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Diversified Occupations, Offshoring and Labor Market Volatility

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ABSTRACT

Are occupations that are well diversified across sectors less volatile, and less susceptible to external shocks? Most external shocks, like manufacturing offshoring or oil shocks, impact the labor market along sectoral lines, i.e. they impact product and output markets; consequently, they affect employment in various occupations. Some shocks, however, like services offshoring, affect horizontals or occupations. We suggest a new approach to assess the vulnerability of jobs due to such shocks. We find that an occupation spread across multiple industries is less volatile in terms of numbers employed and the average wage. Including various measures of an occupation's offshorability does not affect the results; however, geographically clustered occupations seem more "at-risk," after accounting for sectoral diversification.

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Introduction and Motivation

An open economy is susceptible to external shocks, and most shocks to the US economy, whether they are positive demand shocks, brought about by increasing preference abroad for goods produced by the US, or negative supply shocks, caused by increasing energy prices, impact the economy along sectoral lines. These are shocks to output and to product markets, and affect the verticals or sectors of an economy, each of which is populated by people working in a range of occupations.

Manufacturing offshoring also belongs to this category of shocks to the economy; specifically, manufacturing offshoring impacts similar sectors, which are often parts of a cluster, e.g. as has happened in the case of the automotive components cluster and the computer hardware/peripherals cluster. Since the labor market matrix of an economy consists of occupations (horizontal rows) and sectors (vertical columns), one would expect that an occupation that is well-diversified across sectors would be less susceptible and vulnerable to these shocks, and that greater diversification of an occupation across sectors would result in a lesser impact on the number of people employed in it.

On the other hand, in recent years a new category of external shocks has appeared which seems to impact along occupational lines. The burgeoning literature on the phenomenon of services offshoring has brought the occupational structure of the US labor market into sharp focus. A number of papers on services offshoring, such as Forrester (2003), Bardhan and Kroll (2003), Garner (2004), Jensen and Kletzer (2005) and Van Welsum and Reif (2005), have studied the labor market impact of services offshoring from an occupational point of view. The underlying intuition, as expressed by Garner and Bardhan and Kroll, is that services offshoring, unlike that of manufacturing

activity, impacts the labor market along occupational lines, rather than along sectoral lines or "verticals." The initial premise of many of these papers, which attempted to estimate the potential impact of white-collar offshoring on jobs, was that if a certain job in an occupation, say a payroll job, could be performed offshore in one sector, then other jobs in the same payroll occupation but in other sectors were sufficiently similar to be also shipped abroad.

These initial efforts, however, did not take into account a key issue. Assuming a homogeneous occupation within and across sectors ignores the aspect of skill specificity. Skill specificity is conceptually similar to asset specificity, which is a reflection of "the degree to which an asset can be redeployed to alternative uses."[i] It refers to specific know-how or skills, particularly tacit skills and inbuilt routines that have accumulated during the work process, as well as through learning-by-interacting and social networking at the work place. Jobs, which are broadly in the same occupation, therefore, embody different skills and knowledge, and vary widely depending on what the firms produces, its sectoral context, the broader business environment in which it operates, as well as on the specific structure of the firm, its business culture, work practices and organizational setup. An occupation that is diversified across many sectors is therefore less at risk to services offshoring shocks. In other words, occupations requiring a high-level of skills specific to a given industry will suffer less from services offshoring.

The US economy is vulnerable to both manufacturing and services offshoring shocks. In the case of an output shock (e.g. manufacturing offshoring), the impact on a given individual occupation in the labor market will be mitigated by how well-diversified it is across sectors. Shocks from services offshoring, although channeled along

occupational lines (but not necessarily along similar, correlated occupations), are also mitigated and qualified by the spread of an occupation across the sectors of an economy. A measure of how diversified an occupation is across the sectors of an economy would therefore serve to proxy the skill range and variability within an occupation, and thus to qualify possible consequences from horizontal or vertical shocks.

To summarize, the labor market impact on occupational employment in the case of both manufacturing offshoring (or other output/product shocks) and services offshoring, is mitigated by skill specificity, range, and variability across sectors, which can be proxied by some measure of occupational diversification across sectors. The basic hypotheses that we test in this paper can therefore be expressed as: *are occupations that are more diversified across sectors less volatile in employment and hence less susceptible to shocks (or equivalently, are more concentrated occupations more susceptible), both vertical (manufacturing offshoring, external output shocks) and horizontal (services offshoring)*?[ii] To our knowledge, this is the first such attempt to tackle this question.

