Online Appendix for "Return of the Solow Paradox? IT, Productivity, and Employment in U.S. Manufacturing"

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May 2014

This appendix is in three parts. The first part provides a detailed description of how we processed the data used in our paper. The second and third parts contain additional analyses that we omitted from the main text to conserve space.

Data Construction

Employment, Output, and Productivity

Our industry-level employment, output, and productivity outcomes are derived from the NBER-CES Manufacturing Industry Database, which is based largely on the Annual Surveys of Manufacturing (Becker, Gray and Marvakov 2013).[1] Because this database straddles the 1997 conversion from SIC industry codes to NAICS codes, the providers of the NBER-CES publish both a version expressed in 1987 SIC codes and a version expressed in 1997 NAICS codes.

To minimize the risk of classification error, we aggregate the NBER-CES to the level of 387 consistent industries.[2] First, we use a weighted crosswalk to convert the NAICS-based data from the years 1997-2009 into 1987 SIC codes, and append the SIC-based data from the years 1977-1996.

[1] While most of the variables in the NBER-CES are taken from the Annual Surveys of Manufacturing, price deflators and depreciation rates are derived from other data published by the Census Bureau, the Bureau of Economic Analysis, the Bureau of Labor Statistics, and the Federal Reserve Board. NBER-CES data and documentation are available at http://www.nber.org/nberces.

[2] We exclude six industries that were reclassified from manufacturing into non-manufacturing following the conversion to NAICS codes (and are therefore absent from the NBER-CES database after 1996). The 1987 SIC codes for these industries are 2411 (logging), 2711, 2721, 2731, 2741, and 2771 (publishing industries). Aside from these exclusions, our sample spans the entire manufacturing sector.

Second, we map SIC codes into a set of consistent industry codes based on the "SIC87dd" codes used in Autor, Dorn, and Hanson (2013) and in Acemoglu et al. (2013).[3]

Construction of the shipments deflator must be handled carefully due to the cross-walking and aggregation. We compute real shipments separately in the SIC- and NAICS-based NBER-CES files, using the provided shipments deflator ("piship"). Because real and nominal shipments are quantities rather than prices, they can readily be mapped into SIC87dd codes. We then construct the shipments deflator for each SIC87dd industry as the ratio of nominal shipments to real shipments. This procedure is algebraically equivalent to computing the shipments deflator for each SIC87dd industry as a weighted average of the shipments deflators in the SIC/NAICS industries that comprise it, using deflated shipments as the weights. We normalize all shipments deflators to unity in 2007.

For Figure A.5 of this appendix, we compute TFP by implementing the NBER-CES "four-factor" method, which subtracts cost-share-weighted growth in non-production labor, production labor, materials, and capital inputs from the growth rate of real shipments. A factor's cost share for a given industry is estimated as payments to that factor divided by real shipments, averaged between the current and previous year (with the capital share computed as a residual so that the shares sum to unity). The price deflator for material inputs (based on the NBER-CES "pimat" variable) is constructed in the same fashion as the shipments deflator.

Because we focus on productivity growth within IT-using rather than IT-producing industries, most of our results (except Figure 1A) exclude a set of computer-producing industries. Following Houseman, Bartik, and Sturgeon (2013), we define the computer-producing sector as NAICS 334. By mapping these NAICS industries into our final set of 387 consistent industries, we were able to identify a set of 28 SIC87dd industries that together constitute virtually a one-to-one correspondence with NAICS 334.[4] Our set of computer industries encompasses semiconductors and other computer components as well as computer manufacturing proper.

Table A.1 reports the mean and standard deviation of each of our principal outcome variables at decadal intervals, both for our full sample and for a restricted sample of industries in SIC 34-38 (for which data on technology usage are available; further details are given below). For our preferred productivity measure, real shipments per worker, we report summary statistics both including and excluding computer-producing industries. As documented previously by Houseman and coauthors, excluding these industries noticeably reduces the measured rate of productivity growth in manufac-

[3]Our NAICS-SIC crosswalk is based on "cw_n97_s87.dta," which can be downloaded from David Dorn's webpage (http://www.cemfi.es/~dorn/data.htm). The mapping from SIC codes into SIC87dd codes is based on "subfile_sic87dd.do," available at the same webpage.

[4]Specifically, our computer sector accounts for over 98% of NAICS 334 employment throughout our sample period, and our non-computer sector accounts for over 99% of non-NAICS 334 employment throughout our sample period.

turing. For the remaining outcomes, we report summary statistics only for non-computer-producing industries (as computer industries have considerably less influence on the evolution of manufacturing output and employment when these outcomes are examined separately).

IT Intensity

We employ two measures of industry-level IT intensity: rates of computer investment, and usage of a set of manufacturing technologies.

We observe each industry's expenditures on computers and peripheral equipment for the years 1977, 1982, 1987, 1992, 2002, and 2007 (comparable data are not available for 1997).[5] After mapping all computer investment data into SIC87dd codes,[6] we define an industry's raw computer investment rate as 100 times the ratio of its computer expenditures to its total capital expenditures. We impute a small number of missing values.[7] Our preferred measure of computer investment rates is a weighted average of the 1977, 1982, 1987, 1992, 2002, and 2007 rates. To account for the unavailability of 1997 computer investment rates, we place weight 5/32 on the 1977-1992 rates and weight 3/16 on the 2002 and 2007 rates (so that the weighted average year is 1992, the midpoint of 1977–2007). We also report results using 1977/1982 rates, 1987/1992 rates, and 2002/2007 rates (in each case computing the simple average of computer investment rates in the indicated years).

