The Effect of Migration on Wages:
Evidence from a Natural Experiment

By DAKSHINA G. DE SILVA, ROBERT P. MCCOMB, YOUNG-KYU MOH,
ANITA R. SCHILLER, AND ANDRES J. VARGAS*

The objective of this paper is to estimate the effect of immigration on workers' earnings. For this purpose, we take advantage of the natural experiment provided by the abrupt increase in the Houston-area population due to Hurricane Katrina. Unlike previous studies in this realm, and owing to the particular characteristics of this event, our model includes a measure of the demand for local goods and services.

David Card (2009) reviews the extensive literature on the effects of immigration on native populations' labor market outcomes. While there is little evidence that relative wage rates fall significantly as a direct consequence of immigration, none of these studies explicitly accounts for simultaneous shifts or exogenous shocks in demand. A geographically proximate catastrophic hurricane and resultant large scale in-migration, as observed in Houston at the end of 2005, clearly imply a proportionate increase in demand for certain imperfectly localized goods and services. In contrast, demand for production that is largely exported from the local economy and which trades in national or international markets will not be specifically affected by local or even regional demand shocks. There is thus a change in demand, attributable to the event, only for localized goods and services. This then implies an asymmetric response across the local industrial landscape in terms of the induced demand for labor services.

Based on Current Population Survey (CPS) data for November 2005 through August 2006, Molly F. McIntosh (2008) reports estimates that the evacuation resulted in a 3.1 percent increase in the population of the Houston metropolitan area. Most of the evacuees that remained in Houston one year later were younger and less educated than existing residents. Given the characteristics of the evacuees, their influx would have caused the supply of applicants for lower skilled jobs to increase proportionately more than for higher skilled jobs.

Katrina evacuees who remained outside the storm impacted area were provided with both financial and in-kind assistance as the circumstances in New Orleans, in particular, limited possibilities for their early return.[1] Given financial support and a reduced urgency to enter the labor market, demand-side effects in labor markets may have preceded the supply-side effects due to the in-migration. Therefore, this study attempts to account for these demand-side influences by proxy. Actual statistical identification of the separate labor market supply and demand shifts is not possible due to data limitations. However, using sales tax data, we observe changes in the levels of final taxable sales. To the extent that initial effects in output markets are assumed to come from the demand side, the observed change in sales would reflect movement along the firms' supply curves and

[1] Jeffrey A. Groen and Anne E. Polivka (2008) report that 42.4 percent of nonreturnees received some form of governmental assistance.

suggest a proportionate and exogenous change in demand for labor services.

We utilize a differences-in-difference-in-differences (DDD) methodology in which we compare the pre- and post-storm differences between average quarterly wages for workers in the low and high skill industries, by establishment, in the Houston and Dallas-Fort Worth Metropolitan Statistical Areas (MSAs).[2] Using Dallas as a comparison group enables us to control for state specific and broader regional influences on the markets in the two subregions. We find evidence that the average quarterly wages of firms in low skill industries in Houston decreased by 0.7 percent relative to firms in high skill industries when compared to the same group of industries in Dallas before and after the hurricane. Our findings also suggest that the magnitude of this effect depends on the level of sales per firm and that failure to account for demand-side influences following the in-migration produces misleading results.

A theoretical reservation may be that real sales of localized goods and services are endogenous. Separating the endogenous from the exogenous component in the observed shift in demand is beyond the scope of this paper. While we cannot rule out endogenous effects, we can state confidently that a hurricane is exogenous and most evacuees to Houston had little choice in destination. We take the position that, at least in Houston in the aftermath of Katrina, there is a clear rationale for controlling for exogenous output market demand shocks due to the hurricane. Therefore, taking demand-side effects into account is essential when searching for the immigration's supply-side effects on wage rates and employment within this subset of industries.

I. Data and Initial Observations

We use two data sources. We obtained the Quarterly Census of Employment and Wages (QCEW) for Texas from the Texas Workforce Commission. The QCEW contains establishment level monthly employment and quarterly total wages for workers covered by unemployment insurance (UI). To proxy demand-side influences in labor markets, we use gross sales receipts of nontradable goods industries collected from the Texas Comptroller of Public Accounts. The unit of observation in the sales data is quarterly gross sales by industry at the four-digit NAICS for a given county.

