agriculture, mining and natural resource sectors. Government employees have been found to be quite distinct from private workers in their rates of pay, turnover, and sensitivity to economic conditions (McConnell et al. 2003), and were, therefore, excluded. In addition, there is a low level of UI coverage in the agriculture industry (only about 48% of employees working in agriculture are estimated to be covered by UI), and the mining and natural resource sector is very small in Georgia.

The industry groupings used are the same as in Hotchkiss, Pitts, and Robertson (2005). The IT-producing sector is divided into three components: the manufacturing of IT equipment or components, Software and Computer Services, and Communication Services.[10] The non-IT industries are Construction, non-IT Services (including Transportation and Utilities, Wholesale and Retail Trade, Finance, Insurance, and Real Estate, and Miscellaneous Non-IT Services), and non-IT Manufacturing.

C. Full-time Worker Restriction

In defining boom-period employment, the sample is restricted to those who are most likely to be full-time workers who worked at least one complete quarter. With no information on hours of work or number of weeks worked in a quarter, this is accomplished by using only "interior" quarters of earnings to identify employment activity. An interior quarter of earnings is a quarter of real earnings of at least $3000 that is sandwiched between two other quarters of earnings of at least $3000 from the same employer.[11] To assign a unique industry characteristic to each worker in the sample the firm ID is assigned based on the employer from which the worker received his/her greatest earnings during that quarter.

[10] The classifications are based on those used in the Department of Commerce Report: *Digital Economy 2003*, with two modifications: Computer Training Schools are added to the Software and Computer Services category, and Computer Software Wholesalers and Retailers are included in Software and Computer Services instead of Computer Hardware.

[11] This cut-off value was used in a study of Californian IT employment (Dardia et al. 2005). To also maintain the focus on a more "typical" IT worker, any worker whose earnings were top-coded at $100,000 per quarter was also eliminated. The earnings of 99 percent of workers fell well below this cap in every year.

D. Worker Activity and Industry Classification

During the boom a person could have been involved in many activities: unemployed, out of the labor force, employed by one employer, or employed by multiple employers. The sample of interest consists of individuals whose primary activity during the boom is employment in Georgia. While any definition of "primary activity" over a long period of time is necessarily arbitrary, we choose to define a person's primary activity as the activity in which the person is observed during most of the quarters during the boom. "Activity" has two possible designations: observed with at least one interior quarter of earnings in Georgia (employment), or not observed with an interior quarter of earnings (nonemployment). Only individuals whose modal activity during the boom is employment are included in the analysis.

The same strategy is used to identify the industry of employment. The worker's modal industry is the one in which the worker spent most of his/her employed quarters during the boom. These concepts of modal activity and modal industry are used to collapse the 11 years of panel data into a single cross-section which describes an individual's primary activity and characteristics between 1993 and 2003.[12]

E. Defining Entry and Exit

Conditional on having employment as their boom-period primary activity, workers are considered to have entered employment in Georgia if they were absent from

[12] Collapsing the long panel into a cross-section of observations is primarily done to allow identification of a worker's industry during the boom period. There are other strategies to do this. For example, one could be identified as an IT worker during the boom if employed in that sector for at least one quarter, or in that sector for all quarters during the time period. These options are clearly the extremes, and doesn't solve the problem of what to do with someone employed in multiple industries across the period. The construction of a worker's modal activity and model industry seems to be the least arbitrary in terms of identifying the industry that best describes a workers' industry association during the IT boom period.

the Georgia Individual Wage Files during every quarter of the pre-boom period. By construction, a worker who does not enter is one who received earnings in Georgia any of the pre-boom period quarters. Workers are considered to have exited employment in Georgia if they were absent from the Wage Files during every quarter of the post-boom period. Again, by construction, a worker who does not exit is employed during some quarter in the post-boom period.[13] Obviously there are many ways to define entry and exit. The definitions used here ensure the "cleanest" entrance and exit possible, relative to the boom period, given the limitations of the data at hand. For a worker to not have been present for three years prior to the boom and for three years after the boom guards against identifying a consistently *marginally* attached (i.e., moving in and out of the workforce) worker as someone whose behavior was affected by the timing of the IT boom.