In addition, we pose other related questions, such as how is the relationship between volatility and occupational diversification or concentration affected by wage spread/inequality within an occupation? Can we use wage spread as a proxy for skill range and specificity of jobs within the same occupation but across all sectors in an economy? How does the extent of self-employment impact occupational employment volatility? Do the various lists of at-risk occupations, i.e. occupations vulnerable to offshoring, compiled by Blinder (2007), Jensen and Kletzer (2005), Bardhan and Kroll (2003), behave differently than others after accounting for diversification, etc.?

Literature Review

The importance of diversification to mitigate risk is well-captured by the homily "don't put all your eggs in one basket." In the context of finance, industrial organization, and business practice, this wisdom translates to investing in different financial assets or sectors so as to spread the risk of failure in any one venture across many independent ones, in effect spreading out idiosyncratic volatility. Literature on corporate diversification across industry and product lines emphasizes multiple motivations: besides stability of returns, which accrue from operating in independent sectors that cover the entire business cycle, other theories include production synergies, scale economies, network externalities, and strategy management.[iii]

The idea that diversification reduces risk also appears in models of portfolio investment and asset pricing.[iv] Finance literature provides a wealth of theory on the benefits of diversification, starting with the pioneering studies by Markowitz (1952) and Tobin (1965) on the modern portfolio theory (MPT), and Sharpe (1964) and Lintner (1965) on the capital-asset pricing model (CAPM).

The absence of a unified theoretical basis for corporate diversification has not prevented economists from conducting a substantial number of empirical studies that run the gamut of the industrial spectrum. In particular, research on the positive relationship between risk reduction and diversification includes sectors like banking[v], manufacturing[vi], real estate[vii], as well as firm-level studies on multinational expansion[viii] and conglomerates.[ix] Many studies that have attempted to quantify the degree of corporate diversification, specifically in the context of growth, have utilized two common

measures, namely the Herfindahl[x] and entropy[xi] indices. Both indices measure concentration based on the share of individual sector sales relative to overall revenues.[xii]

Surprisingly, little research has been carried out on the role of diversification (or concentration) relating to a fundamental factor of production, labor. As mentioned earlier, given that occupations differ in skill content and industry applicability, it is reasonable to think that an occupation present in a large number of industries would reap the benefit of diversification in the form of lower employment volatility. An occupation that is diversified across multiple industries (eg, administrative assistants are employed in banks, hospitals, factories, indeed in most sectors) is likely to be less susceptible to industry shocks, e.g. as in shocks due to offshoring of manufacturing, since the risks of job instability are spread across multiple sectors, whereas a more concentrated occupation is more vulnerable. Of course, diversification in this sense works if most shocks are not economy-wide and if an occupation is spread out across unrelated industries. This general premise of the trade-off between occupational diversification and occupational vulnerability has wide-ranging implications given the globalization of (labor) markets and the debate on international outsourcing.

Studies that have used the occupational structure of the labor market, in addition to those mentioned earlier dealing with the offshoring phenomenon, have done so in contexts like urban planning, regional economics and skill intensity. Markusen (2004) advocates the use of occupational targeting in addition to policies targeting industries in order to ameliorate developmental differences between regions and to deal with employment insecurity. Magnusson and Alasia (2004) discuss the differences in concentrations of unskilled occupations between rural and urban Canada, with rural areas

gaining unskilled labor relative to urban areas in the 1990s. Autor et al (2003) find that the computerization of occupations has decreased demand for unskilled labor, and Michaels (2005) reports that industries with a more complex division of labor employ relatively more clerks, with production processes and industries being defined as complex when they require a wide range of different occupations. Michaels proxies the complexity of a manufacturing industry as one minus the Herfindahl index of the occupations of its employees, excluding managers, clerks, accountants, and auditors. In other words, the Michaels paper looks at different occupations across individual sectors, or how diversified a sector is in terms of occupations, whereas in our case, we analyze individual occupations across different sectors, or how diversified an occupation is in terms of sectors.