The period of the DDD analysis is from the first quarter of 2004 through the fourth quarter of 2007. We exclude all tradable goods industries, industries that are not common to both Houston and Dallas, and self-employed workers. Our selection of nontradable goods industries is based on the work of Bradford J. Jensen and Lori G. Kletzer (2005). They estimate Gini coefficients of geographic concentration for each industry at the Metropolitan Statistical Area level. They categorize industries with a Gini coefficient below 0.1 as nontradable and industries with a Gini coefficient greater than or equal to 0.1 as tradable. The low skill sector comprises 27 industries with a total of 14,662 establishments and 487,894 workers in Houston and 17,028 establishments and 539,182 workers in Dallas. In the 55 industries that constitute the high skill sector, Houston has 16,057 establishments with 721,255 workers, and Dallas has 18,188 establishments with 774,740 workers.

Figures 1 and 2 present the density functions of the log of real average quarterly wages for low and high skill industries in Houston and Dallas before and after August 2005.[3] We refer to the ratio of real average quarterly wages in the low skill industries relative to the high skill industries as relative average quarterly wages. Figure 1 shows that average quarterly wages for Houston-area low skill industries shifted left (declined) while high skill wages remained unchanged after Hurricane Katrina. It also suggests that the distributional shift for low skill industries can be observed for all ranges of wages. In contrast, Figure 2 shows that Dallas average quarterly wages for both low and high skill industries exhibited a slight rightward shift, indicating that relative wages have remained roughly unchanged since August 2005. Together, Figures 1 and 2 suggest that relative average quarterly wages declined in Houston but not in Dallas after Hurricane Katrina.

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[2] References to Houston and Dallas in this paper are intended to refer to the respective MSAs, not to the municipalities.

[3] Average quarterly wages represent the establishment-level total wage bill during the calendar quarter divided by the average monthly employment of the establishment during the quarter.
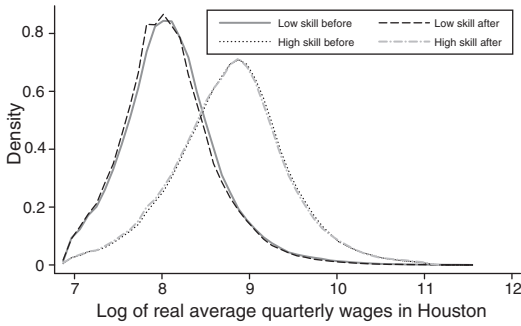
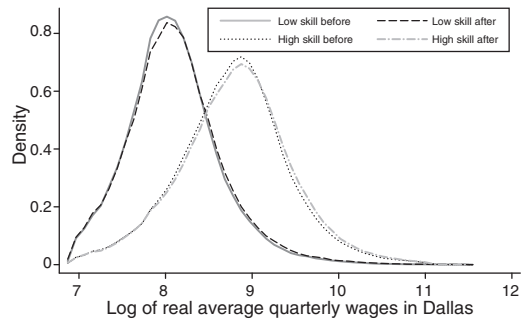FIGURE 1. AVERAGE QUARTERLY WAGE DISTRIBUTIONS FOR HOUSTON MSA

FIGURE 2. AVERAGE QUARTERLY WAGE DISTRIBUTIONS FOR DALLAS MSA

II. Empirical Model and Estimation Results

The much greater in-migration of low skill workers into Houston should have led to a greater decline in relative average quarterly wages in Houston than in Dallas-Fort Worth. This effect might vary according to the demand for goods and services that the firm faces, as proxied by the level of sales per firm in the industry to which the firm belongs. The DDD estimation procedure can be summarized in the following reduced form wage equation:

$$(1) \quad w_{imt} = \varphi_i + \alpha'_1 H_m + \alpha'_2 L_i + \alpha'_3 (H_m L_i)$$
$$+ \beta'_1 A + \beta'_2 (H_m A) + \beta'_3 (A L_i)$$
$$+ \beta'_4 (H_m A L_i) + \beta'_5 E_{imt}$$
$$+ \beta'_6 (E_{imt} L_i) + \beta'_7 S_{imt}$$
$$+ \beta'_8 (S_{imt} H_m) + \beta'_9 (S_{imt} L_i)$$
$$+ \beta'_{10} (S_{imt} H_m L_i)$$
$$+ \beta'_{11} (S_{imt} A)$$
$$+ \beta'_{12} (S_{imt} H_m A)$$
$$+ \beta'_{13} (S_{imt} A L_i)$$
$$+ \beta'_{14} (S_{imt} H_m A L_i) + \varepsilon_{imt}.$$

where w_{imt} is the log of the real average quarterly wage of establishment i in metropolitan area m at time t, φ_i controls for establishment level fixed effects, H_m, A and L_i are indicators for the

Houston MSA, the post-Katrina period, and the low skill sector, respectively. In addition, E_{imt} is the average employment of the establishment relative to the average employment of the industry in the county in a given quarter, and S_{imt} is the log of the industry sales per firm. Lastly, ε_{imt} is the random error term.

Note that we are interested in examining the change in establishment level average quarterly wages. We use a fixed effects estimation technique to examine the within establishment variation, controlling for establishment level unobservable heterogeneities. We estimate the fixed effects model using two different samples: (i) only firms in existence both before and after Hurricane Katrina, and (ii) all the firms in the sample regardless of their entry or exit date. In order to observe the effect of allowing for a differential impact of the in-migration according to the level of sales, we estimate the fixed effects regressions with and without the sales per firm interactions.

Table 1 reports results of the establishment level fixed-effects estimation of equation (1) using clustered standard errors at the establishment level. Columns 1a and 2a include interactions of sales per firm, whereas columns 1b and 2b do not. The β_4 coefficient compares the difference in average quarterly wages in the low skill firms in the Houston and Dallas MSA counties before and after the population influx generated by Hurricane Katrina to the same difference for the set of high skill firms. The β_{14} allows for the previous effect to vary with the level of sales per firm.

In the specifications that include the sales per firm interactions, most of the coefficients

Table 1—Regression Results for Log of Real Average Quarterly Wages

	Before and after firms		All firms	
	With sales (1a)	Without sales (1b)	With sales (2a)	Without sales (2b)
After Hurricane Katrina (β_1)	−0.005 (0.008)	0.007*** (0.002)	−0.004 (0.008)	0.007*** (0.002)
Houston × after Hurricane Katrina (β_2)	0.080*** (0.013)	0.016*** (0.003)	0.079*** (0.013)	0.016*** (0.003)
After Hurricane Katrina × low skill (β_3)	0.017 (0.018)	−0.018*** (0.002)	0.018 (0.018)	−0.018*** (0.002)
Houston × after Hurricane Katrina × low skill (β_4)	−0.110*** (0.026)	−0.005 (0.004)	−0.112*** (0.026)	−0.005 (0.004)
Employment ratio (β_5)	−0.630*** (0.067)	−0.627*** (0.067)	−0.667*** (0.063)	−0.663*** (0.063)
Employment ratio × low skill (β_6)	−0.398*** (0.116)	−0.408*** (0.116)	−0.420*** (0.111)	−0.429*** (0.111)
Sales per firm (β_7)	0.045*** (0.002)	0.032*** (0.001)	0.044*** (0.002)	0.032*** (0.001)
Sales per firm × Houston (β_8)	−0.015*** (0.003)		−0.013*** (0.002)	
Sales per firm × low skill (β_9)	−0.018*** (0.003)		−0.017*** (0.003)	
Sales per firm × Houston × low skill (β_{10})	0.014** (0.005)		0.013** (0.005)	
Sales per firm × after Hurricane Katrina (β_{11})	0.001 (0.001)		0.001 (0.001)	
Sales per firm × Houston × after Hurricane Katrina (β_{12})	−0.005*** (0.001)		−0.005*** (0.001)	
Sales per firm × after Hurricane Katrina × low skill (β_{13})	−0.003 (0.001)		−0.003 (0.001)	
Sales per firm × Houston × after Hurricane Katrina × low skill (β_{14})	0.009*** (0.002)		0.009*** (0.002)	
Observations	1,051,812	1,051,812	1,254,407	1,254,407
Adjusted R^2	0.853	0.853	0.853	0.853

Note: Robust clustered standard errors at the establishment level are in parentheses.
 ***Significant at the 1 percent level.
 **Significant at the 5 percent level.

are statistically significant at conventional levels. Only the coefficients for the dummies that control for the change in the average quarterly wages of high and low skill firms in Dallas after Hurricane Katrina (β_1, β_3, β_9, and β_{13}) are statistically insignificant. It is important to note that there are no significant differences in the results between the regressions that include all the firms in the sample and those that include only firms in existence both before and after hurricane Katrina.