A further important consideration for the analysis is what being "absent from the Individual Wage File" means. A worker may be absent from the Wage File for a number of reasons. A person absent from the Wage File may be living in Georgia, but not working (because they are unemployed or out of the labor force), or may be living outside of Georgia, either working or not. Unfortunately, we are not able to identify from where workers are coming upon entry, or where they go when they exit.

F. Sample Characteristics

The probability of entry/exit is modeled as a function of boom-period individual characteristics: the rate of employer turnover, modal industry of employment, the

[13] The "full-time" restriction applied in the boom time period is not enforced for identifying workers who were employed during the pre-boom and post-boom time periods.

individual's average earnings in that industry during the boom, and the individual's average earnings interacted with modal industry. Pre-boom absence is also included as a regressor in probability of exit estimation since one might expect that individuals who undertook the cost to enter the Georgia workforce are naturally more mobile and hence more willing to exit as well. This "migration tendency" is also why the individual's rate of employer turnover might be expected to affect entry and exit decisions.

The industry of employment during the boom is the regressor of primary interest. Because the data do not contain information on a worker's human capital, and because others have found that migration tendencies vary across human capital characteristics, we also interact a worker's average boom period earnings with the worker's modal industry of employment.[14] Earnings are found to vary systematically across industries, with some of the highest paid workers being found in the IT industry. The interaction of earnings with industry controls for human capital differences in migration decisions allows for conclusions specific to industry of employment.[15] The descriptive statistics for these variables are presented in Table 1.

[Table 1 here]

Note that 26 percent of all workers employed in the boom period were absent from the Georgia workforce in the three year pre-boom period (entered) and 21 percent were absent in the three year post-boom period (exited). Controlling for the quarters worked, workers had an average of 0.3 employers per quarter, or, in other words, the

[14] To the extent that migration is less costly for workers with more education (e.g., they have greater access to information), then more educated workers will exhibit greater tendency to migrate. For example, see Feliciano (2005) and Chiquiar and Hanson (2005).

[15] The use of observed earnings to control for unobserved human capital characteristics is referred to as taking a value-added approach to measuring human capital (Todd and Wolpin 2003). See Zoghi et al. (2004) for another labor market application of this methodology.

average worker changed employers every 3.33 quarters. The rate of employer switching was greater for those who were absent pre-boom or absent post-boom (every 2.17 quarters and every 2.22 quarters, respectively). The mean of average boom-period earnings was $9,071 per quarter, in 2003 dollars. Most workers were employed in non-IT Service industries during the boom (65.5 percent), followed by non-IT Manufacturing (20.3 percent). About seven percent of Georgia workers worked in one of the three IT-producing industries. The highest paying industry is Software and Computer Services (an average of $15,663 per quarter). Although Construction is the lowest paying industry (an average of $8,397 per quarter), there is very little difference in the mean of average earnings in each of the three non-IT sectors.

The entry and exit percents show some variation across industries with the greatest percent of workers in the Software and Computer Services industry (34%) having been absent from the Georgia workforce prior to the boom. This is closely followed by the percent of Construction workers that were absent (31%). Construction workers were the most likely to exit the Georgia workforce after the boom (26%). While these sample means tell us about the migration activity of the average worker in each industry, they do not indicate whether differences across workers in different industries are the result of the opportunities that differ across the industries or whether they are the result of differences in the characteristics of the average worker in the different industries. The results of the probit estimation and simulations that follow yield migration probabilities net of worker characteristics.

IV. Probit Estimation Results

The probit estimation results for entry and exit are reported in Table 2. As expected, an increase in the rate of employer change increases the probability of having been absent during the pre-boom period. The effect on the exit probability is also positive, but marginally smaller. This suggests that individuals that are more prone to moving across geographic labor markets may also be more prone to moving within them (across employers). Further evidence of workers having general tendencies (or not) for migration is found in the positive coefficient in the exit estimation on having been absent prior to the boom.