Our measure of technology usage is derived from the US Census Bureau's 1988 and 1993 Surveys of Manufacturing Technology (SMT), which queries manufacturing plants on their usage of 17 advanced manufacturing technologies.[8] Our SMT measure of IT intensity is defined as the

[5]Computer investment data for 1977, 1982, and 1987 were provided to us by Eli Berman. Data for 1992 were transcribed from the manufacturing industry series at http://www.census.gov/prod/www/economic_census.html. Data for 2002 and 2007 were downloaded using the US Census Bureau's American FactFinder tool (tables EC0231I3 and EC0731I1, respectively).

[6]The data for 1977, 1982, and 1987 are expressed in 1972 SIC codes; 1992 data are expressed in 1987 SIC codes; 2002 data are expressed in 2002 NAICS codes; and 2007 data are expressed in 2007 NAICS codes. We apply crosswalks sequentially to map data into SIC87dd codes. The 1972-1987 SIC crosswalk is downloaded from http://www.nber.org/nberces. The 2002-1997 NAICS crosswalk is downloaded from http://www.census.gov/econ/census02/data/bridge. The 2007-2002 NAICS crosswalk is downloaded from American FactFinder (table EC0700CBDG1).

[7]Computer investment data are available for all 387 SIC87dd industries in the years 1977, 1982, 1987, and 2002. We impute missing 1992 values for 27 industries by linearly interpolating their 1987 and 2002 computer investment rates. We impute missing 2007 values for two industries by extrapolating from their 2002 computer investment rates using manufacturing-wide changes in computer investment rates between 2002 and 2007.

[8]SMT data were used by Doms, Dunne, and Troske (1997) in their plant-level analysis of technology and skill upgrading in manufacturing. Kenneth Troske generously aggregated these confidential plant-level data to the industry level for use by other researchers. The 17 technologies included in the SMT are automatic guided vehicle systems; automatic sensors used on inputs; automatic sensors used on final products; automatic storage/retrieval systems; computer aided design (CAD); CAD controlled machines; digital CAD; technical data network; factory network; intercompany network; programmable controllers; computers used on the factory floor; numerically controlled machines; flexible manufacturing systems/cells; material working lasers; pick and place robots; and other robots. See Doms, Dunne and Troske (1997) for further details on the SMT data.

employment-share-weighted fraction of these 17 technologies used by plants within an industry, averaged between the 1988 and 1993 surveys.[9] Presumably because of the specialized nature of the survey questions, SMT data are available only for the 148 SIC87dd industries that comprise SIC codes 34-38 (with the number of industries falling to 120 when we exclude computer-producing industries). All analyses using SMT data are conducted on this reduced set of industries.

Table A.2 provides summary statistics for each of our IT measures. Table A.3 reports the correlation between each pair of IT measures. In keeping with our implicit assumption that computer investment rates proxy for "permanent" differences in industries' susceptibility to computerization, these rates are positively correlated over time. Consistent with our concerns stated in the text regarding the best way to measure IT-intensity, computer investment rates are uncorrelated with our measure of technology usage in the restricted set of industries for which SMT data are available.

To facilitate comparison of estimated coefficients across different measures of IT intensity, we standardize all IT measures to have zero mean and unit standard deviation across employment-weighted industries.

Additional Results using Main Regression Specification

The figures at the end of this appendix perform additional analyses that we were unable to include in the main body of the paper. As per equation (1) in the paper, our regression model takes the form

$$\log Y_{jt} = \gamma_{\mathbf{j}} + \delta_{\mathbf{t}} + \sum_{t=81}^{09} \beta_t \times IT_j + e_{jt},$$

where $\log Y$ is 100 times the log of an outcome of interest, γ is a vector of industry fixed effects, δ is a vector of time dummies, IT is a static measure of industry IT-intensity, and e is an error term. This specification normalizes the coefficient on the IT variable to zero in the base year, and hence the series $\{\beta_{81}, \beta_{82}, ..., \beta_{09}\}$ may be read as the level of the coefficient on IT in each subsequent year relative to 1980. See the main text for additional details.

A priori, it is possible that an IT investment measure that focused on the most recent years of IT investments—rather than averaging over three decades—might prove more predictive of recent industry-level changes in productivity, output, and employment since such a measure would better

[9] The 1988 SMT data are expressed in 1977 SIC codes, while the 1993 SMT data are expressed in 1987 SIC codes. We convert the 1988 data into 1987 SIC codes using the crosswalk at http://www.census.gov/epcd/www/SIC1987%20to%20SIC1977%20correspondence%20tables.pdf, and then aggregate the 1988 and 1993 data to the level of SIC87dd industries.

reflect the current locus of the IT frontier. As a check on this possibility, Figures A.1 through A.4 explore the relationship between IT and productivity, output, and employment using several different vintages of our computer investment variable. In each of these figures, the 1977–2007 series uses computer investment rates averaged over 1977, 1982, 1987, 1992, 2002, and 2007, as described above. The remaining series use computer investment rates averaged between the indicated years. All of these measures have been standardized to have zero mean and unit standard deviation across employment-weighted industries.

Figure A.1 suggests that the choice of vintage does not qualitatively affect our results on labor productivity. Each of the three vintages shown (1977/1982, 1987/1992, and 2002/2007) indicates that IT-intensive industries experienced relatively faster productivity growth during the late 1990s but not during the 2000s. The strongest evidence for a late 1990s productivity boom actually comes from the oldest computer investment data (1977/1982), suggesting that attenuation bias is unlikely to be driving our findings. Similar statements apply to our results on output and employment. Figures A.2, A.3, and A.4 show that IT-intensive industries have experienced relative declines in real shipments, nominal shipments, and employment since 1990. These figures provide some reassurance that our results are not sensitive to the precise timing of the IT measure.