Data and Results

Our data source is the Bureau of Labor Statistics and its Occupational Employment Statistics program, as well as its publication, the *BLS Occupational Projections and Training Data*, 2006-07 edition. While the data on employment figures by occupation, wages and wage distribution in percentiles are available from the former, the latter provides us with data by occupational categories on the proportion of workers that are self-employed or have at least a college degree. The BLS resorts to the Standard Occupational Classification system for reporting occupational data, which consists of 821 detailed occupations, grouped into 23 major groups. An occupation is defined on the basis of a common, essentially the same set of activities, functions or tasks that are performed, regardless of the industry, as well as knowledge, specific skills and abilities

required. The SOC lists individual occupations that may have many different job titles. It does not attempt to list all job titles in the real world, and includes workers having different job titles, but similar job duties in the same occupation. The idea is to be exhaustive, so that the entire labor force is covered, keep the occupations and their tasks and duties distinctive, while retaining a reasonable number of occupations. The classification system therefore recognizes firm and industry specific skills and functions that individual jobs in the same occupation but in different sectors might acquire and require.[xiii]

For our measure of diversification, we experiment with three different metrics as follows:

1) A Gini Coefficient, defined as follows: $1-\sum_{j}\left(\sigma Y_{i-1,j}+\sigma Y_{i,j}\right)\left(\sigma X_{i-1}-\sigma X_{i}\right)$

where σY_i is the cumulative employment share of occupation *i* in industry *j*, and σX_i is the cumulative share of occupation *i* in total employment.

2) A Herfindahl Index: $\sum_{j} n_{i,j}^{2}$

where n is the employment share of occupation *i* in industry *j*.

and,

3) An additional Diversification Metric, defined as: $\sum_{j}\left[\frac{n_{i,j}}{\sum_{j} n_{j}}-\frac{\sum_{j} n_{i,j}}{\sum_{i}\sum_{j} n_{i,j}}\right]^{2}$

where *n* is the employment of occupation *i* in industry *j*.

All the three measures above are defined so that they lie between zero and one, with the least diversified or most concentrated occupations (i.e. those that are present in a

few sectors) yielding measures close to one, and the well-diversified ones yielding measures closer to zero. These measures are therefore more accurately known as measures of concentration. The 2005 BLS matrix of 800 odd occupations and around 300 NAICS sectors was used to calculate these measures of occupational concentration. We also define a measure of wage spread in an occupation as the difference in wage between the 90th percentile and 10th percentile of the occupation across industries. This difference is then normalized (i.e. divided by) using either the 10th percentile (1st version) or the 90th percentile (2nd version) to yield two different measures; for ease of exposition, we show results only with the first version. Our measure of employment volatility of an occupation is defined as the standard deviation of the annual percentage change in the employment over the period 1999 to 2005. All the other variables are for the year 2005, unless specified otherwise.

Some of the least diversified occupations/jobs in the US are locomotive firers, animal breeders, railroad conductors and yardmasters, motion picture projectionists, slaughterers and meat packers, choreographers, tax preparers, and a number of occupations in the general sphere of personal services. Among the most diversified are occupations in management and business support, including switchboard operators, office managers and sales managers, many back office clerical occupations, such as accounting and payroll clerks, as well as network computer systems administrators and other information technology-related occupations.

In terms of the wage spread, or inequality measure, occupations with a very high range of range of wages include jobs in the entertainment world such as artists, television and radio announcers, musicians and fashion designers, plus many occupations in the

world of finance and business, such as financial advisors, real estate agents, CEOs and professional athletes. At the low end of the wage spread are some white-collar occupations like postal clerks, many fast food-related occupations, some mining jobs, as well as pharmacists and laundry workers. The middle range is occupied by occupations such as physicists and software engineers.

The self-employment variable also reveals some interesting information. While the lowest proportion of self-employment is in some obvious occupations, e.g. legislators, natural sciences managers and postmasters (zero percent self-employment in all of them), jobs with a high percentage of self-employment include personal services occupations like barbers (71 percent) and massage therapists (64 percent), some creative occupations like writers (68 percent) and painters/sculptors (62 percent) as well as real estate brokers (60 percent).