[Table 2 here]

The impact of earnings on the decision to migrate varies by industry of employment. The marginal effects of a percentage point increase in quarterly earnings on the likelihood of having been absent pre-boom is given in the brackets under the coefficient estimates of the interaction terms, with the impact of earnings on the migration decision of non-IT manufacturing workers in brackets under the coefficient for the non-interacted earnings regressor. For workers in all industries except Communication Services, the marginal effect of earnings is positive. That is, higher earners (during the boom) generally were more likely to have been absent from Georgia pre-boom. This is consistent with others' finding that workers who change jobs require a return in the form of higher earnings for doing so (for example, see Hotchkiss, Pitts, and Robertson 2004).

The marginal impact of earnings during the boom on the exit probability indicates that for workers in all industries, except Software and Computer Services and

Construction, high earners were more likely to exit during the bust. Since we don't know whether the exit was the result of a voluntary or involuntary employment separation, it could be that high earners suffered more involuntary action through production re-structuring and management re-organization or were simply more likely to have a net marginal gain from relocation.

Table 3 contains the average predicted probabilities of entering and exiting the Georgia workforce constructed from the estimated parameter coefficients in Table 2; the sample entry and exit proportions by industry are also included for comparison purposes. The probability of entry and exit for industry *j* was calculated for all workers as if they had been employed in industry *j* during the boom, given their individual characteristics. These individual predicted probabilities were then averaged across the entire sample to yield the average predicted probabilities.[16]

[Table 3 here]

The first thing to notice in Table 3 is that the spread between the highest and lowest entry and exit probabilities is larger in the raw sample averages than in the predicted probabilities. This indicates that other characteristics included in the estimation (e.g., rate of employer change and earnings) vary across industry and that the raw means will generally over-state differences in entry and exit probabilities across industries. However, it is also of interest to note that the percentage point difference between the highest entry probability and the next highest entry probability increases from three percentage points in the sample means (34% for Software and Computer Services and 31% for Construction) to six percentage points after controlling for other individual

[16] Alternative, less stringent, definitions of entry and exit were investigated, with no appreciable difference in the conclusions presented here.

characteristics, with the entry probability for Software and Computer Services still the highest probability of entry.

Focusing on the predicted probability of entry, workers in IT Software and Computer Services have the highest probability (33 percent) of having been absent from the Georgia workforce prior to the IT boom. This entry probability is six percentage points higher than the next highest probability of 27 percent, which is seen for workers in Communication Services, Construction, and non-IT Services. The closeness of the predicted probabilities for IT and non-IT Manufacturing is consistent with the finding of Hotchkiss, Pitts, and Robertson (2005) that workers in the IT Manufacturing sector behave more like non-IT Manufacturing workers than like other IT workers. The lowest probabilities of entry into both the IT and non-IT Manufacturing sectors is also not surprising, given the relatively slow employment growth in these sectors over the boom period.

The higher probability of entry into Software and Computer Services, relative to other IT-producing sectors, is likely at least partially explained by the tremendous growth in that particular IT sector. Between 1993 and 2000, total employment in Software and Computer Services in Georgia increased 92 percent while employment in IT Manufacturing and Communication Services increased by 26 and 43 percent, respectively. This significantly larger total employment growth reduced the possibility of supplying the growth in Software and Computer Services solely with workers already in the Georgia workforce. Indeed, the percent of workers employed in Software and Computer Services during the boom who were absent from the Georgia workforce prior to the boom was *greater than* the percent that were employed in Software and Computer

Services in Georgia prior to the boom. In contrast, the greatest proportion of workers employed in other industries during the boom was also employed in those industries in Georgia during the pre-boom period. It may also be the case that workers in the Software and Computer Services industry were more ready to respond to the growing demand for workers in Georgia since they would typically have greater flexibility in applying their skills across employers than workers in IT Manufacturing or in Communication Services, making migration less costly.