Supplementing the outcomes investigated in the main text of the paper, Figures A.5, A.6, A.7, and A.8 explore the connection between IT intensity and four additional outcomes: TFP, nominal value added, the shipments deflator, and the wage bills paid to non-production and production workers.

Our TFP results (Figure A.5) reveal no evidence of relatively faster productivity growth in IT-using industries. When measured by technology usage, IT intensity is essentially uncorrelated with TFP growth between 1990 and 2009. When measured by computer investments, IT intensity is actually *negatively* correlated with TFP growth over this period. While we prefer real shipments per worker as a measure of productivity (since TFP relies on potentially erroneous input price deflators), these results underscore the non-robustness of the relationship between IT and productivity in manufacturing industries.

The results for nominal value added (Figure A.6) parallel those for real and nominal shipments. Using either measure of IT intensity (computer investments or technology usage), IT-intensive industries experienced relative declines in nominal value added beginning in the early 1990s. Although real and nominal shipments are our preferred output measures because they are not susceptible to problems arising from changes in input deflators, it is reassuring that nominal value added yields similar conclusions.

In Figure A.7, we find no evidence that IT-intensive industries have experienced relative declines in their shipments deflators (i.e., output prices). This is a surprising result: if IT allows firms to lower production costs, one would expect prices to fall in IT-intensive industries. It is theoretically possible, however, that declining production costs are offset by increases in product quality that cannot be detected in our data.

Finally, Figure A.8 provides ambiguous evidence on the relationship between IT and skill intensity. While both computer investments and technology usage are associated with declines in the wage bill paid to both non-production and production labor, the measures disagree as to whether IT-using industries experience steeper declines in non-production or in production labor. Panel A confirms the earlier finding of Berman, Bound, and Griliches (1994) and subsequent authors that rates of computer investment are positively correlated with the ratio of non-production labor to production labor. Panel B shows, if anything, the opposite result when IT is measured by technology usage.[10] A possible explanation for these contradictory findings is that IT may complement some types of non-production workers (such as managers) while substituting for others (such as clerical workers). Computer investments and technology usage may differ in the relative strength of these complementarities and substition effects.

Results using Changes in the Rate of Computer Investment

As a final exercise, Table A.4 addresses the possibility that *changes* in the rate of computer investment may be more predictive of productivity growth and output growth than the *levels* of this rate. The ratio of computer investments to total capital expenditures may be influenced by factors that have little to do with an industry's susceptibility to computerization, such as the depreciation rate of its non-computer capital. For each of our core outcomes, we therefore run a regression of the form

$$\Delta \log Y_{jt} = \delta_{\mathbf{t}} + \beta \times \Delta IT_{jt} + e_{jt},$$

where $\log Y$ is 100 times the log of an outcome of interest, IT is 100 times the ratio of computer investments to total investments, the Δ operator signifies annualized changes over 5- or 10-year periods, and δ is a full set of time effects. In a departure from the rest of the paper, the computer investment rate used here is *not* standardized to have zero mean and unit standard deviation (results are qualitatively similar when we use standardized measures). We pool annualized changes over the

[10]Although Panel A and Panel B are estimated on different samples (with Panel B restricted to SIC 34-38), unreported results using computer investment rates in the restricted SIC 34-38 sample are qualitatively similar to Panel A.

periods 1977-1982, 1982-1987, 1987-1992, 1992-2002, and 2002-2007. Except for column (1), all specifications exclude computer-producing industries.

The results provide little indication that changes in the rate of computer investment are predictive of productivity or output growth. Columns (1) and (2) show that changes in real shipments per worker are actually slightly negative correlated with changes in computer investment, whether or not we exclude computer-producing industries.[11] Changes in real shipments, nominal shipments, employment, and wage bills are uncorrelated with changes in the rate of computer investment. We do however find that industries experiencing faster growth in computer investments also experience modestly faster growth in their use of non-production labor (with little change in their use of production labor), a finding consistent with our evidence of skill upgrading in Panel A of Figure A.8.

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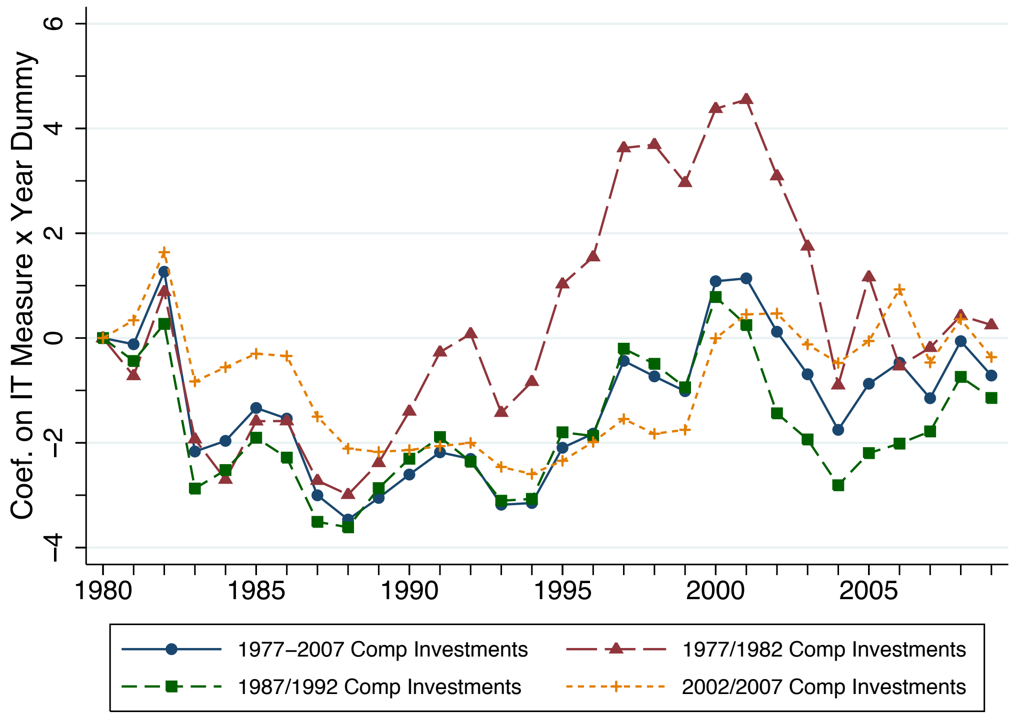
[11] Unlike Figure 1A, where excluding the computer sector substantially dampens the positive correlation between computer investments and productivity growth, doing so here actually leads to a less-negative correlation between changes in the rate of computer investment and changes in productivity. These findings can be reconciled by noting that computer-producing industries experienced relatively sluggish growth (and sometimes declines) in the rate of computer investment over the period 1977-2007.

