Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants*

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Abstract

We examine the role of international trade in the reallocation of U.S. manufacturing within and across industries from 1977 to 1997. Motivated by the factor proportions framework, we introduce a new measure of industry exposure to international trade that focuses on where imports originate rather than on their overall level. Across industries, we find that plant survival and growth are negatively associated with industry exposure to low-wage country imports. Within industries facing low-wage imports, we show that manufacturing activity is disproportionately reallocated towards capital-intensive plants. Finally, we provide the first evidence that firms adjust their product mix in response to trade pressures. Plants are more likely to switch industries when exposure to low-wage countries is high.

Keywords: Low-Wage Country Import Competition, Manufacturing Plant, Comparative Advantage

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1. Introduction

U.S. manufacturing declined dramatically between 1960 and 2000. Manufacturing employment fell from 26 percent to 14 percent of the U.S. workforce, while its output as a share of GDP shrank from 27 percent to 16 percent. However, this overall decline masks substantial reallocation of activity within manufacturing. Indeed, industries like Instruments and Plastics are adding jobs even as others, such as Apparel and Footwear, are all but disappearing. This paper finds that both cross-industry and within-industry reallocation of manufacturing follows the predictions of endowment-based trade theory. Moreover, it provides the first evidence that U.S. firms respond to the pressures of increased trade by changing their product mix.

As U.S. trade barriers have fallen in recent years, low-wage countries like China and India have begun exporting to the United States many of the more labor-intensive products formerly produced at home. This product cycling – where the United States moves out of labor-intensive products like T-shirts and sneakers as lower-cost developing countries move in – is a key feature of endowment-driven trade theory. Given their high relative wages, it is virtually impossible for U.S. firms to earn profits producing labor-intensive goods. We find a strong relationship between U.S. trade with low-wage countries and the reallocation of U.S. economic activity both across industries within manufacturing, and across plants within industries.

Our analysis is structured around three questions. First, are plant survival, employment growth and output growth disproportionately lower in industries that are more exposed to imports from low-wage countries? Second, within industries, are capital- and skill-intensive plants – i.e. the plants most likely to be producing goods consistent with U.S. comparative advantage – more likely to survive and grow than labor-intensive plants? Finally, do manufacturing plants seek to escape exposure to low-wage countries by changing industries?

We find substantial evidence of reallocation in answer to all three questions. Across industries, increased exposure to low-wage country imports is negatively associated with plant employment and output growth and with the probability of plant survival. Within industries facing low-wage imports, capital-intensive plants are more likely to survive and grow than labor-intensive plants. Finally, plants respond to high exposure from low-wage country imports by switching industries. When this switching occurs, plants move into industries that are less exposed to low-wage country imports and that are more capital- and skill-intensive than the industries they leave behind. These results offer compelling support for the view that U.S. manufacturing is moving away from comparative-disadvantage activities both within and across industries.

A primary contribution of our analysis is the use of plant- rather than industry-level data. Plant-level data allow us to examine a richer set of U.S. responses to international trade with low-wage countries, including exit and product-mix changes, than is possible with industry-level data. In addition, plant-level data can be used to examine whether reallocation within industries is consistent with U.S. comparative advantage. In particular, we check whether activity within industries shifts towards capital- and skill-intensive plants. Plants with relatively labor-intensive production techniques are more likely to be producing the more labor-intensive products within their industries and are therefore relatively more exposed to imports from low-wage countries.

A second contribution of our paper is the introduction of a new method for identifying an industry's exposure to international trade. We measure this exposure via the share of industry imports that originate in countries with less than 5 percent of U.S. per capita GDP. This focus on where imports originate is motivated by the factor proportions framework and allows for a cleaner test of the influence of comparative advantage than more traditional measures of import competition, such as import penetration and import price indexes, that treat imports from high- and low-wage countries symmetrically.