Comparing the overall probabilities of entry with the probabilities of exit in all sectors, suggests that positive economic conditions during the boom provided a stronger pull on workers into the Georgia workforce than negative conditions during the bust did in pushing workers out. The smaller average probabilities in column 5 compared with those in column 3 indicate that workers were less likely to be absent in the post-boom period than they were to have been absent during the pre-boom period, regardless of the sector in which they were employed during the boom. Nucci et al. (2002) find that civic attributes of a community act as a counter-veiling force against economic push factors that might drive workers away from a declining labor market. For instance, the civic attributes of Atlanta, which is the main IT center in Georgia, may be working in its favor for the retention of any highly-skilled IT workers that were pulled into the state during the IT boom.[17] Certainly, once drawn to a location with attractive attributes, the loss of those attributes from moving away increases the marginal cost in a decision to move away.

[17] One might suggest that we would always expect to find smaller exit probabilities than entry probabilities in a panel data set, since post-boom workers simply have more labor market experience and one might expect migration tendencies to decline as labor market attachment increases. If this is what was driving the lower exit probabilities, we would expect to see exit probabilities to be lower than entry probabilities by some fixed amount across industries. This is not the case.

More important evidence of the weakness of push-migration lies in the relative magnitude of the probabilities *across sectors*. Whereas the disproportionate growth in Software and Computer Services employment pulled workers into the Georgia labor market at a faster rate than other sectors, the probability of exit of these workers (22 percent) is practically identical to the exit of workers from other sectors--sectors that experienced more moderate employment declines in the post-boom period.[18] The similar exit probabilities of IT workers with those in other sectors is consistent with the fact that the IT employment bust was not unique to Georgia. The result is that employment opportunities in other IT centers weren't pulling workers away from Georgia; all IT centers were experiencing dramatic employment declines.

The similarity across all industries in exit probabilities also provides some insight into another lingering question. It has been stated several times that the data do not allow us to identify those who physically migrated to Georgia to join the workforce from those who were living here already and newly entered or re-entered the workforce. It is likely that re-entrants might be considered marginally attached to the workforce, entering during times of opportunity and exiting easily during downturns. The absence of similarly large exit probabilities in those industries that saw large entry probabilities suggests that the entrance into those industries was *not* dominated by marginal workers or re-entrants. However, we still can not distinguish between migrants and new entrants.

A natural question that arises from observing that workers in the IT industry during the boom did not disproportionately exit the Georgia workforce even though total employment in that industry declined dramatically (20 percent between 2000 and 2003

[18] Dardia, et al. (2005) found exit rates of roughly 30 percent among IT workers in California. The exit probabilities and exit means are smaller here because our definition of exit (absence from the wage files for three years) is more stringent than that of Dardia, et al.

compared with only a 3 percent employment decline in non-IT industries), is what happened to those workers. Other research (Hotchkiss, Pitts, and Robertson 2005) has found that workers transitioning out of the IT sector after the boom generally suffered a large wage penalty. However, workers who had been in IT service during the boom earned more in their post-boom (non-IT) industry than comparable workers who had been in that non-IT industry during the boom.

V. Sensitivity Analysis: Post-boom Entry

The disproportionate entry of workers into the Software and Computer Services industry in Georgia during the IT boom suggests that workers migrated into the Georgia workforce to take advantage of the employment and earnings opportunities in that sector. The absence of a parallel exit of workers from that industry indicates that the higher entry probability was not merely the result of a higher migration tendency among workers in the Software and Computer Services sector; that there was something unique about the opportunity for these workers in Georgia during the IT boom that motivated movement into the state's workforce.

A test of the robustness of this conclusion was performed by looking at entry into the Georgia workforce during the post-boom period across industries. A probit estimation identical to that described by equation (1) was estimated, except the sample is now conditioned on being employed in Georgia during the post-boom period and an entry is defined as having been absent from the Georgia wage files prior to the post-boom time period.[19] If, indeed, workers in the Software and Computer Services industry were

[19] Again, less stringent definitions of entry were investigated with no change in the conclusions reported here.

motivated to enter the Georgia workforce because of the employment and earnings opportunities available during the IT boom, we should not see these workers entering the workforce at any greater rate than workers in other industries during the post-boom period, since opportunities for IT workers were shriveling during the post-boom. Table 4 presents the results from this probit estimation.

