NBER WORKING PAPER SERIES

EXCHANGE RATES AND LOCAL LABOR MARKETS

Linda Goldberg
Joseph Tracy

Working Paper 6985
http://www.nber.org/papers/w6985

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 1999

Jenessa Gunther and Henry Schneider provided valuable research assistance. We appreciate the useful comments of Andrew Rose, Jane Little, Jose Campa, and participants of the NBER Conference on Trade and Wages in Monterey CA, February 1998. The views expressed in this paper are those of the authors and do not reflect those of the National Bureau of Economic Research, the Federal Reserve Bank of New York, or the Federal Reserve System.

Exchange Rates and Local Labor Markets
Linda Goldberg and Joseph Tracy
NBER Working Paper No. 6985
February 1999
JEL No. F31, F3, F4, J30, E24

ABSTRACT

We document the consequences of real exchange rate movements for the employment, hours, and hourly earnings of workers in manufacturing industries across individual states. Exchange rates have statistically significant wage and employment implications in these local labor markets. The importance and size of these dollar-induced effects vary considerably across industries and are more pronounced in some U.S. regions. In addition to the importance of exchange rate shocks, we confirm prior research results showing that relatively strong local conditions drive up wage in local industries, while anticipated future (positive) local shocks reduce current wages.

Linda Goldberg
Federal Reserve Bank of NY
Research Department
33 Liberty St.
New York, NY 10045
and NBER
Linda.Goldberg@ny.frb.org

Joseph Tracy
Federal Reserve Bank of NY
Research Department
33 Liberty St.
New York, NY 10045
and NBER
Joseph.Tracy@ny.frb.org

I. Introduction

With the increased internationalization of the U.S. economy, the implications of dollar movements for workers has emerged as a pressing question. A literature has developed that considers this and related themes. First, the exchange-rate pass-through literature discusses the degree to which prices of goods -- whether exported, imported, or produced domestically for home consumption -- are influenced by exchange rates. In the United States export prices tend to be fairly stable in dollar terms. Import prices appear to be more responsive to exchange rates movements, but this responsiveness varies considerably across types of goods and across trading partners. Import-competing products show much smaller elasticities of response to exchange rates.[1] Exchange rates also matter for producer profitability, and for decisions about capital spending and employment. Industry features –such as their trade orientation and competitive structure -- scale the importance of these exchange rate effects.[2]

The labor market effects of exchange rates are an open question. For the United States, analyses using data through the mid-1980s show that exchange rates have had significant implications for wages (Revenga 1992) and for employment across manufacturing industries (Branson and Love 1988).[3] A recent cross-country, cross-industry study by Burgess and Knetter (1996) found statistically significant effects of exchange rates for employment, with the size of these effects related to industry characteristics such as competitive structure.

However, recent work by Campa and Goldberg (1998) found weaker implications of exchange rates for employment in U.S. industries, but more pronounced effects for wages. This study used a longer time series than previous empirical work (about twenty-five years of annual data) and focussed on two-digit industry employment, wages, overtime activity and overtime wages. The testing methodology allows for exchange rate transmission channels to vary over time with industry trade exposures to exchange rates through both revenues and

---

[1]See Goldberg and Knetter (1997) for a survey. The distribution of exchange rate elasticities of the set of United States import prices thus far examined appears to be centered around 0.5, but the set of goods studied is by no means exhaustive.

[2]See Clarida (1997) and Sheets (1996) on profitability and exchange rates. Campa and Goldberg (forthcoming) show that investment spending is time-varying in accordance with the export and imported input orientation of producers across various industries and across countries and is strongest in industries with low price-over-cost markups (which can be viewed as closer to perfectly competitive market structures).

costs. Exchange rate effects were statistically significant mainly for wages, and strongest in industries that are more trade oriented and in industries that generally have lower profit margins.

The combination of significant wage responsiveness to exchange rates, without comparable employment effects poses some interesting questions. One possible reconciling argument is that a dollar appreciation, for example, could lead workers to lose their jobs, but then be re-employed at lower wages within the same broad industry group but in a different narrower industry definition. Such findings would be consistent with observed patterns of labor force adjustment to oil price shocks (Davis and Haltiwanger, 1997). If this is the case, a related question is whether workers take new positions in a similar industry within a local labor market, or if they look for opportunities in a similar industry elsewhere in the country. Employment changes can entail worker relocation as well as the type of wage adjustments from moving within and across manufacturing industries that have been detailed by Revenga (1992). Another argument is that under adverse employment conditions from a dollar appreciation, for example, workers may engage in less on-the-job search for better paying jobs.[4] Under these conditions, one might observe relatively stable employment with magnified wage restraint. By unraveling these issues, we hope to better understand the degree of labor market disruption associated with dollar fluctuations.

The present paper examines more than two decades of data on average hourly earnings, hours, and employment for 2-digit industries located within the individual states of the United States. This approach has several advantages over prior studies. First, since the trade orientation of industries varies by industry location, we are able to better identify the magnitude of currency shocks hitting local industries. Second, we are able to consider the spillovers of exchange rate effects across local industries. From a local labor market perspective, such spillovers may help explain the magnified wage responses and reduced employment sensitivity to exchange rates. Third, by examining state-level data, we capture

[3]Examining the 1970s into the early 1980s, Branson and Love estimate that durable goods producers had jobs were most responsive to exchange rates. Using Revenga's computed elasticities, the estimated effects on jobs are increasing gradually to the extent that import competition exists in an industry.

[4] See Mortensen (1986) for a discussion of on-the-job search models.

the adjustments made by workers who might move across state lines, yet remain within the same broad industry.

We find that real exchange rates contribute significant explanatory power to regressions on average hourly earnings, hours, and employment. In pooled industry regressions, dollar appreciations (depreciations) are associated with small but statistically significant declines (increases) in hourly earnings by workers. In individual industry regressions, we observe significant variability across industries in the levels of these earnings implications and even in the sign of these effects. Moreover, even within individual industries, some regions are particularly sensitive to dollar movements. Cross-industry spillovers, which we interpret as providing an indirect means of worker exposure to exchange rates, are significant for average hourly earnings and for employment within high-markup industries.

In contrast with results drawn from nationally-aggregated data for industries, the state-level data exhibit more pronounced responsiveness of employment and hours worked within industries. On balance, dollar appreciations (depreciations) are associated with employment declines (increases) for high- and low- profit-margin industry groups. As industries increase their export orientation, the adverse consequences of appreciations for employment also increase. However, some of these adverse consequences are counteracted as industries increase their reliance on imported inputs. Both forces are significant in determining the employment effects of exchange rates, and they differ qualitatively and quantitatively across regions and across industries.

Finally, our analysis also focuses on and confirms the type of dynamic patterns of adjustment in local labor markets previously reported by Topel (1986). Using Topel's methodology, we construct state- and industry-specific relative demand shocks, both actual and anticipated. Similar to Topel's finding using micro date, we find that wages increase in response to current relative demand shocks and decrease in response to expected future relative demand shocks.

II. The Theory

Our theoretical set-up pairs a model of dynamic labor demand and exchange rate exchange rate exposure (Campa and Goldberg 1998) with a dynamic local labor supply specification. The theory shows clear reasons why industries should be differentially affected by exchange rates. One reason is that industries differ in trade orientation. But, even controlling for these differences, exchange rate effects on wages and employment should vary across industries depending on: (*i*) the industry product demand elasticity at home and abroad; (*ii*) the initial labor share in production; and (*iii*) the elasticity of labor supply facing the industry in that locality. Industries with high labor demand elasticity with respect to wages will exhibit more employment response and less wage response to exchange rate movements.

Each industry within each locality (defined as a state in our data) can experience shocks that alter its wages directly or indirectly. *Direct effects* of exchange rates arise through own-industry trade orientation. *Indirect effects* arise through spillovers across local industries via expected alternative wages. Local unemployment rates are important since they influence the probability that a worker will be able to find a job that offers the alternative wage. Some shocks can change the current or future attractiveness of an entire locality and lead to labor supply shifts through in- or out-migration, as in Topel (1986).

Controlling for direct and indirect effects of exchange rates could help identify the separate channels for wage and employment responsiveness. For example, if an industry is export-oriented, in general a dollar appreciation is expected to reduce the competitiveness of its products, and as a consequence place downward pressure on industry wages and lead to layoffs. However, if other local industries also are export-oriented, the dollar appreciation can lower the alternative wage available to workers and locally expand the labor supply to the initial industry. The offsetting direction of movement in labor demand and labor supply to the industry may lead to magnified wage effects and muted employment effects.

A. Exchange Rates and Labor Demand: We begin with profit maximizing producers who sell to both domestic and foreign markets. Producers make decisions in a dynamic and uncertain environment, and consider the future paths of all variables influencing their profitability. The unknowns for the producer are aggregate demand in domestic and foreign markets, y and y^*, and the exchange rate, e, defined as domestic currency per unit of foreign exchange. Production uses three factors: domestic labor L, other domestic inputs Z, and imported inputs, Z^*. Respective factor prices are denoted by w, s, and es^*. Labor is a homogeneous input into production and levels of non-labor inputs can be adjusted in the short-run without additional costs.