A plausible alternative explanation of the link we find between low-wage imports and poor plant performance is that low-wage countries enter industries that U.S. plants are abandoning for other reasons, including weak domestic productivity growth or skill-biased technological change. These explanations are unlikely for two reasons. First, our analysis associates *prior* levels of exposure to low-wage countries to *subsequent* plant outcomes. Robustness checks reveal no relationship between employment changes and low-wage country exposure when this timing is reversed: prior declines in industry employment are not followed by subsequent increases in low-wage country exposure. Second, we show that our results are robust to controlling for industry characteristics that are plausibly correlated with both exposure to low-wage country imports and to subsequent plant performance. Additional robustness tests indicate that exposure to low-wage country imports maintains its significant relationship with plant outcomes even after controlling for the potential influence of other groups of countries, e.g. the Asian Tigers.

The results in this paper build upon previous, industry-level studies of the effect of import competition on U.S. manufacturing employment. While the earliest of these efforts find little or no association between the level of imports and industry employment growth (Krueger 1980; Grossman 1987; Mann 1988), more recent efforts based on larger sets of industries have established a negative correlation between employment growth and either imports (e.g. Freeman and Katz 1991, Sachs and Shatz 1994) or changes in import prices (e.g. Revenga 1992). Our findings indicate that these negative relationships are driven in part by a combination of plant closure, plant decline and plant product-mix changes.

The remainder of the paper is organized as follows. Section 2 summarizes the theoretical framework guiding our analysis and outlines testable hypotheses. Sections 3 and 4 summarize our data and the construction of our low-wage country import value shares. Sections 5 and 6 present our econometric results and robustness checks. Section 7 concludes.

2. The Factor Proportions Framework

A key implication of the Heckscher-Ohlin trade model is that the industries produced in a country are a function of its relative endowments: in an open world trading system, relatively capital- and skill-abundant countries like the United States are expected to produce a more capital- and skill-intensive mix of industries than relatively labor-abundant countries like China.

The standard Lerner (1952) diagram for depicting this free-trade equilibrium is displayed in the left panel of Figure 1. It illustrates the relative level of development of two countries – capital-abundant U.S. and labor-abundant China – in a world of two factors and four industries. Industries are represented by unit value isoquants, with the capital intensity of industries increasing from Apparel to Chemicals. Exogenous world prices identify relative wages – which anchor isocost lines – for each cone of diversification.[1] The equilibrium depicted in Figure 1 has four cones of diversification: the United States is in the capital-abundant cone and produces Machinery and Chemicals while China is in the labor-abundant cone and produces Apparel and Textiles.

The slopes of the isocost lines indicate that capital-abundant U.S. offers high wages (w_{US}) relative to the return to capital (r_{US}). As a result, production of labor-intensive Apparel and Textiles in the United States is unprofitable.[2] Relatively high capital costs in China, on the other hand, render production of capital-intensive Chemicals and Machinery unprofitable in that country. Though Figure 1 builds intuition for these relationships using just two factors and four goods, these results are easily generalized to a world of many factors and goods (Leamer 1987).

The right panel of Figure 1 illustrates an equilibrium where the United States imposes trade barriers on labor-intensive imports. These trade barriers raise the U.S. price of labor-intensive industries (light grey isoquants) above the world price (dark isoquants).[3] Removal of trade barriers, i.e. moving from the right panel of Figure 1 to the left panel, induces a reallocation of U.S. output and employment away from the labor-intensive imports formerly receiving protection and towards the capital-intensive industries in which the United States has comparative advantage. This reallocation causes the U.S. Apparel and Textile industries to decline as imports from labor-abundant low-wage countries increases.[4] It is precisely this link between changes in the share of industry imports originating in low-wage countries and plant performance that our empirical work investigates.

One difficulty in using the Heckscher-Ohlin model to motivate an inquiry into manufacturing plant behavior is that the model focuses on industries, not firms. An intuitive and reasonable solution to this problem is

[1] "Cone" refers to the set of endowment vectors that select each pair of industries.