[Table 1 here]

The descriptive statistics in Table 1 show that two of the three measures of occupational concentration[xiv] decreased between 1999 and 2005. This suggests that across sectors all occupations on average became somewhat more diversified. At the same time, two of the measures show increased variance, indicating that while on average occupations became more diversified, there were also greater differences in diversification among occupations as a whole. In addition, while the average number of jobs per occupation decreased, the average wage of occupations increased, which suggests a disproportionate loss of low-wage jobs.

[Table 2 here]

Table 2 shows the correlation matrix, and includes all the key variables including the dummy variables for those occupations identified as tradable/offshoreable by various researchers. Bardhan and Kroll (2003) compile a list of offshoreable occupations by matching the task descriptions of all the occupations in the US labor market to a set of job offshorability attributes and criteria developed by them, such as no face-to-face contact, low social networking requirement and telecommutability. Blinder (2007) creates an index of offshorability based on whether an occupation requires a US work location, as well as the degree of personal communication/contact with end users of the service. His index uses detailed task descriptions for various occupations from the O*NET data created for the US Department of Labor.[xv] Jensen and Kletzer's (JK) list comprises occupations that are geographically concentrated domestically, and hence more tradable, since clustering reflects a propensity to be mobile, and hence exportable; theirs is an attempt to overcome the heuristic-judgemental approach of Bardhan and Kroll (BK), and settle on some objective criteria.[xvi]

The results from the correlation analysis show significant positive relationships between the three concentration measures and employment volatility. This is consistent with the interpretation that the greater the concentration of an occupation among industries, the higher the volatility in the occupation's employment across industries, which gives an early hint of support for our hypothesis that diversification dampens volatility and promotes job stability for an occupation.

A couple of other things may be noted about the correlation table. The education variable is positively correlated with the different offshorability measures, although not

significantly with the Blinder index. This suggests that at least for the BK and JK dummies, their authors' vision of offshoreable occupations are those embodying relatively higher skills and educational qualifications. The concentration variables are all negatively correlated with the Blinder index and the BK dummy, which is reasonable considering that the former considers how easily certain tasks can be routinized (and thus applicable across multiple industries), similar in spirit to the latter's list of at-risk occupations that includes mostly very well diversified occupations like computer programmers, business support and back office jobs. Intriguingly, this finding may partially explain the hitherto limited impact of offshoring on these jobs. On the other hand, there is no clear relationship between the concentration measures and the JK dummy variable. The latter, however, is significantly correlated with employment volatility, suggesting these occupations are vulnerable to external shocks.

Another interesting piece of information that can be gleaned from the table is that occupational concentration is positively correlated with both the self-employment and college graduate variables, which may indicate specialized skills suitable for a smaller pool of industries. The Blinder index is negatively correlated with the proportion of self-employment in an occupation, which is a testimony to its value as an appropriate index of offshorability, since most occupations with high levels of self-employment are non-tradable personal services, such as door-to-door sales workers, barbers, massage-therapists, artists and real estate agents. The Blinder index is also negatively correlated with our wage spread measure, corroborating the intuition expressed by him in "Fear of Offshoring" (2005) on the issue of wage inequality, that "…under the greatest wage

pressure in the future, are *not* mostly low-end jobs. They are jobs providing impersonal services, some of which now pay very handsome wages and some of which do not."

Table 2 also shows that college graduates have a greater spread in wages, earn a higher average wage compared to non-graduates, and are geographically more mobile, as indicated by the positive correlation with the JK dummy variable. It seems that for college grads, the gain in terms of education and skills is counteracted by a loss of diversification in terms of employment opportunities in some sectors. The significant positive relationship between the wage spread and average wage, indicating higher within-occupation inequality for some of the better paying careers (e.g. musicians, professional athletes), seems to point to the winner-take-all markets that some of these occupations operate in.