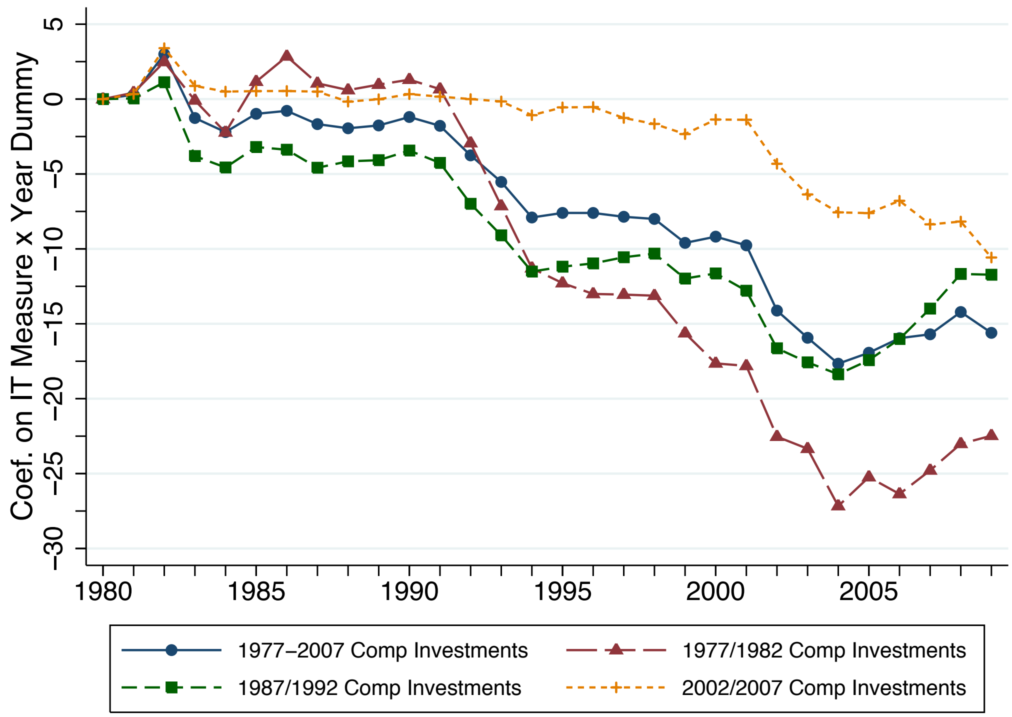
A Figures and Tables

Figure A.1: Computer Investment Rates and Log Real Shipments per Worker, 1980-2009



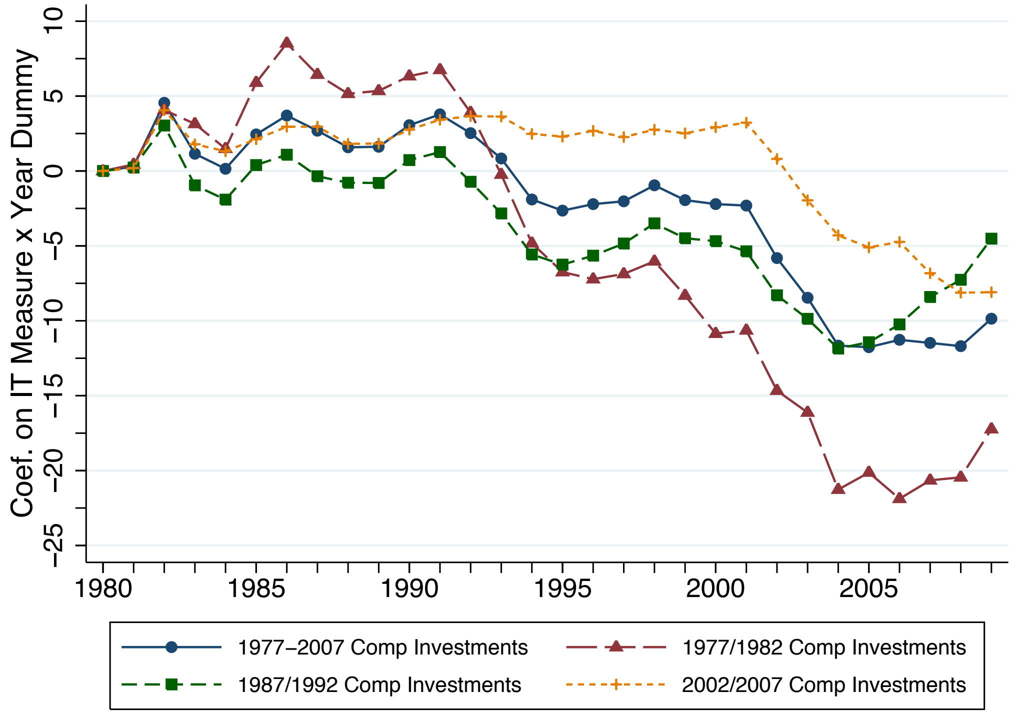
Notes: Coefficients from regressions of 100 x log real shipments per worker on measures of IT intensity. The sample consists of 359 non-computer-producing manufacturing industries, observed at annual frequency over 1980-2009. Each industry's IT intensity is defined as the ratio of its computer investments to its total investments, averaged over the indicated years. The 1977-2007 series averages this ratio over the years 1977, 1982, 1987, 1992, 2002 and 2007 (no 1997 measure is available), placing slightly greater weight on the last two periods to compensate for the absence of the 1997 measure). For the remaining series, we take the simple average of the computer investment ratios in the indicated years. Each measure of IT intensity is then standardized so that the final measure has zero mean and unit standard deviation across employment-weighted industries. Real shipments are expressed in constant dollars using industry-specific price deflators. We regress 100 x log real shipments per worker on industry fixed effects, year effects, and IT intensity x year interactions (omitting the 1980 interaction). Industries are weighted by their average share of total manufacturing employment over the sample period.