[2] The negative profits that would be earned in those sectors can be seen by comparing the amount of capital and labor that can be bought for one dollar in the U.S. versus the amount of capital and labor needed to produce one dollar's worth of Apparel or Textile output.

[3] Increasing an industry's price moves its isoquant toward the origin: less capital and labor are required to produce one dollar's worth of output.

[4] Once trade barriers are eliminated the U.S. will no longer have any products in common with low-wage countries. Rather, it is in the important transition from protection to free trade that reallocation takes place.

to assume that plants produce bundles of disaggregate products. Though researchers can observe the primary industry in which a plant operates, they cannot observe the particular bundle of products produced. Under this interpretation, a plant's input intensity provides a signal about the mix of products being produced and about its exposure to imports from low-wage countries. The most labor-intensive plants within an industry most likely produce the most labor-intensive products in that industry, and are therefore more susceptible to competition from low-wage countries.

Furthermore, viewing firms as bundles of products provides an explanation for why reallocation does not result in the immediate death of *all* plants operating in labor-intensive industries. While protected by trade barriers, U.S. plants are indifferent to producing capital- and labor-intensive goods, with the result that some plants may produce both types while others produce only one type. As low-wage countries enter the U.S. market, plants solely producing labor-intensive products disappear along with their product lines. However, plants that formerly produced both types of goods do not necessarily die. Instead, they may reallocate resources toward more viable products.

We consider three testable hypotheses from the factor proportions framework:

Hypothesis 1 *Across industries, plant survival and plant growth decrease with an industry's exposure to imports from low-wage countries.*

The first hypothesis is a cross-industry prediction that follows directly from Figure 1. It implies plant survival and plant growth is lower for industries at odds with U.S. comparative advantage, i.e. industries where exposure to imports from low-wage countries is high.

Hypothesis 2 *Within industries, plant survival and plant growth is increasing in plant capital and skill intensity and plant productivity.*

The second hypothesis is a within-industry prediction that assumes plant input techniques are correlated with underlying product variation: labor-intensive plants within an industry are assumed to produce labor-intensive products within that industry, and are therefore assumed to be more at odds with U.S. comparative advantage than capital-intensive plants.

As a result, labor-intensive plants are expected to fail or shrink relative to capital-intensive plants. The implication with respect to plant productivity is the recognition that sufficiently high productivity can allow U.S. plants producing labor-intensive goods to survive head-to-head competition with labor-abundant countries.

Hypothesis 3 *Plants that switch industries move towards more capital- and skill-intensive industries and towards industries facing less exposure to imports from low-wage countries.*

In addition to failing or shrinking in response to the removal of trade barriers, plants may adapt by re-orienting their output away from that of low-wage countries. Approximately ten percent of the plants in our sample alter their underlying product mix enough to change their primary industry code across the four panels we study. We investigate whether these plant responses are related to international trade.

3. U.S. Exposure to Low-Wage Country Imports

We introduce a new measure of import exposure to examine the link between U.S. manufacturing outcomes and international trade. It differs from traditional measures of import competition, including import penetration and import price indexes, by focusing on *where* imports originate rather than on their level. This alternate focus is critical because the intra- and inter-industry reallocation implied by the factor proportions framework is a function of trade between countries with very different relative endowments. For the United States, imports from China are expected to have a very different impact on manufacturing than imports from Germany. Our measure provides a strong signal about which U.S. industries are most exposed to trade with low-wage countries.[5]

Let VSH_{it} (for *value share*) denote the share of industry i's imports from low-wage countries in year t,

$$VSH_{it} = \frac{M_{it}^{L}}{M_{it}}, \tag{1}$$

[5] A number of factors, including tariff barriers, non-tariff barriers and transportation costs can induce heterogeneity of exposure, even across industries of similar labor intensity.

where M_{it}^L and M_{it} are the value of imports from low-wage countries and the total value of imports. VSH is bounded by zero and unity; a VSH of unity indicates all of an industry's imports originate in countries whose wages are very low compared to those of the United States.