Producers optimize over levels of factor inputs and total output in order to maximize expected profits, π, (equation 1) subject to the constraints posed by the production function (equation 2) and product demand conditions in domestic and foreign markets (equation 3). Revenues arise from domestic market sales, q, and foreign market sales, q^*. In both markets, the exchange rate influences demand by altering the relative price of home products versus those of foreign competitors. The exchange rate also directly enters costs through the domestic price of imported inputs.

$$\pi(y_t, y^*_t, e_t) = \max_{Q_t, L_t, Z^*_t, Z} \sum_{t=0}^{\infty} \phi_t \begin{bmatrix} p(q_t : y_t, e_t) q_t \\ + e_t p^*(q^*_t : y^*_t, e_t) q^*_t \\ - w_t L_t - e_t s^*_t Z^*_t - s_t Z_t \\ - c(\Delta L_t) \end{bmatrix} \tag{1}$$

subject to $Q = q + q^*$, $Q = L^{\beta} Z^{*\alpha} Z^{1-\alpha-\beta}$, (2)

and $p(q : y, e) = a(y, e) q^{-1/\eta}$ and $ep^*(q^* : y^*, e) = a^*(y^*, e) q^{*-1/\eta^*}$ (3)

The time discount factor is defined by $\phi_t = \prod_{\tau} \delta^{\tau}$. In equations (2) and (3) we have dropped the period t time subscripts for convenience.[5] A Cobb-Douglas production structure is assumed for simplicity, but our main results also will hold under a more general CES production structure. In equation (3) the parameters η and η^* are the domestic and foreign product demand elasticities facing producers. The demand curves in domestic and foreign

[5] A Cobb-Douglas production structure is assumed for simplicity, but our main results also will hold under a more general CES production structure.

markets include multiplicative demand shifters, $a(y,e)$ and $a^*(y^*,e)$, which capture the influence of real income differences across markets and exchange rates.

It is assumed that an industry's labor input L is costly to adjust. We assume quadratic adjustment costs that are proportional to the prevailing wage in the industry (equation 4). The parameter b allows for additional industry variation in the cost of adjusting employment levels.

$$c(\Delta L_t) = w_t \frac{b}{2}(L_t - L_{t-1})^2 \qquad (4)$$

Following Nickell (1986), the solution of this optimization problem is a dynamic equation for optimal labor demand, where labor adjusts toward a target level $\tilde{L}$ that would be optimal in the absence of adjustment costs. The speed of adjustment of labor demand to $\tilde{L}$, (1-μ), is reduced when industries face high adjustment costs, b, and have low wage sensitivity of marginal revenue product. Nickell shows that labor demand in any period can be approximated by

$$L_t = \mu L_{t-1} + (1-\mu)(1-\delta g \mu)\sum_{j=0}^{\infty}(\delta g \mu)^j \tilde{L}_{t+j} \qquad (5)$$

where g is the rate of real wage growth for an industry. Solving the optimal labor problem of equations (1) to (4), Campa and Goldberg (1998) show that the labor demand target $\tilde{L}$ is sensitive to exchange rates, with the effects of exchange rates transmitted through three separate channels – revenues from home market sales, revenues from foreign market sales, and costs of imported inputs into production. The elasticity of response of $\tilde{L}$ to exchange rates is

$$\frac{\partial \tilde{L}}{\partial e} \Big/ \frac{\tilde{L}}{e} = \frac{1}{\beta}\begin{pmatrix} p(\cdot)(1+\eta^{-1})\eta^{pe} + \chi\left(ep^*(\cdot)(1+\eta^{*-1})(1+\eta^{p^*e}) - p(\cdot)(1+\eta^{-1})\eta^{pe}\right) \\ -\alpha e s^*(\partial Q/\partial Z^*)^{-1} \end{pmatrix} \qquad (6)$$

where $\chi^i = p^{*i}q^{*i}/(p^i q^i + p^{*i}q^{*i})$ represents the share of export sales in revenues, and η^{pe} and η^{p^*e} are domestic and foreign price elasticities with respect to exchange rates. Observe that the three groups of terms on the right-hand side of equation (6) correspond to the three exposure channels: the sensitivity to exchange rates of labor demand through revenues from domestic sales, revenues from foreign market sales, and the costs of productive inputs. By invoking basic relationships on exchange-rate pass-through elasticities and ex-ante law of one price, we rewrite this relationship as:

$$\frac{\partial \tilde{L}}{\partial e} \Big/ \frac{\tilde{L}}{e} = \frac{p}{\beta}\left(\left(1+\eta^{-1}\right)kM + \left(1+\eta^{*-1}\right)\chi - \left(\partial Q/\partial Z^{*}\right)^{-1}\alpha\right) \tag{6'}$$

Equation (6') clearly shows the three channels and industry features which magnify or reduce the degree of industry response to exchange rate movements. First, more import penetration of domestic markets (*M*) increases the sensitivity of labor demand to exchange rates by increasing the price competitiveness of foreign goods. Second, more export-orientation (χ) increases the sensitivity of labor demand to exchange rates, since export revenues are relatively more responsive to exchange rates. Third, greater reliance on imported components (higher α) can offset or even reverse the adverse consequences of a stronger currency (for example) on industry labor demand. Fourth, more labor intensive production (i.e. high β) is associated with reduced sensitivity of labor demand to exchange rates. Finally, industries characterized by greater competition among firms (with low η or η*) are expected to have labor demands that are more sensitive to exchange rates.

Using equations (5) and (6'), and introducing log-linearized terms for domestic and foreign aggregate demand conditions, we generate the following reduced form for optimal labor demand by an industry.[6]

$$L_t^i = \mu^i L_{t-1}^i + \left(1-\mu^i\right)\begin{pmatrix} c_0 + c_1 y_t + c_2 y_t^* + \left(c_{3,0} + c_{3,1}\chi^i + c_{3,2}M^i + c_{3,3}\alpha^i\right)e_t \\ + c_4 w_t^i + c_5 s_t + c_6 s_t^* \end{pmatrix} \tag{7}$$

where all variables other than χ, *M*, and α are defined in logs.[7] All variables and parameters are specific to an industry except for y_t and y_t^*.[8] Within an industry, state or regional differences in labor demand may arise from local differences in trade exposures.

6 Changes in foreign currency input costs through foreign wages are absorbed into the α term.

B. Labor Supply: Our approach to labor supply focuses on the behavior of forward-looking workers in a local labor market. These workers choose their labor supply to an industry by considering the wages offered by that industry relative to the alternative wage (as offered locally by other industries). Local labor supply also responds to both current and expected future local demand conditions, all relative to conditions outside of the locality. As Topel (1986) demonstrates, these conditions can lead to in-migration or out-migration from an area.

A reduced form representation for labor supply to an industry *i* in a locality *r* is

$$L_t^{ir} = a_1^r + a_2^i\left(w^{ir}{}_t - \hat{w}^{ir}{}_t\right) + a_3^r y^r{}_t \tag{8}$$

where $y^r{}_t$ is a vector of terms for local relative conditions (current relative strength of the locality, and expected future relative strength), and $\hat{w}^{ir}$ is the alternative wage in industries outside of industry *i* in the locality.[9] Exchange rates can shift the labor supply curve facing an industry in a locality through their impact on the alternative wage, with the magnitude of the shift depending on the trade orientation of the other local industries, $\overline{X}^{ir}$.[10] The likelihood that industry *i* workers could get this alternative wage depends on the tightness of local labor markets. We proxy this tightness as inversely related to the local unemployment rate $Unemp^r$. So, $\hat{w}^{ir}{}_t \approx a_4^r{}'\overline{X}^{ir}e_t + a_5^r{}'Unemp^r{}_t$, and we write the new reduced form equation for labor supply as:

$$L^{ir}{}_t = a_1^r + a_2^i w^{ir}{}_t + a_3^r y^r{}_t + a_4^r \overline{X}^{ir} e_t + a_5^r Unemp^r{}_t \tag{9}$$

[7] The actual parameters on the shocks introduced in our equation (7) depend on the perceived degree of permanence of the shock. A shock that is transitory will have a much smaller impact on labor demand than a shock that is viewed as permanent.

[8] Real bilateral exchange rates all are exogenous to an industry. These bilateral exchange rates with currencies of individual countries are weighted differently for each industry, depending on the importance of a country as the industry's trading partner.

[9] Labor supply is upward sloping in an industry's wage if there is heterogeneity in the workforce, either in terms of preferences for industry job attributes or mobility costs.

[10] The alternative wage should be viewed as an equilibrium alternative wage, so that it ---in fact--- would be a function of all of the variables that shift labor demand (as shown in equation 7). Introducing this full set of terms at this point would complicate notation and have no bearing on our ultimate estimation structure or our interpretation of the exchange rate channels. The existence of these other terms would matter for the interpretation on coefficients on the domestic and foreign income and factor price terms in the regressions if one were to attempt a semi-structural interpretation of these coefficients.

for industry *i* in a state / region *r*.

C. Labor Market Equilibrium: Setting labor demand by a local industry (equation 7) equal to local labor supply (equation 9) yields equations in industry employment and wages:[11]

$$\begin{aligned} w_t^{ir} = {} & \omega_0^{ir} + \omega_1^i y_t + \omega_2^i y^*_t + \omega_3^i s_t + \omega_6^{ir} Unemp^r{}_t \\ & + \left(\omega_{5,0}^i + \omega_{5,1}^i X^i + \omega_{5,2}^i M^i + \omega_{5,3}^i \alpha^i + \omega_{5,4}^{ir} \overline{X}^{ir}\right) \cdot e_t + \omega_6^i y^r{}_t + \omega_7^i L^i{}_{t-1} \end{aligned} \quad (10a)$$

$$\begin{aligned} L^{ir}{}_t = {} & \lambda_0^{ir} + \lambda_1^i y_t + \lambda_2^i y^*_t + \lambda_3^i s_t + \lambda_4^{ir} Unemp^r{}_t \\ & + \left(\lambda_{5,0}^i + \lambda_{5,1}^i X^i + \lambda_{5,2}^i M^i + \lambda_{5,3}^i \alpha^i + \lambda_{5,4}^{ir} \overline{X}^{ir}\right) \cdot e_t + \lambda_6 y^r{}_t + \lambda_7^i L^i{}_{t-1} \end{aligned} \quad (10b)$$

Equations (10a) and (10b) form the basis for our tests of exchange rate and local demand effects on the labor market of industry *i* operating in region *r*. The wage and employment response in an industry to local shocks depends on the elasticities of labor demand and supply, as well as the costs of adjusting employment in that industry. When labor demand or supply curves are steep – indicating low employment sensitivity to wages -- shocks to either demand or supply lead to relatively less employment response and more wage response. When industries have high labor force adjustment costs, the short-run shift in labor demand in response to any given shock is smaller. Given an industry's trade orientation, a more concentrated (and less competitive) industry will experience a smaller labor demand shift from any given shock.