Figure A.2: Computer Investment Rates and Log Real Shipments, 1980-2009



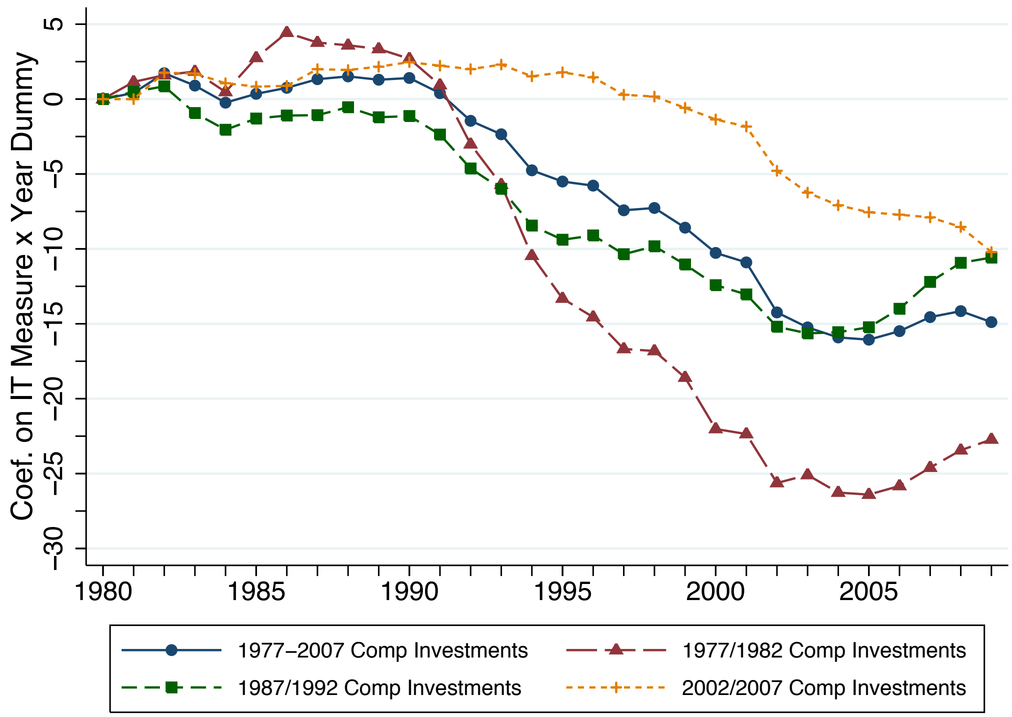
Notes: See Figure A.1 for details.

Figure A.3: Computer Investment Rates and Log Nominal Shipments, 1980-2009



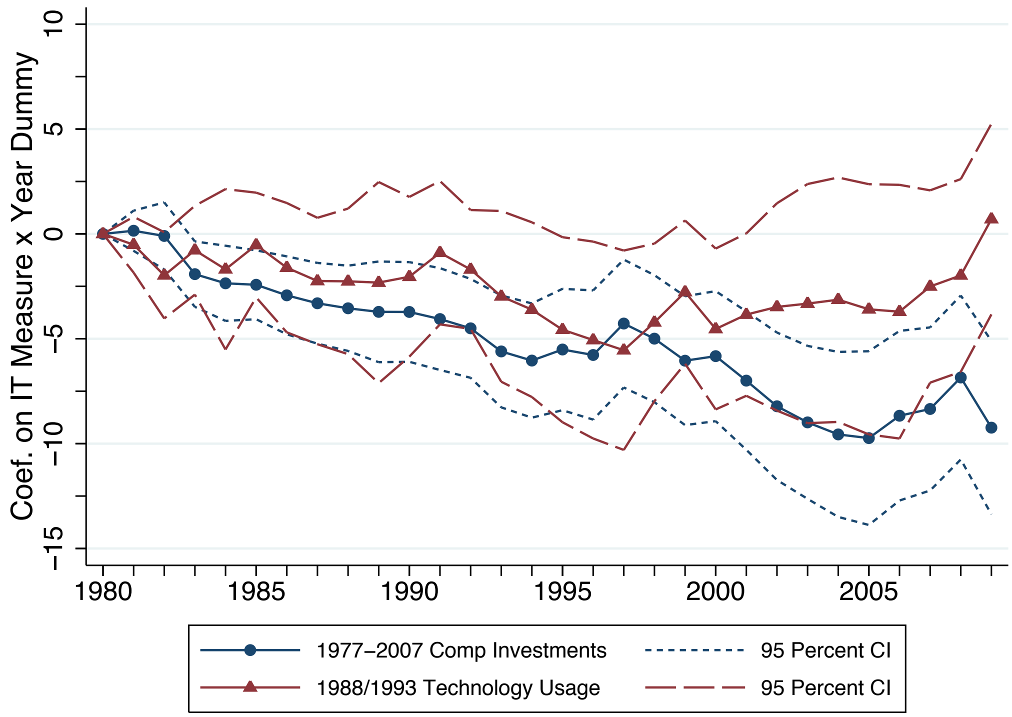
Notes: See Figure A.1 for details.