In addition to its conceptual advantages, VSH also has practical benefits. Most important, it is largely robust to shocks affecting both domestic production and imports. Import penetration ratios (imports relative to domestic absorption), for example, can induce negative correlation with plant output and employment growth due to the presence of domestic production in the denominator. A second advantage, relative to import price indexes, is that VSH is available for disaggregate industries and for a long time series.[6]

We classify a country as low-wage in year t if its per capita GDP is less than 5 percent of U.S. per capita GDP.[7] GDP is useful for classifying countries because it is available for a much larger sample of countries than, for example, estimates of manufacturing wages. Our cutoff captures an average of 50 countries per year. Table 1 provides a list of the countries which are classified low wage in all years of the sample. This set of countries includes China and India as well as relatively small exporters such as Haiti. Using data and concordances compiled by Feenstra (1996) and Feenstra et al. (2002), we are able to compute VSH for 385 of 459 four-digit SIC (SIC4) manufacturing industries between 1972 and 1992. These 385 industries encompass 88 percent of manufacturing employment and 91 percent of manufacturing value.

We choose a 5 percent cutoff to classify countries as low wage for several reasons. Most important, it represents the world's most labor-abundant cohort of countries and therefore the set of countries most likely to have an effect on U.S. manufacturing plants according to the factor proportions framework. Second, though this cohort of countries is responsible for

[6]Feenstra (1994) demonstrates that VSH is related to import price indexes. The intuition for this relationship is that unavailable low-wage country varieties effectively have an infinite price, so a price index which includes these unavailable goods declines as they become available, i.e. as VSH rises.

[7]We compare countries to the U.S. in terms of dollar-denominated, non-PPP adjusted per capita GDP. For countries with such low levels of income, the use PPP-adjusted per capita GDP sharply limits the numer of available countries and years due to a lack of data.

a relatively small *level* of exports, it accounts for a relatively significant share of U.S. import growth over time.[8] Among countries with less than 30 percent of U.S. GDP per capita, the cohort of countries below the 5 percent cutoff experienced the largest increase in import share, by far, between 1972 and 1992. Finally, the set of countries defined by this cutoff is relatively stable in terms of countries entering and leaving the set over the sample period we consider.[9]

Table 2 summarizes VSH by two-digit SIC manufacturing industry and year. The data reported for each year are an average of the preceding five years ($t-5$ to $t-1$) to smooth out annual fluctuations. The years for which VSH is reported conform to the year for which we can observe plant activity in the U.S. Census of Manufactures. The final row of the table reports VSH for U.S. manufacturing as a whole. Across all manufacturing, VSH increases from 1.9 percent in 1977 to 5.7 percent in 1992, with much of this increase occurring in the most recent years.

The rows of Table 2 reveal that VSH varies substantially across both industries and time. VSH is higher and increases more rapidly among generally labor-intensive industries like Apparel, Textiles and Leather. Figure 2 reinforces this message by plotting the the change in four-digit SIC industries' VSH between 1977 and 1992 against their initial capital intensity. While there is substantial variation in the change of low-wage import shares, the biggest increases in VSH are concentrated in industries with the lowest capital intensities, as predicted by the theory.

Changes in VSH are also related to changes in industry employment. The last column of Table 2 reports the change in industry employment between 1972 and 1997. Overall, U.S. manufacturing employment declined 4 percent between 1972 and 1997. This aggregate loss, however, obscures the fact that some industries (e.g. Industrial Machinery, Instruments) have grown substantially even as others (e.g. Apparel, Textiles) have declined.

Though our empirical analysis focuses on relating VSH to plant outcomes, we demonstrate that our results are robust to controlling for tra-

[8] Even a low *level* of imports from low-wage countries can play a significant role in U.S. manufacturing outcomes. The key consideration is whether or not imports from low-wage countries overlap with goods produced in the U.S. (Leamer 1999). It is precisely the effect of such overlap that we investigate in this paper.