The effects of a dollar depreciation on wage and employment in a particular industry are illustrated in Figure 1. For an industry with primary external orientation through its export sales, a dollar depreciation increases labor demand. In the absence of a labor supply shift, labor market equilibrium moves from point A to point B. The *direct effects* of the depreciation are expanded employment and higher wages in the industry. Yet, if *other* local industries are also trade-oriented, labor supply to industry *i* might contract if alternative wages rise in those other industries. The decline in labor supply to industry *i* because of the exposure of other local industries moves the equilibrium to point C or point D. These indirect effects can be moderate (point C), so that local-

[11] The coefficients on the interacted exchange rate terms are interpreted in relation to the individual labor demand and labor supply equations in Campa and Goldberg (1998). The main difference between the current system of

labor-market spillovers mitigate some of the employment effect of the dollar depreciation but reinforce the wage effect. However, if the wages of other local industries are very sensitive to exchange rates, employment in the initial industry can be unchanged or even may contract (point D). A depreciation generally raises wages, provided that the dominant channels of industry exposure are through favorable revenue effects.

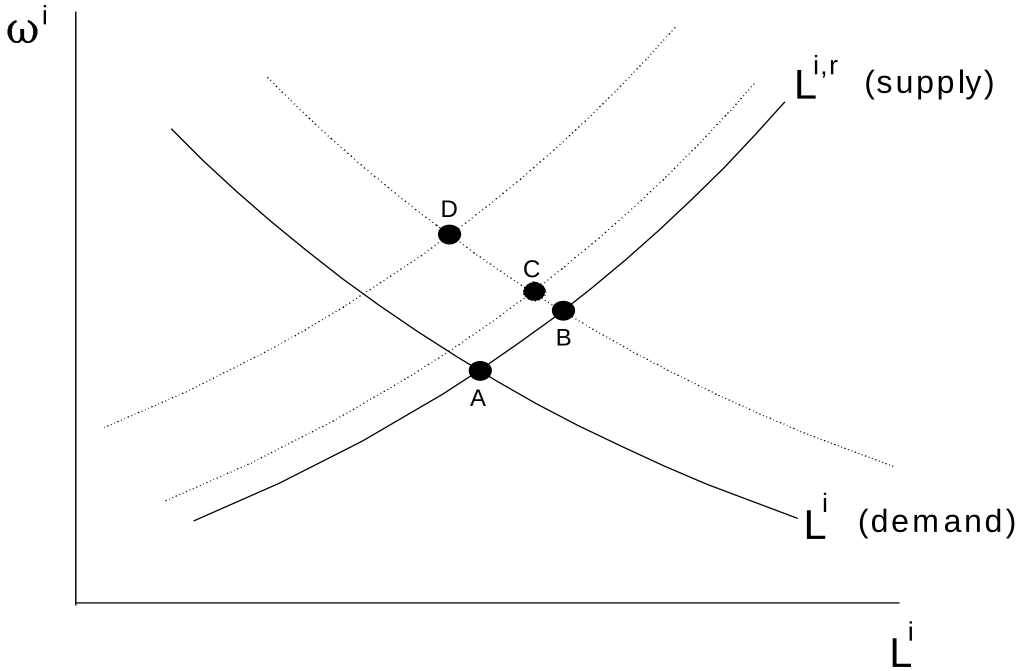


Figure 1: Local Labor Market Equilibrium for Industry *i*

III. Data

Labor market series. The dependent variables in our study are average employment, hours and wages from the Bureau of Labor Statistics (BLS) *Employment and Earnings* with all data disaggregated by 2-digit SIC industry. We consider the movements in the national data (as a means of generating a set of reference facts), as well as in data disaggregated by states and areas.[12] Firms are classified into industries based on their principal product using 1987 SIC

equations (10) and the prior paper is the inclusion of local labor market effects and the dynamic labor supply decision.

[12] This data is derived from the Current Employment Statistics survey that is sent out monthly to all employers with at least 250 workers and a random sample of smaller employers. See BLS, *Handbook of*

classifications. We exclude Alaska, Hawaii, and the District of Columbia from the state data. The data span 1971 through 1995.

The *employment data* capture all persons on establishment payrolls who received pay for any part of the pay period that includes the 12th day of the month. Proprietors, self-employed, unpaid volunteers and family workers, and domestic workers are excluded. Persons on paid vacation or sick leave are counted, as are workers who are unemployed or on strike for some but not all of the pay period. The *hours data* reflect hours paid, which may differ from scheduled hours or hours worked. Overtime hours and hours paid to workers on vacation or sick leave are included. Worker absenteeism and work stoppages cause paid hours to fall below scheduled hours and are not included.

The *earnings* data reflect average weekly earnings divided by average weekly hours. Workers who are not paid weekly have their earnings and hours expressed on a weekly basis. Earnings reflect payments for all workers who were on the payroll for any part of the pay period covering the 12th of the month. Gross payroll prior to deductions for social security, life insurance, tax withholding, and union dues is used. Overtime, holiday, and incentive pay as well as regular bonus payments are included, while non-regular bonus payments are excluded. Firm contributions to fringe benefits, such as health insurance and retirement accounts, are not included.

<u>Exchange rate series</u>. Our empirical work uses export and import real exchange rates for each industry. These industry-specific real exchange rates are constructed by weighting the bilateral real exchange rates of U.S. trading partners in accordance with the importance of these partners in industry exports or imports in each year. To convert nominal exchange rates into real series, the nominal measures are adjusted by the GDP deflators of the respective trade partners (*International Financial Statistics* data). The resulting real trade-weighted dollar exchange rates follow the empirical convention that an increase in the exchange rate corresponds to an appreciation of the dollar. *This convention is opposite that used in our theoretical section*.

Methods (1997) for details. This sampling implies that smaller employer response to stimuli may be less well captured by the data set.

We use industry-specific exchange rates, rather than a common trade-weighted measure, because these better reflect the actual shocks to individual industries. The industry-specific series are generally highly correlated with the overall real exchange rate for the United States (Appendix Table 1 provides correlation coefficients). However, for some industries the export exchange rates clearly are more similar to the aggregate real exchange rate measure than are the import exchange rates. The industry for which the export exchange rate is least correlated with the aggregate measure is Lumber and Wood Products, with a 0.63 correlation coefficient. On the import index side, the correlation coefficients between the industry exchange rates and the aggregate real exchange rate were as low as 0.36 for the Petroleum and Coal Industry, 0.50 for Paper and Allied Products, and 0.58 for Lumber and Wood Products. Therefore, our industry-specific series are most relevant for capturing industry-specific shocks to import-competitiveness or imported input providers.

Industry trade orientation series. In some regression specifications, we interact the real exchange rates with measures of industry export share and imported input share (Campa and Goldberg, 1997 constructions, based on U.S. Department of Commerce series and U.S. input-output tables). These industry series are not differentiated across states or regions of the United States.

We are able to perform such state differentiation for our export measures by using a shorter time series of export data reported by state of origin and by industry, compiled by the Massachusetts Institute for Social and Economic Research (MISER).[13] These series are only available by 2-digit SIC beginning in 1988. For our regressions, we take this information on the relative importance of exports to an industry in a state over this shorter time period, and use it to scale – at the state level -- the longer annual series on national export orientation numbers for each industry .

These state-specific data on industry exports make a powerful statement about the diversity of export-orientation of industries located in different areas of the United States. To demonstrate this point, Map 1 shows the degree of export orientation of production in each state, based on the MISER data.[14] The larger and heavily export-oriented areas include the Pacific region, Texas,

[13] Comparable numbers are not available for imported input share of industries by state.

[14] To construct this map we used MISER data on the export-orientation of manufacturing industries in each state, weighted these series by the importance of the specific industry within the state, and assumed a zero export share on

Florida, New York, Vermont, and the Carolinas. Indeed, according to these measurements, which use the value of exports to gross state product, Vermont is the most export-oriented state.

Map 2 shows the biased view of state-export orientation that would arise if one used national export shares for individual industries of individual states. This map presents the ratio of state export orientation as implied by the MISER data versus that implied by the overall national export shares of the industries.[15] A value greater than one on this map indicates that the export orientation of a state (based on MISER data) is greater than that implied using the national data on industry export orientation. The states with dark shading have the most understated export orientation when the national data on industry export shares is used; the states without shading have the most overstated export orientation from national series. For some states this misrepresentation can be enormous. The national aggregates vastly overstate the export orientation of manufacturing industries in the Mountain region and vastly understate the export orientation of various coastal and border areas.

Other data. Aggregate demand conditions are proxied by (the change in log) real GDP (IMF *International Financial Statistics*, line 99b). Other factor costs are captured by (the change in log) real oil prices (line 001) and the (change in log) 10-year T-bill rate deflated by the wholesale price index. The aggregate prime age male unemployment rate is our proxy for national labor market tightness. The state prime age male unemployment rate is our proxy for local labor market tightness.

Our regressions also include measures of local relative demand shocks. We use an adaptation of Topel's (1986) empirical methodology for measuring current and anticipated relative demand shocks to a local labor market. Like Topel, we use states as our definition of a local labor market. For each industry in a state we adjust the employment in the state by subtracting out the employment for that industry. The current relative demand shock for industry i in state r during year t measures the percent deviation of the adjusted state

---

output of non-manufacturing industries.

$$\left(\frac{\text{manufacturing GSP}}{\text{total GSP}}\right)\cdot\sum_j\left(\left(\frac{\text{state employment in industry j}}{\text{total state manufacturing employment}}\right)\cdot\left(\frac{\text{MISER exports}}{\text{industry j GSP}}\right)\right),$$

this measure is computed using data for each year between 1988 and 1994, and averaged over these seven years of data.

employment from its trend relative to the percent deviation of national employment from its trend in year *t* (see the appendix for details). This variable captures the extent to which the current local labor demand conditions deviate from labor demand conditions nationally.