[Table 4 here]

The predicted probabilities in Table 4 indicate that IT workers (including those in Software and Computer Services) were not any more likely to enter the Georgia workforce during the post-boom than workers in other industries.[20] Again, this is further evidence that workers respond to economic opportunities in making migration decisions. Two other observations support this conclusion. First, the highest probability of entry during the post-boom was by workers in the Construction industry. Although Construction employment declined during this time period, the loss of jobs was less than half in percentage terms than in Manufacturing. The higher rates of exit among construction workers during the same time period (see Table 3) is also evidence that these workers have highly mobile skills, lowering their cost of chasing employment opportunities. The second observation is that the lowest probabilities of entry during the post-boom were among workers in industries that were experiencing the largest employment losses.

[20] The magnitudes of the percentages in Table 4 are not directly comparable to those in Table 3, since these two analyses are conditioning employment and defining entry over periods of time of different lengths. However, comparing relative differences across industries is legitimate.

VI. Summary

The IT boom pulled workers into Georgia's Software and Computer Services industry. The decline of the IT sector did not result in an analogously disproportionately large push of these workers out of the Georgia workforce. The decline did, however, stem the inflow of workers into the industry, relative to the rate at which workers were flowing into other industries during the period following the IT boom. Given that workers in the Software and Computer Services industry are among the highest paid in the workforce, the large inflow followed by a much smaller outflow suggests that the IT boom in Georgia resulted in a net gain of skilled workers in the workforce. In fact, the results support policies that aim to attract industries that employ more high skilled workers to an area, because these workers are less likely to exit during economic downturns than is an average worker.[21] Moreover, this may also be an attractive economic growth strategy since it has been shown that locations with more highly skilled workers are generally better able to weather negative economic shocks (Glaeser and Saiz 2003).

[21] Partridge (1993) offers specific recommendations about how to structure state fiscal policy in order to attract IT-producing firms.

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Table 1. Sample means.

	Mean (std. dev.)
Percent of workers absent from Georgia workforce pre-boom	26%
Workers in IT Manufacturing during boom	21%
Workers in Software and Computer Services during boom	34%
Workers in Communication Services during boom	23%
Workers in Construction during boom	31%
Workers in Non-IT Services during boom	27%
Workers in Non-IT Manufacturing during boom	21%
Percent of workers absent from Georgia workforce post-boom	21%
Workers in IT Manufacturing during boom	17%
Workers in Software and Computer Services during boom	21%
Workers in Communication Services during boom	17%
Workers in Construction during boom	26%
Workers in Non-IT Services during boom	22%
Workers in Non-IT Manufacturing during boom	20%
Percent of workers employed during the boom:	
In IT Manufacturing	0. 8%
In Software and Computer Services	3.5%
In Communication Services	2.3%
In Construction	7.6%
In Non-IT Services	65.5%
In Non-IT Manufacturing	20.3%
Total number of quarters during the boom with Interior Earnings	9.76 (6.52)
Number of different employers during the boom divided by total number of quarters employed during the boom	0.3034 (0.2980)
Average quarterly earnings during the boom	$9,071 (6,972)
IT Manufacturing	$11,848 (8,154)
Software and Computer Services	$15,663 (9,553)
Communication Services	$14,271 (7,684)
Construction	$8,397 (5,028)
Non-IT Services	$8,698 (7,001)
Non-IT Manufacturing	$8,683 (5,923)
Sample size = 3,207,132	

Note: Standard deviations of continuous variables are in parentheses.