[9] In sensitivity analyses not reported here, we obtain similar results when using cutoffs of 10 and 15 percent.

ditional estimates of import competition and as well measures of exposure to other, potentially influential groups of countries. Here, in Table 3, we report the correlation of VSH with these additional variables across the industries and years included in the sample.[10] The first two rows of Table 3 report the correlation of VSH with import penetration (imports divided by domestic absorption) and changes in real import price indexes.[11] As expected, VSH is positively correlated with import penetration and negatively, but not significantly, correlated with changes in real import prices. The latter result may be due to both the sparseness and relatively high level of aggregation of the import price indexes. The remaining rows of Table 3 report the correlation of VSH with share of industry imports from the OECD and the Asian Tigers.[12] As expected, VSH is negatively correlated with the share of imports from the OECD and positively associated with the share of Asian Tiger imports.

4. U.S. Manufacturing Plant Activity

Manufacturing plant data comes from the Censuses of Manufactures (CM) of the Longitudinal Research Database (LRD) of the U.S. Bureau of the Census starting in 1977 and conducted every fifth year through 1997. The sampling unit for the Census is a manufacturing establishment, or plant, and the sampling frame in each Census year includes detailed information on inputs, output, and products on all establishments. Regression analysis covers plant outcomes for four panels: 1977 to 1982, 1982 to 1987, 1987 to 1992 and 1992 to 1997.[13]

From the Census, we construct plant characteristics including the total value of shipments, total employment, total capital stock (K, the book

[10] The correlations are net of time effects: each measure of import exposure is regressed on time dummies, and residuals from these regression are used to compute correlations.

[11] Three-digit SIC import price indexes are from Feenstra (1996). Data are available for less than one third of the industries across the sample period and are generally unavailable prior to the mid-1980s. The VSH - import price correlation in Table 3 is based upon an aggregation of VSH to SIC3 industries, which is the reason it has far fewer observations than the other correlations in the table.

[12] OECD countries are the 22 members as of 1974, i.e. excluding subsequent entrants such as Mexico and Korea. Asian Tigers are Korea, Taiwan, Singapore and Hong Kong.

[13] We do not consider plant outcomes from earlier Censuses of Manufactures because we do not observe VSH prior to 1972.

value of machinery, equipment, and buildings) and the quantity of and the wages paid to non-production (N) and production (P) workers in each Census year. Plant output is recorded at the four-digit SIC level of aggregation, which is our definition of industry for the remainder of the paper. Plant failure (alternately plant death or plant shutdown) is defined as the cessation of operations of the plant and represents a 'true' death; plants that merely change owners between Census years remain in the sample.

In constructing our sample, we make several modifications to the basic data. First, while the LRD does contain limited information on very small plants (so-called Administrative records), we do not include these records in this study due to the lack of information on inputs other than total employment. Second, we drop any industry whose products are categorized as 'not elsewhere classified' because these 'industries' are typically catch-all categories for relatively heterogeneous products. In practice, this corresponds to any industry whose four-digit code ends in '9'. This reduces the number of industries in the sample to 337. Finally, we drop any manufacturing establishment that does not report one of the required input or output measures. We are left with roughly 443,000 observations encompassing roughly 245,000 unique plants in the four panels.

4.1. Measuring Plant Factor Input Intensities

Two input intensities can be observed in the LRD. Plant capital intensity is measured as the log of the ratio of plant capital stock to plant production workers. Skill intensity is harder to measure as there is relatively little information in the LRD on the characteristics of the workforce. We measure plant skill intensity as the non-production worker wagebill to production worker wagebill ratio,

$$N/P\ Wagebill\,Ratio \;=\; \frac{w_N N}{w_P P}, \tag{2}$$

where w_N and w_P are the wages of non-production and production workers, respectively. We use the wagebill ratio rather than the raw input ratio (N/P) to account for unobserved skill variation across plants and regions (Bernard and Schott 2002).[14]

[14] In the two-factor version of the factor proportions framework developed in Figure 1, industries were identified by their capital intensity. Our empirical work controls for

4.2. Measuring Plant Productivity

It is possible for firms to survive exposure to low-wage countries via productivity improvements. As a result, we control for plant total factor productivity (TFP) in our empirical analysis. As is well known, accurately measuring a plant's multi-factor productivity is quite difficult, and we are constrained here in our choice of productivity measures because we have only single observations for many of the establishments in our sample. We measure TFP as the residual of a five-input production function for each industry and year, where the inputs are two types of capital, two types of labor and purchased inputs. By construction the measure is mean zero for each industry in each period.