[Table 3 here]

Table 3 shows the OLS regression results with employment volatility, measured as the standard deviation of the annual occupational employment change between 1999 and 2005, as the dependent variable. As mentioned earlier, we use employment volatility as a general proxy for the vulnerability of an occupation. The period from 1999 to 2005 provides us with a consistent dataset for all the relevant variables, with over 700 occupations, and covers those years when external shocks in the form of both manufacturing and services offshoring had become widespread. We find that all three measures of occupational concentration have a significant positive impact on volatility; that is, an occupation that is more concentrated among industries is also subject to greater job insecurity. This is demonstrated by the positive coefficient on the Herfindahl

concentration variable.[xvii] Moreover, these results are robust to different model specifications, like the inclusion of occupational dummy variables and interaction terms between the control variables.[xviii] Furthermore, we check the results from our diversification measures against another variable that counts the number of "zeroes" in an occupation, i.e. the number of sectors where there is no employment of that occupation in a particular industry. This additional proxy for occupational concentration also corroborates our earlier regression results. It should be noted however that the more diversified occupations are also those employing larger numbers of people, and the more concentrated ones being generally those with lesser numbers, although exceptions abound.[xix]

Other variables that we control for include the average wage, the wage spread (as an auxiliary measure of skill specificity uncorrelated with diversification), and both the proportion of self-employed workers and college graduates within an occupation across different industries. None of these variables seem to have a consistent, significant relationship with volatility, although high-wage occupations and self-employment do show some vulnerability during this period in some specifications. To control for inter-industry variation, we relax the assumption that random shocks to the labor market have identical effects across different categories of jobs and include 22 clustered categories of occupations as dummy variables.[xx]

Even well-diversified occupations can be susceptible to services offshoring shocks, if those occupations correspond with the Bardhan-Kroll offshorability attributes list or with Blinder's criteria of impersonal services, i.e. these jobs are information-based, telecommutable, and there is no personal presence requirement. Indeed, as mentioned

earlier, quite a few of the occupations listed as vulnerable by Blinder and BK are indeed well diversified across sectors. We therefore refine our earlier regressions by controlling for the "offshorability" criteria, using the BK dummy, the Blinder index, and the JK dummy for "geographic concentration." Neither the Blinder index (not shown) nor the BK variable are significant in any of the specifications in Table 3, whereas the coefficient on the JK variable is positive and significant, suggesting that the "tradable" occupations identified by Jensen and Kletzer are susceptible to shocks even after controlling for diversification, perhaps an indication that shocks impact agglomerative regions disproportionately.[xxi]

The justification for using a "self-employment" measure is the increasing trend to insure oneself against the vagaries of the labor market by taking refuge in a self-employed capacity. Some specifications in Table 3 give a marginally significant positive relationship between self-employment and volatility, but there is no consistent pattern.

We carry out a limited robustness check using the University of California, San Diego's National Industry-Occupation Employment Matrix: 1983-1998 Time Series database. Although certain variables are missing for this older dataset, like wage distribution data by occupation, self-employment and college education, and only occupational employment by sector is available, we can still construct a Herfindahl concentration measure and analyze its relationship with employment volatility between 1983 and 1998.[xxii] The correlation between occupational concentration and volatility is positive (0.14) and statistically significant, albeit somewhat less in magnitude when compared with the corresponding figure for our 1999-2005 dataset from Table 2, which is 0.207. We also deal with the "strength in numbers" argument (see endnote 16) by

including the number employed in an occupation as an additional independent variable, as well as in interaction with the Herfindahl measure. Our key result – the negative relationship between occupational diversification across sectors and occupational employment volatility remains unchanged.

[Table 4 here]

We also check for another kind of labor market adjustment, i.e. price adjustment. In other words, we investigate the impact of diversification on the volatility of occupational wages. Occupational diversification does appear to have a similar, significant impact on wage volatility, as shown in Table 4. The greater the concentration of an occupation in a few sectors, the more volatile the average wage. The only other variable that is consistently significant is again the JK dummy, for perhaps the same reasons as before.[xxiii] The college education variable is significant in some model specifications, unlike in Table 3, perhaps tentatively hinting at easier price than quantity adjustment for some skilled jobs, particularly the self-employed ones.

Concluding Remarks

Our analysis provides some tentative evidence that occupational concentration is fairly well correlated with labor market volatility, and greater diversification across industries and sectors appears to increase job security. We use a number of other variables to qualify the result, such as a measure of wage inequality and spread within an occupation, which proxies for skill specificity and is not correlated to diversification, as well as self-employment and college education. Our results support the hypothesis that

workers in more diversified occupations will be less sensitive to industry-specific shocks. We argue that this is due to their higher probability of finding similar employment in a different industry.