Table 2: Probit Estimation of Entering and Exiting the Georgia Workforce

	Prob(Entering)	Prob(Exiting)
	Coef (std. error)	Coef (std. error)
Absent from Georgia Workforce Pre-Boom = 1	--	0.0506 (0.0019)
Number of different employers during the boom divided by total number of quarters employed during the boom	1.4074 (0.0227) [0.4156]	1.1095 (0.0028) [0.3034]
Log Average Quarterly Earnings during the boom	0.0675 (0.0035) [0.0200]	0.0564 (0.0035) [0.0154]
Boom Industry		
IT Manufacturing = 1	-2.6573 (0.1489)	-0.9592 (0.1528)
Software and Computer Services = 1	-0.4338 (0.0712)	0.5482 (0.0758)
Communication Services = 1	1.2724 (0.0998)	-0.6980 (0.1047)
Construction = 1	0.5088 (0.0607)	0.8342 (0.0618)
Non-IT Services = 1	-0.2092 (0.0338)	-0.6653 (0.0341)
Interaction Terms		
Log Ave. boom Earnings * IT Manufacturing	0.2930 (0.0161) [0.1064]	0.0981 (0.0166) [0.0423]
Log Ave. boom Earnings * Software and Computer Services	0.0830 (0.0076) [0.0444]	-0.0604 (0.0081) [-0.0011]
Log Ave. boom Earnings * Communication Services	-0.1285 (0.0106) [-0.0180]	0.0625 (0.0111) [0.0325]
Log Ave. boom Earnings * Construction	-0.0411 (0.0068) [0.0078]	-0.0884 (0.0069) [-0.0087]
Log Ave. boom Earnings * Non-IT Services	0.0372 (0.0038) [0.0309]	0.0725 (0.0038) [0.0353]
Constant	-1.8120 (0.0310)	-1.6698 (0.0311)
Sample size = 3,207,132		

Notes: All coefficients are significant at the 99 percent confidence level. Sample includes all workers with earnings during the boom period. Manufacturing (non-IT) is the excluded sector category. Entry means that the worker was absent from the Georgia wage files for all of the pre-boom time period. Exit means that the workers was absent from the wage files for all of the post-boom period. Marginal effects of a percentage change in quarterly earnings on each probability is in the brackets under the interaction term coefficients; the impact of earnings on the migration decision of non-IT manufacturing workers is in the brackets under the coefficient for the non-interacted earnings regressor. An absence could mean the person is living in Georgia and is either unemployed or not in the labor force, or the person is working or not working outside of Georgia.

Table 3. Predicted probability of entering and exiting Georgia's workforce by boom period industry.

	Absent Pre-Boom (Probability of Entry)		Absent Post-Boom (Probability of Exit)	
Boom Period Industry	**Sample Average**	**Predicted Probability**	**Sample Average**	**Predicted Probability**
IT Manufacturing	21%	22%	17%	20%
Software and Computer Services	34%	33%	21%	22%
Communication Services	23%	27%	17%	18%
Construction	31%	27%	26%	23%
Non-IT Service	27%	27%	22%	21%
Non-IT Manufacturing	21%	23%	20%	22%

Note: Absent pre-boom (entry) means that the worker was absent from the Georgia wage files for all of the pre-boom time period. Absent post-boom (exit) means that the worker was absent from the wage files for all of the post-boom period. An absence could mean the person is living in Georgia and is either unemployed or not in the labor force, or the person is working or not working outside of Georgia. Predicted probabilities are the averages across the sample of individual predicted probabilities (using parameter coefficients from Table 2) holding everything about that person constant except the industry in which he/she worked during the boom.

Table 4. Predicted probability of entering Georgia's workforce during the post-boom period by post-boom period industry.

	Probability of Entry into Workforce Post-boom	
Post-boom Period Industry	**Sample Average**	**Predicted Probability**
IT Manufacturing	5%	5%
Software and Computer Services	11%	12%
Communication Services	6%	8%
Construction	15%	13%
Non-IT Service	13%	12%
Non-IT Manufacturing	9%	10%

Note: Entry means that the worker was absent from the Georgia wage files during the boom time period, but working in Georgia during the post-boom. Coefficient estimates from the estimated probit model are available from the authors upon request.