We use the persistence of this measure of local relative demand shocks to control for future local relative demand shocks. We regress the current local relative demand shock measure for a given industry and state on its value lagged one and two years and on the current national demand shock measure. We use this estimated model to generate forecasts of future relative demand shocks to the locality. Our measure for anticipated future local relative demand shocks is a weighted average of the one, two, and three-year ahead forecasts.

IV. Empirical Results

A. Regression method. Starting with the basic forms of equations (10a) and (10b), we estimate the wage and employment equations in first differences using weighted-least-squares with lagged industry employment providing the weights. The estimation equations are

$$\Delta w_t^{ir} = \omega_0^{ir} + \omega_1^i \Delta y_t + \omega_2^i time + \Delta \omega_3^i s_t + \omega_6^{ir} \Delta Unemp^r{}_t + \left(\omega_{5,0}^i + \omega_{5,1}^i X^{ir} + \omega_{5,2}^i M^i + \omega_{5,3}^i \alpha^i + \omega_{5,4}^{ir} \overline{X}^{ir}\right) \cdot \Delta e^i{}_t + \omega_6^i \Delta y^{ir}{}_t + \omega_7^i \Delta L^i{}_{t-1} \tag{10a}$$

$$\Delta L_t^{ir} = \lambda_0^{ir} + \lambda_1^i \Delta y_t + \lambda_2^i time + \lambda_3^i \Delta s_t + \lambda_4^{ir} \Delta Unemp^r{}_t + \left(\lambda_{5,0}^i + \lambda_{5,1}^i X^{ir} + \lambda_{5,2}^i M^i + \lambda_{5,3}^i \alpha^i + \lambda_{5,4}^{ir} \overline{X}^{ir}\right) \cdot \Delta e^i{}_t + \lambda_6 \Delta y^{ir}{}_t + \lambda_7^i \Delta L^i{}_{t-1} \tag{10b}$$

The implied unit of observation is a worker in manufacturing, not a state or SIC aggregate. All regressions include industry fixed effects, industry time trends, and lagged changes in industry employment. Regressions using state data also include state fixed effects and state time trends. All regressions control for the percent change in real GDP, the percent change in real oil prices, the percent change in real interest rates, and the unemployment rate (at national or state levels as appropriate). The regressions using state level data allow the coefficients on

[15] Again, we assume that the non-manufacturing industries within a state have no export orientation. The implied state export share is the weighted average of the industry export shares where the weights are the industry shares in state output.

these aggregate variables to vary by industry.[16] The interacted-trade-shares for each industry are lagged by one period to avoid simultaneity issues.

All of our specifications include both the industry-specific export and import exchange rates. The export exchange rate series proxies the relevant stimuli to export market sales. The import exchange rate series combines the two other trade transmission channels for exchange rates, as shown in our theoretical derivation. Ideally, we would include separate measures for imported input exchange rates and import-competition exchange rates. However, the import penetration of industries is highly correlated with the imported input shares of industries. Because of this strong correlation, the data do not allow us to effectively distinguish between the import competition channel and the imported input channel of exchange rate stimuli. Thus, by including only one import term, we recognize that the estimated parameter on the import exchange rate is likely to be combining the two distinct exposure effects. A priori, we cannot predict the sign of its coefficient.

B. Regression Results: Nationally Aggregated Series for Industries. As a first pass through the data, we examine industry data on labor market outcomes collected at a national level. These regressions (shown in Appendix Table 2) consider whether exchange rate movements are associated with changes in the employment, hours or wages of workers who are differentiated from each other only in terms of the industries in which they work. In these national data, if a worker changes jobs within a two-digit industry, but moves across state lines, there will not be an observable change in employment. Because of this feature, such data may mask the extent of possible disruption attributable to exchange rates. Employment changes show up in this data only when a worker moves in or out of a two-digit industry.

The regressions using industry aggregates on wages, hours, and employment impose various parameter constraints. The elasticity of labor market outcomes to exchange rate movements are constrained to be common across all industries, or to differ across industries or over time only due to differences in the industry trade orientation. We do not investigate with the national data differences in elasticities due to other industry-specific features, like

[16] By including the industry-specific coefficients, along with the state and industry fixed effects and trend terms, we reduce the likelihood that our regressions are plagued by the problems caused by combining explanatory variables based on different levels of aggregation.

competitive structure (as in Campa and Goldberg 1998), labor market norms, or costs of adjusting the workforce. Given these cross-industry restrictions, it is not surprising that exchange rate implications appear small and generally insignificant for each of our labor market variables.

C. Regression Results: Data Disaggregated by States and by Industries. The main body of our empirical work, presented in Tables 1 to 5, uses our full dataset on labor market outcomes, by industry, by state, and over time for 1971 through 1995 (about 8,000 observations). Tables 1 through 3 separately consider the elasticities of response of, respectively, real average hourly earnings, weekly hours, and employment. The industries are grouped together according to their average price-over-cost markups.[17] High markup industries, all else equal, would be expected to have less responsive labor market outcomes.

For each industry group, Tables 1 to 3 presents the results of three different specifications of exchange rate effects on the associated labor market outcome. The most constrained specifications are those given in columns 1 and 4 of each table where the exchange rate effects are constrained to be common across industries in the group and over time. In columns 2 and 5, the exchange rate elasticities are allowed to vary with the size of the export orientation or the import orientation of an industry in a state and at any point in time. The coefficients on the exchange rate terms in these regressions are interpreted as the direct (and contemporaneous) implications for labor markets.[18]

Other useful summaries of the effects of exchange rates on the three dependent variables are given in Tables 4 and 5. Table 4 provides independently estimated exchange rate elasticities for each industry. For the results reported in Table 4, we constrain the industry-specific elasticities to be constant over time and across localities in the United States. In separate tests, we consider whether the data reject equality of the industry exchange rate elasticities across regions of the United States. If the answer is yes (reject equality), we report

[17] The "Low Markup" group of industries includes primary metal products, fabricated metal products, transportation equipment, food and kindred products, textile mill products, apparel and mill products, lumber and wood products, furniture and fixtures, paper and allied products, petroleum and coal products, and leather and leather products.

an "*r*" superscript on the associated term in Table 4. For those industries where the data reject equality across regions, Table 5 provides details on the regional variation in the exchange rate effects.

Exchange rates and average hourly earnings (Table 1). In state-level data, real exchange rates matter for average hourly earnings, even in the most constrained regression specifications. For both high and low markup industries, dollar appreciations generally lower the hourly earnings of workers.[19] For both categories of industries, the estimated magnitudes of the direct effects are small, with an average net effect of at most -0.1 percent from a 10 percent dollar appreciation. Indirect effects, from local industry spillovers, are significant but on net go in the opposite direction to that expected from the alternative wage arguments.

The first two columns of Table 4 report the industry-specific estimates of average hourly earning elasticities with respect to export and import exchange rates. Exchange rates enter significantly in fourteen of the twenty industries. The separate channels for exchange rate effects can be large and sometimes offsetting. Clear examples of these counteracting forces are found in the Food, Chemical, and Transportation Equipment industries. In eight industries *the net elasticities of hourly earnings responses to exchange rates* are significantly different from zero, but the sign pattern is mixed.

Table 5A shows the pattern of regional differences in earnings sensitivity for Food, Electronics, Instruments and Miscellaneous Manufacturing. For Electronics, the West South Central and Pacific regions are most significantly effected by changes in the real exchange rates of export and of imported input partners.

Exchange rates and average weekly hours (Table 2). Dollar movements have significant implications for average weekly hours in manufacturing. When the dollar appreciates against the currencies of its export partners, hours worked decline for both high and low markup industries. Symmetrically, when the dollar appreciates against the currencies of countries from

[18] We averaged the ratio of the Miser industry export orientation (by state) to the aggregate industry export orientation for the years covered by the Miser data. We then adjusted the aggregate industry export orientation rates in each state and year by this average ratio.

which the U.S. industries purchase inputs, hours worked expand. These two effects largely offset each other so that the net effect of dollar movements on hours is small. We find no important cross-industry spillover effects of exchange rates on hours.

Estimates of industry-specific coefficients for the two transmission channels tell a similar story (Table 4, columns 3 and 4). In eleven of the twenty industries, average weekly hours respond significantly to dollar movements through either the export or the import channels. While both channels for the exchange rate effects often are significant, the net effect on hours is significantly different from zero only in the case of Textile Mill Products and Fabricated Metal Products (where a 10 percent appreciation reduces average weekly hours by 1.1 percent and 0.6 percent, respectively). Regional differences in the responsiveness of hours to dollar movements are evident for six of the twenty manufacturing industries. As shown in Table 5B, no single region has industry hours that are uniformly more responsive to exchange rates.

Exchange rates and average industry employment (Table 3): The data show that exchange rate movements are clearly correlated with changes in industry employment. For high-markup and low-markup industries, these regressions support the expected pattern of direct effects through export and imported-input channels. Dollar appreciations against export partners are associated with employment declines (both through direct and indirect industry effects), while appreciations against input providers are associated with employment expansion.[20]

There is considerable heterogeneity across industries in the effect of dollar movements on employment (Table 4). In thirteen of the twenty industries, employment is responsive to exchange rates through at least one of the trade channels. At the state level some of these local employment effects are very large, even in net terms. Regional differences in employment elasticities are important for six of the twenty manufacturing industries.