Since well-diversified jobs can also be vulnerable to offshoring if they satisfy the "offshorability" criteria, we control for the latter, using Blinder's index and both the BK and JK dummy variables. The horizontal occupation-specific shocks that Bardhan and Kroll, Blinder, Garner and others have described can also be mitigated by diversification since our diversification and wage-range measures proxy for skill specificity and range of know-how within an occupation. This suggests a further refinement for development of measures and indices of offshorability. The vulnerability of geographically concentrated tradable occupations listed by Jensen-Kletzer, even after accounting for sectoral diversification, suggests some initial evidence in favor of the disproportionate impact of offshoring and external shocks on agglomerations and clusters.

Of course, there are many caveats to these results. As mentioned earlier, it might be "strength in numbers", or a large numbers argument, since the more diversified occupations employ larger numbers (there is no correlation with average wages however), although it does not completely explain the results and in turn begs further questions. Also, we have a limited time-span available for calculating volatility (1999-2005), since data from earlier years is not compatible. On the other hand, we do carry out a partial robustness check with data from 1983-1998. Additional data and more research might clarify a number of issues.

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Table I: Descriptive Statistics

	1999		2005	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
Diversification Metric	0.263	0.209	0.345	0.274
Gini Coefficient	0.974	0.052	0.918	0.082
Herfindahl Index	0.420	0.351	0.355	0.280
Employment per Occupation	168176	366471	163421	373964
% Self Employed			7.987	13.484
% College Graduate			35.374	33.149
Wage (current $)	36294	17137	43534	21152
Wage Spread, Low	1.709	0.768	1.459	0.510
Wage Spread, High	0.608	0.091	0.562	0.069

Source: BLS. Both the numbers for Self-Employed and College Graduate are for 2004, the most recent year available; see *BLS Occupational Projections and Training Data,* 2006-07 edition.

Table II: Correlations

	EmpVol	DivMet	Gini	Herf	Self-Emp	College	Wage	Spread	Blinder Index	BK Dummy	JK Dummy
Employment Volatility 99-05	1.000										
Diversification Metric[1]	0.225*	1.000									
Gini Coefficient	0.232*	0.547*	1.000								
Herfindahl index	0.207*	0.997*	0.551*	1.000							
Self-Employed	0.088*	0.088*	0.086*	0.072*	1.000						
College Graduate	0.042	0.052	0.132*	0.073*	0.018	1.000					
Average Wage	0.085*	0.043	0.020	0.047	0.066	0.696*	1.000				
Wage Spread	0.129*	0.055	0.039	0.059	0.230*	0.466*	0.429*	1.000			
Blinder Index[2]	-0.055	-0.317*	-0.290*	-0.332*	-0.080*	0.026	0.006	-0.090*	1.000		
Bardhan-Kroll Dummy	-0.045	-0.178*	-0.253*	-0.176*	-0.063	0.089*	0.042	-0.036	0.453*	1.000	
Jensen-Kletzer Dummy	0.165*	0.022	0.129*	0.016	-0.037	0.240*	0.273*	0.105*	0.148*	0.080	1.000

(Source: BLS)

[1] Unless otherwise noted, all independent variables are for the year 2005.
[2] Blinder (2007) uses 2006 US Department of Labor occupation descriptions to construct his index. See text for more information.

*: significant at the 5% level

Table III: Regression Results

Dependent Variable: Employment Volatility 1999-2005

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Observations	698	692	692	703	698	692	427	427
R-squared	0.0541	0.0610	0.0630	0.0487	0.0590	0.0637	0.1834	0.2715
Herfindahl Index[3]	0.0473‡	0.0462‡	0.0468‡	0.0450‡	0.0464‡	0.0459‡	0.0830‡	0.0926†
	(0.009)	(0.009)	(0.0088)	(0.0085)	(0.0086)	(0.0087)	(0.0148)	(0.0165)
Average Wage[4]	0.0002*		0.0002		0.0002*			
	(0.0001)		(0.0001)		(0.0001)			
Wage Spread[5]		0.0137*	0.0110			0.0139*	0.0107	0.0202*
		(0.0073)	(0.0068)			(0.0078)	(0.0081)	(0.0115)
Self-Employed				0.0004†	0.0003*	0.0002	-0.0003	-0.0004
				(0.0002)	(0.0002)	(0.0002)	(0.0004)	(0.0004)
College Graduate						-0.0001	-0.00003	-0.00001
						(0.0001)	(0.0001)	(0.0002)
Interaction (Self-Employed *College Graduate)							0.00001	0.00001
							(0.00001)	(0.00001)
Bardhan-Kroll Dummy							-0.0024	-0.0011
							(0.0065)	(0.0091)
Jensen-Kletzer Dummy							0.0151‡	0.0103*
							(0.0053)	(0.006)
Occupation Dummies[6]								included