Figure A.4: Computer Investment Rates and Log Employment, 1980-2009



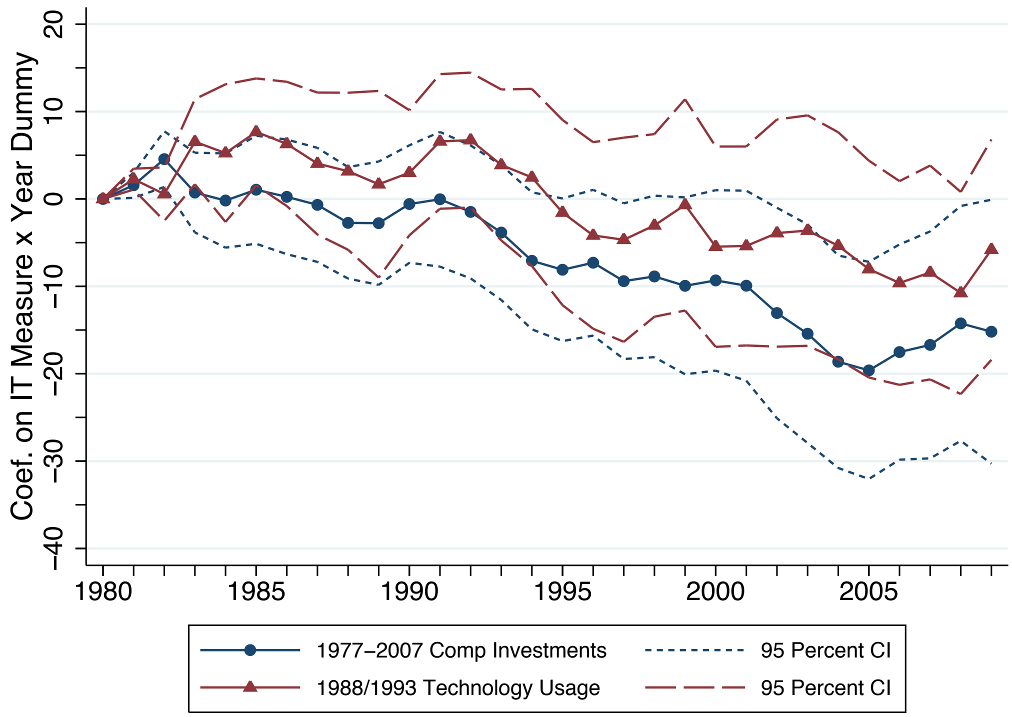
Notes: See Figure A.1 for details.

Figure A.5: IT Measures and Log TFP, 1980-2009



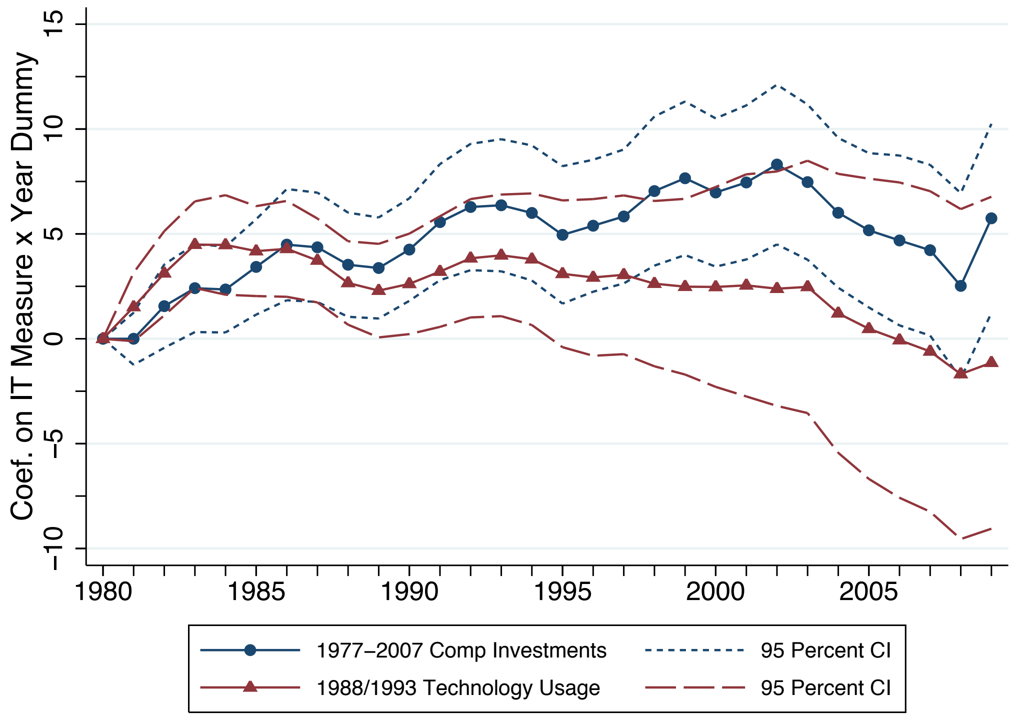
Notes: Coefficients from regressions of 100 x log TFP on measures of IT intensity. For the series labeled "1977-2007 Comp Investments," the sample consists of 359 non-computer-producing manufacturing industries. For the series labeled "1988/1993 Technology Usage," the sample consists of 120 non-computer-producing manufacturing industries that fall within SIC codes 34-38. In the technology usage series, an industry's IT intensity is defined as the employment-weighted share of 17 advanced manufacturing technologies used by plants within that industry. As with the computer investment measure, the technology usage measure is standardized to have zero mean and unit standard deviation across employment-weighted industries. The regression specification parallels that used throughout the paper. The 95-percent confidence intervals are based on standard errors clustered on industry. See Figure 1 of the paper for further details.