Over the full time period (1971 through 1995) the net effect of a dollar appreciation appears to be expansion of employment. However, tests of the stability and robustness of the

---

[19] The key exception is the positive earnings effect found for dollar appreciations through the export channel in high markup industries.

regression coefficients across different subperiods suggest that caution is warranted. The coefficient estimates are fairly stable or sign-consistent into the mid-late 1980s, but for the late 1980s and early 1990s the fit of the regression equations significantly deteriorates. In many cases, there are even sign reversals on many estimated coefficients.

Actual versus anticipated shocks, and local labor markets: Finally, the results from our constructed measures of state relative demand shocks are of independent interest for understanding the dynamics of labor market adjustment to stimuli. Using Current Population Survey data from 1977-1979, Topel (1986) finds that an increase in his current relative demand shock measure leads to significantly higher average weekly wages. In contrast, an increase in his expected future relative demand shock measure leads to significantly lower average weekly wages. Topel interprets the positive wage response to the current shock as consistent with a labor demand shift with a stable labor supply, and the negative wage response to expected future shocks as consistent with a labor supply shift with a stable labor demand. Current labor supply shifts in advance of expected future labor demand shifts as workers attempt to arbitrage lifetime earnings differentials across separate labor markets.

While our study uses aggregate data and not micro data and controls for a different set of variables, our results nonetheless confirm Topel's pattern of wage adjustments to these state relative demand shock measures. Average weekly wages show a large positive and statistically significant response to current relative demand shocks. In addition, average weekly wages fall in response to expected future relative demand shocks (Table 2, data row 8). For both high and low-markup industries, the elasticity with respect to the current shock is more than double the elasticity with respect to the expected future shock.

If the local market experiences a demand shock that is large relative to the stocks experienced by other localities, we also expect local employment and hours to increase.[21] From Table 2, we observe a significant qualitative difference across high versus low markup industries on the response of hours worked. Hours worked in low-markup-industries are very

---

[20] Again, the exception is for dollar appreciations through the export channel for high markup industries where we find a positive employment effect. However, when we interact the export exchange rate with the industry export intensity we find the predicted negative employment effect.

[21] Topel (1986) only looks at the impact on average weekly earnings.

sensitive to relative local demand conditions: hours increase in response to the current (favorable) shocks, and decrease in anticipation of future (favorable) shocks. Table 3 confirms the same sign pattern of employment adjustment to these shocks, and suggests that market-structure may play a role in determining the magnitude of responsiveness to current shocks. Whereas wages were more responsive to current shocks, hours and employment is more responsive to perceived future conditions.

V. Conclusions

In this paper we have used labor market data disaggregated by industry and by state to explore the labor market implications of exchange rates. This approach offers several potential advantages over prior studies. First, we can better specify the alternative wage by using data at the state versus the national level. Second, given the nonrandom distribution of industry employment across labor markets, aggregate industry level data may pick up spurious state or region labor market effects. Third, we are able to introduce state and industry-specific export orientation data, and can consider spillovers within and across labor markets. Finally, and importantly, if exchange rate movements lead to reallocation of workers and jobs across state lines, but still within similar industries, we are likely to pick up some effects that may be missed in industry data aggregated up from the state to the national level.

We find that local industries differ significantly in their earnings, hours, and employment responses to exchange rates. Industry wages unambiguously respond to dollar movements in eight of the twenty manufacturing industries, with possible effects surfacing in fourteen of the twenty industries. A dollar depreciation is sometimes associated with earnings growth, but sometimes with wage restraint. For some industries, there are significant regional differences in these elasticities. Employment is unambiguously responsive to exchange rates in twelve of the twenty manufacturing industries. The employment effects of exchange rates are much more easily discerned in the local labor markets than in nationally aggregated series. However, there are clear issues of the stability of empirical specifications which become especially pronounced by the late 1980s. This lack of stability leads us to suggest caution in interpreting and identifying industry-specific responses of labor market outcomes to dollar movements.

References

BLS Handbook of Methods, US Department of Labor, Bureau of Labor Statistics, April 1997, Bulletin 2490, Chapter 2 (Employment, Hours, and Earnings from the Establishment Survey)

Branson, W., and J. Love. 1988. "United States Manufacturing and the Real Exchange Rate." In R. Marston, ed., *Misalignment of Exchange Rates: Effects on Trade and Industry*, University of Chicago Press.

Burgess, S. and M. Knetter 1996. An International Comparison of Employment Adjustment to Exchange Rate Fluctuations. NBER working paper 5861 (December).

Campa, J., and L. Goldberg. "Investment, Pass-Through and Exchange Rates: A Cross-Country Comparison." Forthcoming *International Economic Review.*

Campa, J., and L. Goldberg. 1997. "The Evolving External Orientation of Manufacturing: Evidence from Four Countries." *FRBNY Economic Policy Review* (July): 53-81.

Campa, J., and L. Goldberg. 1998. Employment versus Wage Adjustment and the U.S. Dollar. NBER working paper 6749 (October).

Clarida, R.. 1997. "The Real Exchange Rate and U.S. Manufacturing Profits: A Theoretical Framework with Some Empirical Support." *International Journal of Finance and Economics* 2, no. 3 (July): 177-88.

Davis, S. and J. Haltiwanger. 1997. "Sectoral Job Creation and Destruction Responses to Oil Price Changes and Other Shocks". manuscript, University of Chicago.

Goldberg, P. and M. Knetter. 1997. "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature*. Vol. XXXV no.3 (September): 1243-1272.

Mortensen, Dale. 1986. "Job Search and Labor Market Analysis". In *Handbook of Labor Economics* vol. 2, editors Orley Ashenfelter and Richard Layard (Elsevier Press): 848-919.

Nickell, S.J. 1986. Dynamic Models of Labour Demand. *Handbook of Labor Economics* (Elsevier Science Publishers).

Revenga, A. 1992. "Exporting Jobs? The Impact of Import Competition on Employment and Wages in U.S. Manufacturing." *Quarterly Journal of Economics* 107 (1): pp.255-284.

Sheets, N.. 1996. “The Exchange Rate and Profit in Developed Economies: An Intersectoral Analysis”. Working paper, Board of Governors of the Federal Reserve System.

Topel, R. 1986. "Local Labor Markets." *Journal of Political Economy,* vol. 94, no 3, part 2, pp: S111-143.

Appendix

Local Relative Demand Conditions and Forecast. For each state r and industry i, we construct a time-series of private-sector nonagricultural employment excluding employment in that industry[22] and regress its logarithm on a quadratic time trend. The residuals from these regressions, ε_t^{ri} measure the deviations from trend employment in state r exclusive of industry i at time t. Similarly, we regress the logarithm of national private sector non-agricultural employment in year t on a quadratic time trend. The residuals from this regression, ε_t, capture the aggregate business cycle. Relative local demand shocks in state r and industry i in year t are defined as

$$\Delta y^{ri}{}_t = \varepsilon_t^{ri} - \varepsilon_t , \tag{A1}$$

so that the relative demand shock measures the local employment shock as a deviation from the national employment shock.

We use the persistence of these relative demand shocks to develop a measure of the expected future relative shock to a state/industry. Specifically, for each state/industry we estimate the following regression

$$\Delta y^{ri}{}_t = \alpha_1^{ri} \Delta y^{ri}{}_{t-1} + \alpha_2^{ri} \Delta y^{ri}{}_{t-2} + \beta^{ri} \varepsilon_t \tag{A2}$$

The relative demand shock for industry i in state r is modeled as a function of two lags of the relative demand shock and the current national shock. If β^{ri} is positive, then this industry/state experiences relative cycles that are magnified by the aggregate cycle. This empirical model is used to generate one to three-year ahead forecasts of the relative demand shocks for each industry/state. We use a second-order autoregressive model to forecast the national employment shocks. Following Topel, we summarize these forecasts into a single weighted average of the forecasts, with weights declining linearly over the forecast horizon.

[22] Here is where we deviate from Topel's methodology. Since we are interested in explaining the impacts of relative demand shocks on the wage, hours, and employment in an industry/state, we must remove any direct contribution of that industry/state from our measure of the relative demand shock. We do this by subtracting the employment movements in that industry from our time-series on state employment. This implies that each manufacturing industry in a state will have a slightly different series of estimated relative demand shocks.

Table 1. Response Elasticities of Average Hourly Earnings of Workers in Industries within Individual States

	High Markup Industries			Low Markup Industries		
	(1)	(2)	(3)	(4)	(5)	(6)
Own Industry Channels: percent change in						
• Export exchange rates	.053***			-.009		
	(.013)			(.007)		
• Import exchange rates	-.050***			.004		
	(.009)			(.009)		
• [State] Industry export orientation with export exchange rates		.011	.011		-.009***	-.010***
		(.008)	(.009)		(.003)	(.003)
• [State] Industry imported input orientation with import exchange rates		-.025***	-.025***		.007	.004
		(.008)	(.009)		(.006)	(.006)
Cross-Industry Spillovers: percent change in						
• Other industry export orientation with export exchange rates			-.005			.002***
			(.010)			(.001)
• Other industry imported input orientation with import exchange rates			.190***			.011***
			(.041)			(.004)
State-specific relative demand shock	.249***	.248***	.271***	.164***	.173***	.166***
	(.056)	(.056)	(.057)	(.049)	(.049)	(.049)
Forecasted state-specific relative demand shock	-.118**	-.116*	-.124**	-.584***	–.0634	-.0538
	(.061)	(.061)	(.062)	(.055)	(.055)	(.055)
Adjusted R-square	.387	0.383	0.387	0.347	0.371	0.350
Test for joint significance of exchange rate terms: F -statistic						
Own Industry channels						
• Non-interacted	14.64***			.83		
• Interacted with trade orientation		5.07*	4.25*		4.29*	5.35*
Cross-Industry Spillovers			10.74***			7.57***
Own-Industry & Cross-Industry Spillovers			7.92***			5.94*

Notes: BLS Employment and Earnings: States & Area data. Weighted least squares estimation using prior period's employment levels as weights. Standard errors are given in parentheses. Number of observations is 7,991. Other control variables include industry specific responses to real GDP changes, real oil price changes, real interest rate changes, and state unemployment rate. Industry fixed effects, state fixed effects, and industry- and state-specific time trends are included in all specifications.