[3] Unless otherwise noted, all independent variables are for the year 2005.
[4] In thousands of US dollars (current).
[5] This is normalized by dividing the difference between the 90th and 10th percentile wages with the 10th percentile wage.
[6] These include 22 occupations at the 2-digit SOC level: management, business operations, computing/math, architecture/engineering, science, social services, legal services, education, arts/entertainment, health provision, health support services, security/protection, food services, building maintenance, personal care services, sales, administrative support services, construction, installation, manufacturing, transport services, and military.

Robust Standard Errors in parentheses
*: 10% significance †: 5% significance ‡: 1% significance

Table IV: Regression Results

Dependent Variable: Wage Volatility, 2005

	(1)	(2)	(3)	(4)	(5)
Observations	701	701	701	427	427
R-squared	0.0940	0.0690	0.103	0.1701	0.2439
Herfindahl Index[7]	0.0179‡	0.0188‡	0.0193‡	0.0232‡	0.0242‡
	(0.0033)	(0.0034)	(0.0034)	(0.0039)	(0.0037)
Wage Spread[8]				0.0142†	0.0154†
				(0.0058)	(0.0060)
Self-Employed	0.0003‡		0.0001	-0.0001	-0.0001
	(0.0001)		(0.0001)	(0.0001)	(0.0001)
College Graduate	0.00013‡	0.00013‡	0.00009‡	-0.00001	-0.0001
	(0.00003)	(0.00003)	(0.00003)	(0.00004)	(0.0001)
Interaction (Self-Employed*College Graduate)			0.000007†	0.000003	0.000001
			(0.000003)	(0.000002)	(0.000003)
Bardhan-Kroll Dummy				-0.0055*	-0.0051
				(0.0033)	(0.0048)
Jensen-Kletzer Dummy				0.0052‡	0.0044†
				(0.002)	(0.0021)
Occupation Dummies[9]					included

[7] Unless otherwise noted, all independent variables are for the year 2005.
[8] This is normalized by dividing the difference between the 90th and 10th percentile wages with the 10th percentile wage.
[9] These include 22 occupations at the 2-digit SOC level: management, business operations, computing/math, architecture/engineering, science, social services, legal services, education, arts/entertainment, health provision, health support services, security/protection, food services, building maintenance, personal care services, sales, administrative support services, construction, installation, manufacturing, transport services, and military.

Robust Standard Errors in parentheses
*: 10% significance †: 5% significance ‡: 1% significance

Appendix 1

Least Concentrated Occupations or Occupations Most Diversified Across Sectors
NAME OF OCCUPATION AND NUMBER EMPLOYED IN 2005

General and operations managers	1663810
Production, planning, and expediting clerks	287980
Bookkeeping, accounting, and auditing clerks	1815340
Chief executives	321300
Shipping, receiving, and traffic clerks	759910
Industrial production managers	153950
Sales managers	317970
Inspectors, testers, sorters, samplers, and weighers	506160
Maintenance workers, machinery	83220
Industrial machinery mechanics	234650
First-line supervisors/managers of non-retail sales workers	294010
First-line supervisors/managers of office and administrative support workers	1352130
Executive secretaries and administrative assistants	1442040
Payroll and timekeeping clerks	205600
Customer service representatives	2067700
First-line supervisors/managers of helpers, laborers, and material movers, hand	176030
Purchasing agents, except wholesale, retail, and farm products	267410
Administrative services managers	239410
Training and development specialists	206860

Appendix 2

Most Concentrated Occupations or Occupations Least Diversified Across Sectors
NAME OF OCCUPATION AND NUMBER EMPLOYED IN 2005