Figure A.6: IT Measures and Log Nominal Value Added, 1980-2009



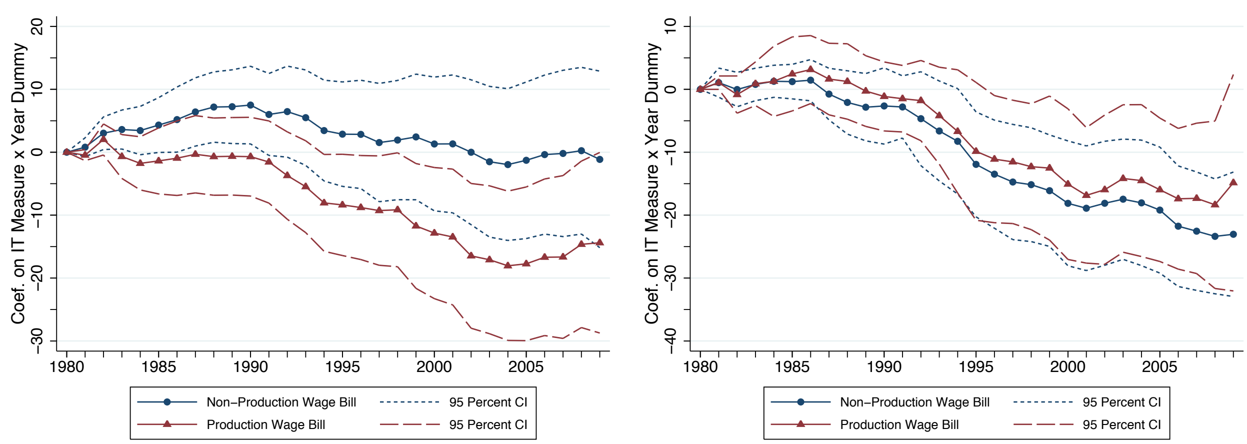
Notes: Nominal value added is computed as nominal shipments minus the nominal cost of materials. See Figure A.5 for details on the regression specifications underlying this figure.

Figure A.7: IT Measures and Log Shipments Deflator, 1980-2009



Notes: See the text of this appendix for details on the construction of the shipments deflator. See Figure A.5 for details on the regression specifications underlying this figure.

Figure A.8: IT Measures and Log Non-Production and Production Worker Wage Bills, 1980-2009



Notes: Panel A defines IT intensity on the basis of 1977-2007 computer investments. Panel B defines IT intensity on the basis of 1988/1993 technology usage. See Figure A.5 for additional details.

Table A.1: Means and Standard Deviations of Key Outcome Variables

	Full Sample					Restricted Sample (SICs 34-38)				
	N	1980	1990	2000	2009	N	1980	1990	2000	2009
Log Real Shipments/Worker	387	4.80	5.10	5.46	5.66	148	4.58	4.92	5.44	5.67
(Including Computer Sector)		(0.96)	(0.81)	(0.60)	(0.64)		(1.12)	(0.84)	(0.43)	(0.49)
Log Real Shipments/Worker	359	4.97	5.21	5.48	5.64	120	4.93	5.15	5.47	5.62
(Excluding Computer Sector)		(0.64)	(0.65)	(0.62)	(0.65)		(0.38)	(0.41)	(0.45)	(0.46)
Log Real Shipments	359	9.39	9.57	9.82	9.53	120	9.43	9.55	9.87	9.64
		(1.19)	(1.23)	(1.30)	(1.47)		(1.10)	(1.13)	(1.21)	(1.20)
Log Nominal Shipments	359	8.78	9.28	9.67	9.56	120	8.80	9.27	9.72	9.70
		(1.17)	(1.22)	(1.29)	(1.46)		(1.11)	(1.18)	(1.24)	(1.19)
Log Employment	359	4.43	4.36	4.34	3.89	120	4.50	4.40	4.39	4.03
		(1.07)	(1.13)	(1.21)	(1.29)		(0.98)	(1.04)	(1.09)	(1.08)
Log Real Wage Bill	359	7.99	7.97	8.06	7.65	120	8.20	8.15	8.24	7.91
		(1.14)	(1.18)	(1.25)	(1.36)		(1.07)	(1.12)	(1.15)	(1.11)

Notes: Real shipments are deflated to 2007 dollars using industry-specific price deflators; real wage bill is deflated to 2007 dollars using the Personal Consumption Expenditures series. Real shipments, nominal shipments, and real wage bill are expressed in millions of dollars; employment is expressed in thousands; and real shipments per worker is expressed in thousands of dollars. All calculations are weighted by industries' average share of manufacturing employment over 1980-2009.