[a] Own-industry and other-industry export orientation measures are adjusted using Miser data to reflect average state/industry differences.

** Significant at the 5% level. * Significant at the 10% level.

Table 2. Response Elasticities of Average Hours of Workers in Industries within Individual States

	High Markup Industries			Low Markup Industries		
	(1)	(2)	(3)	(4)	(5)	(6)
Own Industry Channels: percent change in						
• Export exchange rates	-.031***			-.029***		
	(.008)			(.005)		
• Import exchange rates	.034***			.019***		
	(.006)			(.007)		
• [State] Industry export orientation with export exchange rates		-.020***	-.016***		-.009***	-.009***
		(.005)	(.006)		(.002)	(.002)
• [State] Industry imported input orientation with import exchange rates		.0306	.0013		.0069	.000***
		(.0052)	(.0002)		(.0049)	(.000)
Cross-Industry Spillovers: percent change in						
• Other industry export orientation with export exchange rates			-.009			-.001
			(.007)			(.001)
• Other industry imported input orientation with import exchange rates			.016			-.001
			(.026)			(.003)
State-specific relative demand shock	-.015	-.004	.005	.091***	.096***	.097***
	(.036)	(.036)	(.037)	(.038)	(.038)	(.038)
Forecasted state-specific relative demand shock	-.030	-.036	-.043	-.161***	–.163***	-.164***
	(.039)	(.039)	(.040)	(.042)	(.042)	(.043)
Adjusted R-square	0.210	0.211	0.211	0.261	0.258	0.258
Test for joint significance of exchange rate terms: F -statistic						
Own Industry channels						
• Non-interacted	16.82***			15.53***		
• Interacted with trade orientation		17.11***	17.88***		7.08*	6.78*
Cross-Industry Spillovers			1.1			.38
Own-Industry & Cross-Industry Spillovers			9.11***			3.73

Notes: BLS Employment and Earnings: States & Area data. Weighted least squares estimation using prior period's employment levels as weights. Standard errors are given in parentheses. Number of observations is 7,991. Other control variables include industry specific responses to real GDP changes, real oil price changes, real interest rate changes, and state unemployment rate. Industry fixed effects, state fixed effects, and industry- and state-specific time trends are included in all specifications.

[a] Own-industry and other-industry export orientation measures are adjusted using Miser data to reflect average state/industry differences.

[**] Significant at the 5% level. [*] Significant at the 10% level.

Table 3. Response Elasticities of Average Employment of Workers in Industries within Individual States

	High Markup Industries			Low Markup Industries		
	(1)	(2)	(3)	(4)	(5)	(6)
Own Industry Channels: percent change in						
• Export exchange rates	.064***			-.030***		
	(.018)			(.009)		
• Import exchange rates	.033***			.041***		
	(.013)			(.011)		
• [State] Industry export orientation with export exchange rates		-.035***	-.051***		-.003***	-.003
		(.011)	(.012)		(.004)	(.004)
• [State] Industry imported input orientation with import exchange rates		.118***	.106***		.072***	.072***
		(.011)	(.012)		(.008)	(.008)
Cross-Industry Spillovers: percent change in						
• Other industry export orientation with export exchange rates			.038***			-.001
			(.014)			(.001)
• Other industry imported input orientation with import exchange rates			.189***			-.003
			(.056)			(.005)
State-specific relative demand shock	.110	.156**	.142*	.237***	.244***	.245***
	(.078)	(.077)	(.078)	(.064)	(.064)	(.064)
Forecasted state-specific relative demand shock	-.625***	-.661***	-.643***	-.719***	–.729***	-.729***
	(.085)	(.084)	(.084)	(.072)	(.072)	(.072)
Adjusted R-square	0.568	0.575	0.578	0.565	0.567	0.567
Test for joint significance of exchange rate terms: F -statistic						
Own Industry channels						
• Non-interacted	39.17***			27.62***		
• Interacted with trade orientation		69.66***	40.59***		39.76***	39.62***
Cross-Industry Spillovers			10.71**			.51
Own-Industry & Cross-Industry Spillovers			40.39***			20.13***

Notes: BLS Employment and Earnings: States & Area data. Weighted least squares estimation using prior period's employment levels as weights. Standard errors are given in parentheses. Number of observations is 7,991. Other control variables include industry specific responses to real GDP changes, real oil price changes, real interest rate changes, and state unemployment rate. Industry fixed effects, state fixed effects, and industry- and state-specific time trends are included in all specifications.

[a] Own-industry and other-industry export orientation measures are adjusted using Miser data to reflect average state/industry differences.

** Significant at the 5% level. * Significant at the 10% level.

Table 4: Estimated Industry-Specific Elasticities of Labor Market Outcomes to Exchange Rates

Industry	% Change in Real Average Hourly Earnings		% Change in Weekly Hours		% Change in Employment	
	Export	Import	Export	Import	Export	Import
Food & Kindred Products	–0.203**	0.233**[r]	0.005	–0.003[r]	–0.045	0.087**
	(0.023)	(0.031)	(0.017)	(0.023)	(0.031)	(0.041)
Tobacco Products	–0.084	–0.034	–0.036	–0.007	0.103	0.098
	(0.067)	(0.055)	(0.049)	(0.040)	(0.085)	(0.069)
Textile Mill Products	0.036	–0.073**	–0.114**	0.004	0.005	–0.007
	(0.031)	(0.033)	(0.023)	(0.024)	(0.043)	(0.046)
Apparel & Other Textile Products	0.002	–0.015	–0.044**[r]	0.065**	0.082**[r]	–0.036[r]
	(0.014)	(0.029)	(0.010)	(0.022)	(0.019)	(0.040)
Lumber & Wood Products	–0.068**	0.129**	–0.006	–0.029	0.074**[r]	–0.043[r]
	(0.018)	(0.034)	(0.013)	(0.025)	(0.023)	(0.046)
Furniture & Fixtures	0.086	–0.077	0.007	–0.014	0.091	0.000
	(0.053)	(0.073)	(0.039)	(0.054)	(0.072)	(0.099)
Paper & Allied Products	0.001	0.073**	–0.004	0.020	0.072**	0.009[r]
	(0.023)	(0.021)	(0.017)	(0.016)	(0.031)	(0.027)
Printing & Publishing	0.032	–0.022	0.008	0.005	0.095**	–0.031
	(0.030)	(0.020)	(0.022)	(0.015)	(0.039)	(0.026)
Chemical & Allied Products	0.144**	–0.101**	0.000[r]	0.006[r]	–0.006	0.019
	(0.027)	(0.020)	(0.020)	(0.015)	(0.037)	(0.028)
Petroleum & Coal Products	0.078	–0.146**	0.106**	–0.061	0.021	–0.011
	(0.057)	(0.062)	(0.042)	(0.045)	(0.059)	(0.060)
Rubber & Misc. Plastic Products	0.042	–0.069*	–0.058**	0.076**	0.065	0.188*
	(0.033)	(0.040)	(0.024)	(0.030)	(0.042)	(0.051)
Leather & Leather Products	0.036	0.015	–0.061	0.067**[r]	–0.126[r]	0.097
	(0.070)	(0.045)	(0.052)	(0.033)	(0.096)	(0.062)
Stone, Clay, and Glass Products	0.139**	–0.118**	–0.037	0.044*	0.153**	0.011
	(0.052)	(0.036)	(0.038)	(0.026)	(0.067)	(0.047)
Primary Metal Industries	0.095**	–0.139**	–0.065**[r]	0.060**[r]	–0.054	0.124**
	(0.032)	(0.032)	(0.023)	(0.024)	(0.041)	(0.041)
Fabricated Metal Products	0.152**	–0.113**	–0.088**	0.031**	0.010	0.149**
	(0.024)	(0.019)	(0.018)	(0.014)	(0.032)	(0.025)
Industrial Machinery & Equipment	0.090**	–0.047**	–0.069**	0.052**	–0.097**[r]	0.129**
	(0.025)	(0.015)	(0.018)	(0.011)	(0.032)	(0.019)
Electronic & Other Electric	0.043[r]	–0.049[r]	–0.088**	0.085**	0.473**	–0.161**
Equipment	(0.037)	(0.030)	(0.027)	(0.022)	(0.048)	(0.038)
Transportation Equipment	0.235**	–0.126**	0.002[r]	–0.005	0.235**[r]	0.048**
	(0.027)	(0.016)	(0.020)	(0.011)	(0.032)	(0.018)
Instruments & Related Products	–0.124*[r]	0.066[r]	–0.077	0.073*	0.116	–0.080
	(0.070)	(0.055)	(0.051)	(0.041)	(0.094)	(0.074)
Misc. Manufacturing	–0.273**[r]	0.334**[r]	–0.050	0.060	0.157	–0.114
	(0.108)	(0.129)	(0.079)	(0.095)	(0.128)	(0.152)

Notes: Based on specification (1) from Tables 2-4 where industry fixed-effects were interacted with the percent change in the industry-specific export and import exchange rates. Standard errors are given in parentheses. ** significant at the 5% level; * significant at the 10% level; [r] indicates statistically significant regional differences.