The net effect of the Katrina-induced migration on Houston area wages is given by $\beta_4 + \beta_{14} \times S_{imt}$. Table 2 illustrates this effect at different points on the distribution of sales per firm. Evaluated at its average level, we find a statistically significant 0.7 percent drop in the average quarterly wages of low skill establishments in Houston relative to the change for the same group of industries in Dallas and relative to the corresponding change in the high skill industries. The effect is both negative and greater

TABLE 2—EFFECT ON RELATIVE AVERAGE QUARTERLY WAGES BY LEVELS OF SALES PER FIRM

Percentile	Log sales per firm	Effect (percent)	SE	$P > |t|$	95 Percent confidence interval	
10	9.27	−3.1	0.007	0.00	−4.5%	−1.7%
20	10.98	−1.6	0.004	0.00	−2.5%	−0.8%
30	11.90	−0.9	0.004	0.02	−1.6%	−0.1%
Mean	12.08	−0.7	0.004	0.05	−1.4%	0.0%
50	12.38	−0.4	0.004	0.21	−1.2%	0.3%
70	13.15	0.2	0.004	0.61	−0.6%	1.0%
80	13.54	0.5	0.005	0.23	−0.3%	1.4%
90	14.13	1.0	0.005	0.05	0.0%	2.1%

in magnitude for levels of sales per firm below the median, statistically insignificant for levels of sales per firm between the median and the eightieth percentile, but positive and statistically significant for levels of sales per firm above the ninetieth percentile. The coefficient β_{14} indicates that a ten percent increase in the level of sales per firm reduces the magnitude of the decline in relative average quarterly wages by 0.1 percentage points. Finally, the fact that the DDD coefficient β_4 becomes statistically insignificant if we fail to interact it with the sales per firm variable, as shown in columns 1b and 2b, highlights the importance of including the proxy for demand for location specific goods and services.

Figure 1 illustrates that the distribution of average quarterly wages for low skill industries in Houston shifted left for all ranges of wages. This basic observation can be usefully analyzed using a quantile regression model. We restrict the estimation to three quantiles: 0.25, 0.50, and 0.75. The analysis employs the specification described in equation (1) but with industry rather than establishment level effects. The results are similar to those obtained in the conditional-mean model.

Finally, to investigate whether Houston was already experiencing a downward trend in relative average quarterly wages around the evacuation period, either in absolute terms or relative to Dallas, we estimate the reduced form wage equation using only establishment level data from the pre-Hurricane Katrina time period. The model includes an overall trend term interacted with indicator variables for Houston and the low skill sector. The estimated trend terms point to a general decline in real wages for low skill industries but no change in real wages for high skill industries at the establishment level in both Houston and Dallas. However, the trends for both the high skill and low skill industries are not statistically different between the two regions. Hence, we conclude that prior to Hurricane Katrina, relative average quarterly wages in Houston were not trending downward compared to Dallas.

III. Conclusions

The objective of this paper was to estimate the effect of immigration on workers' earnings. Using a DDD methodology, we find evidence that, evaluated at the average sales per firm, the relative average quarterly wages in Houston decreased by 0.7 percent compared to the same group of industries in Dallas following the abrupt in-migration to Houston. Our results also indicate that a ten percent increase in the level of sales per firm diminishes the magnitude of the reduction in relative average quarterly wages by 0.1 percentage points. Given an inelastic demand for low skilled labor (cf. Daniel Hamermesh 1993), these estimates represent only a lower bound of the actual effect on hourly wages in the low skill nontradable goods industries. Lastly and importantly, the same DDD becomes statistically insignificant if we fail to include a proxy for demand-side effects.

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