Table A.2: Summary Statistics for Measures of Investment Technology

	Including Computer-Producing Industries					Excluding Computer-Producing Industries				
	N	Mean (SD)	Median	Min	Max	N	Mean (SD)	Median	Min	Max
1977-2007 Computer Investments	387	5.65	5.07	0.46	22.58	359	4.95	4.55	0.46	16.62
		(3.80)					(2.95)			
1977/1982 Computer Investments	387	2.74	1.82	0.00	28.24	359	2.14	1.55	0.00	17.37
		(3.40)					(2.02)			
1987/1992 Computer Investments	387	7.25	5.78	0.00	31.28	359	6.07	4.96	0.00	28.55
		(6.16)					(4.60)			
2002/2007 Computer Investments	387	6.73	5.95	0.00	23.50	359	6.37	5.71	0.00	23.50
		(4.01)					(3.85)			
1988/1993 Technology Adoption	148	37.75	36.57	9.96	69.39	120	35.71	33.41	9.96	69.39
		(14.27)					(14.71)			

Notes: The four computer investment measures are defined as 100 times the ratio of an industry's computer investments to its total investments, averaged over the indicated years. The 1977-2007 series averages this ratio over the years 1977, 1982, 1987, 1992, 2002 and 2007 (no 1997 measure is available), placing slightly greater weight on the last two periods to compensate for the absence of the 1997 measure). For the remaining series, we take the simple average of the computer investment ratios in the indicated years. An industry's technology usage is defined as 100 times the employment-weighted share of 17 advanced manufacturing technologies used by plants within that industry, averaged between 1988 and 1993. The technology usage measure is available only for industries within SIC 34-38. All calculations are weighted by industries' average share of manufacturing employment over 1980-2009.

Table A.3: Correlations Between IT Measures

	1977-2007 Computer Investments	1977/1982 Computer Investments	1987/1992 Computer Investments	2002/2007 Computer Investments	1988/1993 Technology Adoption
1977-2007 Computer Investments	1.00				
1977/1982 Computer Investments	0.68	1.00			
1987/1992 Computer Investments	0.90	0.60	1.00		
2002/2007 Computer Investments	0.85	0.36	0.57	1.00	
1988/1993 Technology Adoption	-0.12	0.18	0.06	-0.44	1.00

Notes: Correlations between computer investment measures include all non-computer-producing industries (n=359). Correlations between computer investments and technology usage include non-computer-producing industries in SIC 34-38 (n=120). All correlations are weighted by industries' average share of manufacturing employment over 1980-2009. See notes for Table A.2 for additional details.

Table A.4: Changes in Computer Investment and Changes in Key Outcomes

	(1) Real Shipments / Worker	(2) Real Shipments / Worker	(3) Real Shipments	(4) Nominal Shipments	(5) Emp	(6) Real Wage Bill	(7) Prod Real Wage Bill	(8) Non-Prod Real Wage Bill
Δ in Computer Investment Rate	-0.39*	-0.14	-0.12	-0.02	0.02	0.09	-0.13	0.33**
	(0.20)	(0.09)	(0.17)	(0.18)	(0.14)	(0.15)	(0.16)	(0.15)
1{1977-1982}	0.95***	0.19	-0.85	6.70***	-1.04**	-1.51***	-2.15***	-0.13
	(0.36)	(0.22)	(0.53)	(0.46)	(0.40)	(0.43)	(0.46)	(0.34)
1{1982-1987}	4.50***	3.87***	4.00***	5.77***	0.13	1.25***	1.17***	1.36***
	(0.37)	(0.21)	(0.42)	(0.45)	(0.40)	(0.43)	(0.44)	(0.46)
1{1987-1992}	2.39***	1.73***	1.12***	3.75***	-0.61***	-0.77***	-1.23***	-0.05
	(0.29)	(0.14)	(0.26)	(0.23)	(0.22)	(0.24)	(0.24)	(0.28)
1{1992-2002}	3.55***	2.71***	1.43***	2.60***	-1.29***	-0.18	-0.22	-0.11
	(0.44)	(0.15)	(0.26)	(0.26)	(0.28)	(0.27)	(0.29)	(0.24)
1{2002-2007}	3.43***	2.94***	0.49	3.53***	-2.46***	-2.10***	-2.39***	-1.55***
	(0.23)	(0.18)	(0.35)	(0.47)	(0.33)	(0.35)	(0.40)	(0.33)
Exclude Computer Sector	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Industries	387	359	359	359	359	359	359	359
N	1935	1795	1795	1795	1795	1795	1795	1795

Notes: All specifications are based on a sample of 387 4-digit manufacturing industries observed over five periods. Each column reports results from regressing 100 x annual log changes in the indicated variable on 100 x annual changes in computer investments as a share of total investments, over the periods 1977-1982, 1982-1987, 1987-1992, 1992-2002, and 2002-2007. Columns (2)-(8) exclude a set of computer-related industries, based on the definition of the computer sector used in Bartik, Houseman, and Sturgeon (2013). In columns (7) and (8), "Prod" and "Non-Prod" refer to production workers and non-production workers, respectively. Industries are weighted by their average share of manufacturing employment over the period 1977-2007. Standard errors in parentheses are clustered on industry. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.