Table 5A	Regional Differences in Exchange Rate Implications for Average Real Hourly Earnings								
Industry name	Reject Equality Across Regions?		Combined Regional Coefficient, reported by region only if measurable						
			North-East	Mid-Atlantic	E.North Central	W.North Central	South Atlantic	E.South Central	W.South Central
Food (SIC 20)	XRER	no	-0.24*** (0.09)	-0.28*** (0.05)	-0.27** (0.04)	-0.21*** (0.05)	-0.18*** (0.04)	-0.26*** (0.06)	-0.23*** (0.05)
	MRER	yes	0.32*** (0.11)	0.43*** (0.06)	0.41*** (0.06)	0.21*** (0.07)	0.21*** (0.06)	0.26*** (0.08)	0.22*** (0.07)
Electronics (SIC 36)	XRER	yes		-0.04 (0.16)	-0.01 (0.16)	-0.11 (0.23)	-0.13 (0.17)	-0.19 (0.26)	-0.35* (0.21)
	MRER	yes		(0.02) (0.12)	0.00 (0.12)	0.04 (0.17)	0.12 (0.12)	0.06 (0.20)	0.31* (0.16)
Instruments (SIC 38)	XRER	yes	0.09 (0.19)	-0.16 (0.11)	0.11 (0.18)	0.09 (0.63)	-0.31 (0.34)	0.40 (0.60)	-0.65 (0.40)
	MRER	yes	-0.15 (0.13)	0.12 (0.09)	-0.13 (0.14)	-0.04 (0.49)	0.23 (0.27)	-0.38 (0.46)	0.49 (0.31)
Misc. manufacturing (SIC 39)	XRER	yes	-0.81* (0.40)	-0.18 (0.12)	-1.00*** (0.23)	-0.02 (0.44)	-0.01 (0.37)	-0.81 (0.40)	-1.14*** (0.35)
	MRER	yes		-0.53 (0.49)	0.14 (0.55)	-0.39 (0.67)	-0.74 (.62)		0.81 (0.63)

Note: * denotes statistical significance at the 10% level, ** denote significance at the 5% level, and *** indicate a 1% level of significance.

Table 5B	Regional Differences in Exchange Rate Implications for Average Weekly Hours								
Industry Name	Reject Equality Across Regions?		Combined Regional Coefficient, reported by region only if measurable						
			North-East	Mid-Atlantic	E.North Central	W.North Central	South Atlantic	E.South Central	W.South Central
Food (SIC 20)	XRER	no	0.04 (0.06)	-0.01 (0.03)	0.07** (0.03)	0.04 (0.04)	-0.01 (0.03)	0.03 (0.04)	-.07* (0.04)
	MRER	yes		-0.05 (0.08)	-0.11 (0.08)	-0.09 (0.08)	-0.03 (0.08)	-0.01 (0.09)	0.07 (0.09)
Apparel & Fabric (SIC 23)	XRER	yes	0.05 (0.05)	-0.00 (0.02)	0.01 (0.06)	0.02 (0.16)	-0.07*** (0.02)	-0.08*** (0.03)	-0.14*** 0.04
	MRER	no	0.08 (0.10)	0.03 (0.04)	-0.03 (0.11)	-0.20 (0.30)	0.08* (0.05)	0.10* (0.06)	0.19** (0.09)
Chemicals & Products (SIC 28)	XRER	yes	0.01 (0.07)	0.04 (0.03)	0.00 (0.04)	-0.21* (0.10)	-0.08** (0.04)	-0.09 (0.06)	0.01* (0.06)
	MRER	yes	-0.02 (0.05)	-0.01 (0.02)	0.00 (0.03)	0.17** (0.08)	0.07** (0.03)	0.05 (0.05)	-0.06 (0.04)
Leather & Products (SIC 31)	XRER	no	0.03 (0.07)	0.01 (0.07)	-0.31** (0.15)	-0.14 (0.13)	-0.10 (0.23)	-0.23* (0.13)	-0.32** (0.14)
	MRER	yes	0.02 (0.05)	0.02 (0.04)	0.35*** (0.12)	0.14 (0.10)	0.06 (0.16)	0.19* (0.10)	0.36*** (0.11)
Primary metal products (SIC 33)	XRER	yes		0.09 (0.10)	0.04 (0.10)	-0.20 (0.15)	-0.10 (0.11)	-0.17 (0.12)	-0.09 (0.13)
	MRER	yes	0.08 (0.08)	0.04 (0.04)	-0.01 (0.03)	0.19* (0.11)	0.18* (0.06)	0.11 (0.07)	0.19** (0.08)
Transportation Equipment (SIC 37)	XRER	yes	-0.15 (0.10)	-0.10 (0.09)	0.12** (0.05)	0.00 (0.12)	-0.10 (0.11)	-0.05 (0.15)	-0.21* (0.12)
	MRER	no		-0.05 (0.07)	-0.15** (0.06)	-0.10 (0.09)	-0.02 (0.08)	-0.10 (0.11)	0.06 (0.09)

Note: One asterisk denotes statistical significance at the 10% level, two asterisks denote significance at the 5% level, and three indicate a 1% level of significance.

Table 5C	Regional Differences in Exchange Rate Implications for Average Employment								
Industry Name	Reject Equality Across Regions?		Combined Regional Coefficient, reported by region only if measurable						
			North-East	Mid-Atlantic	E.North Central	W.North Central	South Atlantic	E.South Central	W.South Central
Apparel & Fabric (SIC 23)	XRER	yes	0.07 (0.07)	0.04 (0.03)	0.11 (0.07)	-0.07 (0.19)	0.06* (0.03)	-0.01 (0.04)	0.03 (0.06)
	MRER	yes		-0.18 (0.14)	-0.45** (0.18)	-0.12 (0.39)	-0.16 (0.15)	-0.21 (0.16)	-0.36** (0.17)
Lumber & Wood (SIC 24)	XRER	yes	0.09 (0.08)	0.06 (0.06)	-0.01 (0.04)	0.10 (0.12)	0.12*** (0.04)	0.09** (0.04)	0.10** (0.05)
	MRER	yes	0.31* (0.18)	-0.32** (0.13)	-0.02 (0.08)	-0.28 (0.31)	0.13* (0.08)	-0.14 (0.10)	0.15 (0.10)
Paper Products (SIC 26)	XRER	no	0.02 (0.05)	0.07** (0.04)	0.01 (0.03)	0.05 (0.05)	0.06 (0.04)	0.09* (0.05)	0.01 (0.06)
	MRER	yes	-0.03 (0.04)	0.06** (0.03)	0.00 (0.03)	0.06 (0.08)	0.02 (0.05)	-0.06 (0.07)	0.01 (0.08)
Leather & Products (SIC 31)	XRER	yes	0.09 (0.15)	-0.05 (0.15)	-0.49* (0.28)	-0.39 (0.27)	0.31 (0.44)	-0.76*** (0.26)	-0.10 (0.30)
	MRER	no	0.02 (0.10)	0.05 (0.09)	0.41* (0.22)	0.26 (0.21)	0.12 (0.30)	0.39* (0.20)	0.24 (0.23)
Industrial Machinery (SIC 35)	XRER	yes	-0.17 (0.13)	0.05 (0.09)	-0.09 (0.07)	-0.26*** (0.13)	0.07 (0.12)	0.10 (0.18)	-0.36*** (0.13)
	MRER	no	0.12 (0.08)	0.05 (0.05)	0.16*** (0.04)	0.26*** (0.08)	0.13 (0.08)	0.08 (0.12)	0.27*** (0.08)
Transportation Equipment (SIC 37)	XRER	yes	-0.16 (0.19)	0.03 (0.16)	0.55*** (0.08)	0.22 (0.20)	0.15 (0.18)	0.40* (0.24)	-0.64*** (0.21)
	MRER	no		-0.17 (0.13)	-0.28** (-0.28)	-0.23 (0.16)	-0.24 (0.15)	-0.26 (0.18)	0.09 (0.17)

Note: One asterisk denotes statistical significance at the 10% level, two asterisks denote significance at the 5% level, and three indicate a 1% level of significance.

Appendix Table 1 — Correlation Coefficients between Industry-Specific real exchange rates and an aggregate real exchange rate

Industry Name (Code)	XRER with RER	MRER with RER	XRER with MRER
Food and Kindred Products (20)	0.89	0.93	0.92
Tobacco Products (21)	0.88	0.76	0.56
Textile Mill Products (22)	0.88	0.85	0.75
Apparel and Other Textiles (23)	0.77	0.82	0.61
Lumber and Wood Products (24)	0.63	0.58	0.48
Furniture and Fixtures (25)	0.79	0.82	0.71
Paper and Allied Products (26)	0.92	0.50	0.45
Printing and Publishing (27)	0.91	0.81	0.76
Chemical and Allied Products (28)	0.93	0.89	0.92
Petroleum and Coal Products (29)	0.90	0.36	0.34
Rubber and Misc. Plastic (30)	0.83	0.87	0.68
Leather and Leather Products (31)	0.91	0.65	0.55
Stone, Clay and Glass (32)	0.85	0.86	0.76
Primary Metal Industries (33)	0.90	0.82	0.81
Fabricated Metal Products (34)	0.84	0.80	0.60
Industrial Machinery and Equip. (35)	0.92	0.85	0.85
Electronic and Other Equip (36)	0.88	0.76	0.67
Transportation Equipment (37)	0.90	0.75	0.73
Instruments and Related Prods (38)	0.91	0.81	0.89
Miscellaneous Manufacturing (39)	0.90	0.88	0.90