Funeral directors	21960
Postmasters and mail superintendents	26120
Forestry and conservation science teachers, postsecondary	2990
Prosthodontists	560
Embalmers	9840
Funeral attendants	30220
Shampooers	16040
Postal service clerks	78710
Postal service mail carriers	347180
Postal service mail sorters, processors, and processing machine operators	208600
Animal breeders	1860
Locomotive firers	540
Subway and streetcar operators	7430
Vocational education teachers, middle school	15380
Bicycle repairers	7980
Air traffic controllers	21590
Railroad conductors and yardmasters	38330
Secondary school teachers, except special and vocational education	1015740
Middle school teachers, except special and vocational education	637340
Special education teachers, middle school	103480
Elementary school teachers, except special education	1486650
Barbers	13630
Criminal justice and law enforcement teachers, postsecondary	9880
Tax preparers	58850

Endnotes

[i] Williamson (1981).

[ii] In our regressions we employ volatility rather than a job loss variable as the dependent variable, since the objective here is to look more broadly at the relationship between shocks, both negative and positive, and occupational diversification

[iii] Other terms with overlapping definitions are economic and personal rationality. For a comprehensive review of empirical studies on corporate diversification, see Ramanujam and Varadarajan (1989).

[iv] Alternatives to these models based on the risk-versus-return paradigm appear as arbitrage pricing and rational expectations models; for early work, see Ross (1976) and Merton (1973), respectively.

[v] Demsetz and Strahan (1997).

[vi] Grant et al (1988).

[vii] Liu and Mei (1998).

[viii] Agmon and Lessard (1977).

[ix] Amihud and Lev (1981).

[x] Berry (1971).

[xi] Jacquemin and Berry (1979).

[xii] The Herfindahl index is typically used to measure the concentration of a firm (or an industry); ie, the relative proportion of sales of a firm in different industries (or the market dominance of a single firm/oligopoly within an industry). It is calculated as the sum of squares of sales by segment (firm) over total sales (number of firms), where a single-product (firm) firm (industry) has a Herfindahl measure of one, and a highly diversified firm (industry) with a measure approaching zero: $\sum_i(x_i/X)$, where i is an index for different sectors (firms), x is the sales (market share) of given sector (firm), and X is total firm sales (number of firms).

The entropy index is similar, except it includes an inverse weighting of the segment proportion to overall sales (firms); this increases the sensitivity of the index to smaller sales (firms): $\sum_i[\ln(X/x_i)(x_i/X)]$. See Jacquemin and Berry (1979) for additional details.

[xiii] See: BLS Standard Occupational Classification System: http://www.bls.gov/soc/, and the Occupational Statistics web page (http://www.bls.gov/oes/home.htm).

[xiv] Since our measures increase with concentration and decrease with diversification we sometimes use the term "measure of concentration" rather than diversification.

[xv] Blinder's index includes 817 SOC codes, 18 of which are subdivisions of actual codes. To be consistent with the other indices, we re-merged these codes, taking the average of their Blinder index values for the meta-occupation index value. Furthermore, the 533 codes that he considers highly non-offshorable are each given the index value of 24, given that Blinder does not calculate specific values for them individually to expedite his analysis.

[xvi] We would like to thank Brad Jensen and Lori Kletzer for providing us their list of tradable occupations.

[xvii] The results for the two other measures are similar and not reported in the table.

[xix] See Appendix 1 and 2. There is a significant correlation between the concentration measures and the numbers employed in occupation: -0.16. In other words, the result might be reflecting just another mathematical peculiarity or example of the general trade-off between large, mature entities and their smaller percentage changes. Also, shocks are of finite size and hence can be expected to impact smaller occupations disproportionately; in other words, we might have a "strength in numbers" argument here.

[xx] We do not report our results using occupational employment numbers as an instrument for diversification (more diversified occupations are also ones employing large numbers); the results are qualitatively unchanged.

[xxi] It is understandable that neither the BK dummy nor the Blinder index are significant; our dependent variable after all is not job loss but volatility, a different measure of "vulnerability" and "riskiness" of an occupation.

[xxii] We construct a Herfindahl measure for this older database with data from the year 1998. This database contains 280 occupations, less than half the 703 occupations that we identify in our 1999-2005 sample.

[xxiii] The BK variable is significant to the 10 percent level in column 4, but loses it after accounting for occupational group dummies.