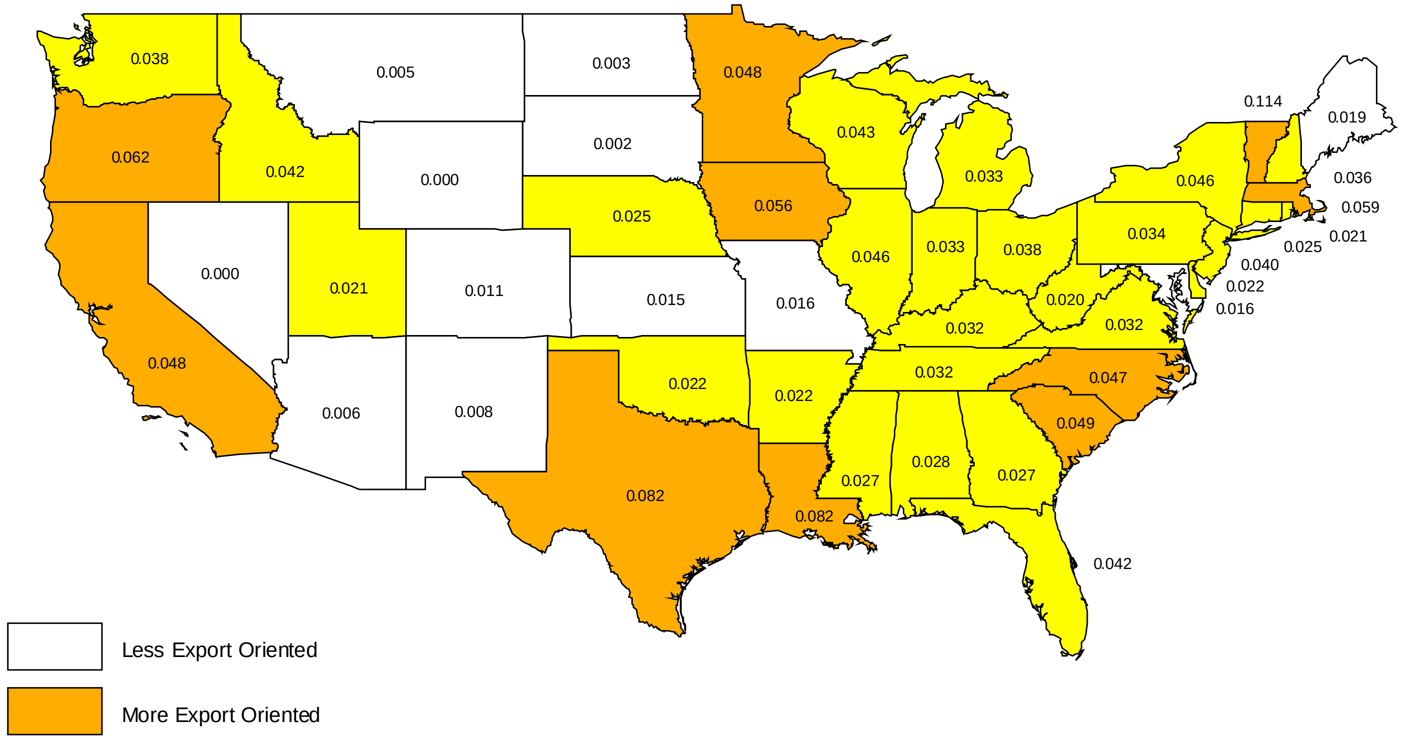
The industry-specific export real exchange rates are denoted by XRER; industry specific import real exchange rates are denoted by MRER; the trade-weighted aggregate real exchange rate is the Federal Reserve Bank of Dallas series.

Appendix Table 2: Nationally-Aggregate Industry Data on Earnings, Hours, and Employment: 1971-1995

	Percent Change in Real Average Hourly Earnings		Percent Change in Average Weekly Hours		Percent Change in Average Employment	
	(1)	(2)	(3)	(4)	(5)	(6)
Percent change in:						
• Export exchange rates	0.018		0.002		0.072**	
	(0.018)		(0.008)		(0.027)	
• Import exchange rates	–0.014		–0.008		0.023	
	(0.014)		(0.007)		(0.022)	
• Industry export orientation with export exchange rates		–0.008		–0.011		0.016
		(0.016)		(0.007)		(0.022)
• Industry imported input orientation with import exchange rates		0.003		–0.002		0.046**
		(0.014)		(0.006)		(0.021)
% change in:						
Real GDP	0.104**	0.108**	0.236**	0.237**	0.879**	0.921**
	(0.037)	(0.037)	(0.017)	(0.017)	(0.055)	(0.054)
Real oil prices	–0.035**	–0.035**	0.004**	0.004**	0.016**	0.017**
	(0.004)	(0.004)	(0.002)	(0.002)	(0.006)	(0.006)
Real interest rates	–0.009	–0.011	0.010*	0.009*	0.081**	0.090**
	(0.012)	(0.012)	(0.006)	(0.005)	(0.018)	(0.017)
National unemployment rate	0.003*	0.002*	0.001	0.001	–0.009**	–0.007**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
Lag employment growth	–0.094**	–0.094**	–0.164**	–0.164**	0.106**	0.137**
	(0.029)	(0.029)	(0.013)	(0.013)	(0.043)	(0.041)
Adjusted R-square	0.6295	0.6283	0.5863	0.5893	0.5704	0.5675
Test for joint significance of exchange rate terms:						
F –statistic/[Change in adjusted R-square]						
• Non-interacted	0.69		0.66		5.87**	
	[–0.0007]		[–0.0008]		[0.0122]	
• Interacted with trade orientation		0.013		1.91		4.79**
		[–0.0019]		[0.0022]		[0.0093]

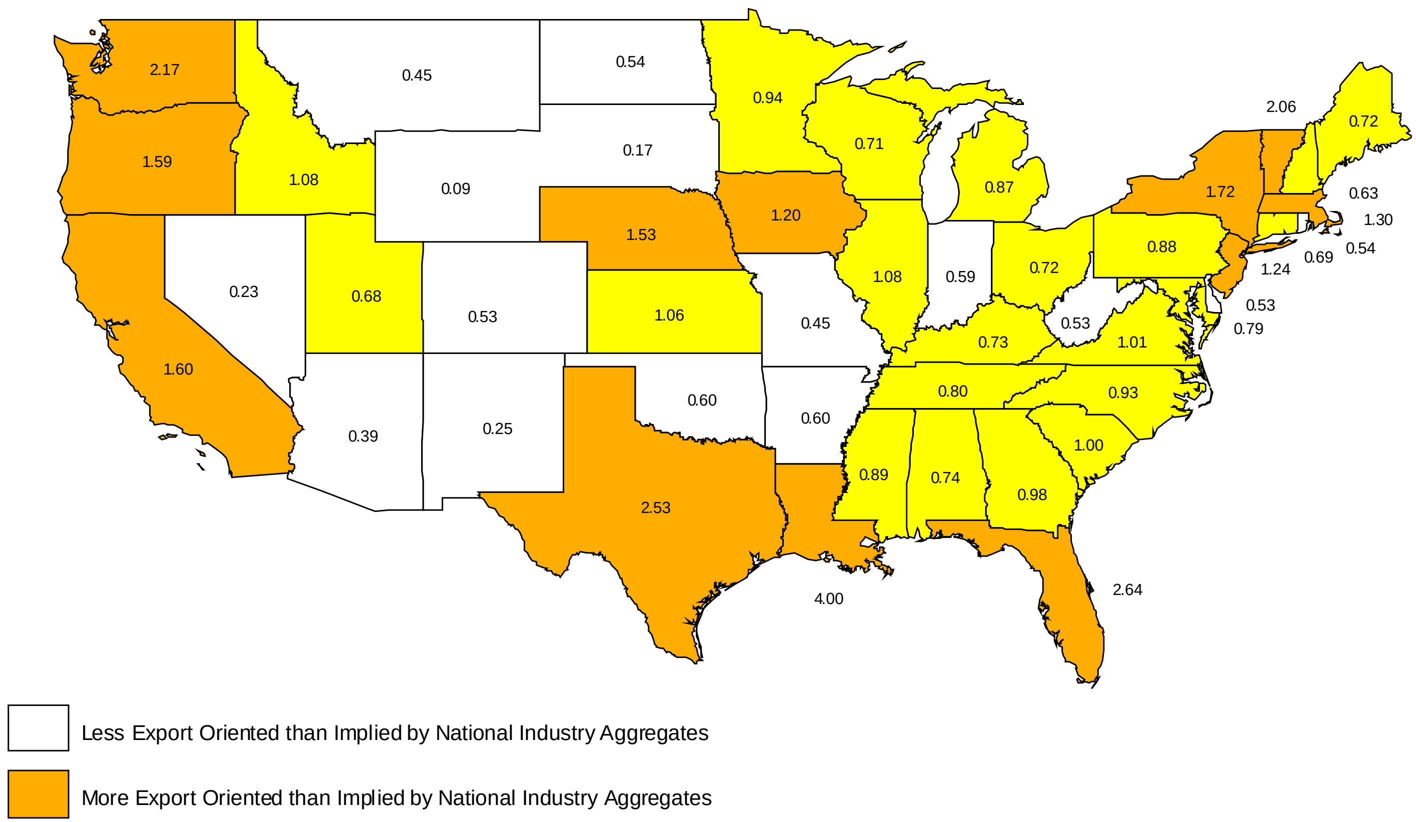
Notes: BLS Employment and Earnings: National data. Weighted least squares estimates with the weight being last period's employment level. Standard errors are given in parentheses. Specifications include a time trend and industry fixed effects. Number of observations is 368 for average hourly earnings and average weekly hours, and 400 for average employment. ** significant at the 5% level; * significant at the 10% level.

Map 1: State Export Orientation, 1988 - 1994 Average



Notes: State export orientation is calculated as the weighted sum across manufacturing industries of the Miser export orientation. The Miser export orientation is Miser exports over gross state product where each is state and industry specific. The weight that is used to sum across industries is state and industry specific employment over state manufacturing employment. The sum is then multiplied by manufacturing gsp over total gsp.

Map 2: State Export Orientation: Ratio of Actual to Implied, 1988 - 1994 Average



Notes: Ratio of actual to implied state export orientations is calculated as the weighted sum across manufacturing industries of the Miser export orientation over the national industry export orientation. The Miser export orientation is Miser exports over gross state product where each is state and industry specific. The weight that is used to sum across industries is state and industry specific employment over state manufacturing employment.