We recognize this procedure's inability to control for the co-movement of markups and productivity, or the co-movements of variable inputs and productivity. We note that our reported results are robust to using plant TFP estimates generated from Bartelsman et al. (2000) industry cost shares. We also note that the relationship we find between plant outcomes and exposure to low-wage countries is robust to omitting TFP from all specifications.

5. Empirical Results: Plant Survival and Growth

Plant outcomes between years t and $t+5$ are related to a set of year t plant characteristics ($\mathbf{Z}_{pt}$), the average import share of low-wage countries in the preceding five years (VSH_{it}), and interactions of plant input intensities and productivity with VSH_{it} ($\mathbf{X}_{ipt}$),

$$Outcome_p^{t:t+5} = f(\mathbf{Z}_{pt}, VSH_{it}, \mathbf{X}_{ipt}). \tag{3}$$

We relate the levels of plant and industry characteristics in year t to changes in plant outcomes across Census years t to $t+5$ to mitigate endogeneity of contemporaneous behavior and plant characteristics. We further discuss the implications of the timing of our regressions in Section 5.5..

We consider three types of plant outcomes. The first is plant death, which we estimate via probit,

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both the capital and skill intensity of an industry to fix its location in a three-dimensional factor space.

$$\Pr\left(Death_p^{t:t+5}\right) = \Phi\left(\mathbf{Z}'_{pt}\boldsymbol{\alpha} + VSH'_{it}\beta + \mathbf{X}'_{ipt}\boldsymbol{\gamma} + \delta_t\right). \tag{4}$$

Our set of plant characteristics encompasses log total employment ($N + P$), age, log TFP, log capital intensity (K/P) and skill intensity, i.e. the N/P wagebill ratio from equation (2).[15] Our inclusion of controls for plant size (total employment) and plant age is motivated by the empirical work of Dunne et al. (1988, 1989) and subsequent theoretical models by Hopenhayn (1992a,b), Olley and Pakes (1996) and others.[16] Equation (4) also includes time fixed effects, δ_t; industry or plant fixed effects are also added to some specifications, as noted. Standard errors are adjusted for clustering at the plant level.[17]

The second and third outcomes we consider are changes in plant employment and plant real output, which we estimate by OLS,

$$\Delta Employment_p^{t:t+5} = c + \mathbf{Z}'_{pt}\boldsymbol{\alpha} + VSH'_{it}\beta + \mathbf{X}'_{ipt}\boldsymbol{\gamma} + \delta_t + \boldsymbol{\varepsilon}_{pt}, \tag{5}$$

$$\Delta Real\ Output_p^{t:t+5} = c + \mathbf{Z}'_{pt}\boldsymbol{\alpha} + VSH'_{it}\beta + \mathbf{X}'_{ipt}\boldsymbol{\gamma} + \delta_t + \boldsymbol{\varepsilon}_{pt}. \tag{6}$$

Plant output is deflated with industry shipment deflators available in the NBER Productivity Database compiled by Bartelsman et al. (2000).[18] For symmetry, we use the same plant characteristics in (5) and (6) as in the death specification.[19] All three specifications control for plant capital and skill intensity as well as plant productivity.

[15] The LRD does not record the precise start year for any plant. Instead, we only know the first year the plant appears in a Census of Manufactures starting with the 1963 Census. Our measure of plant age is the difference between the current year and the first recorded Census year. Plants that are in their first Census are given an age of zero.

[16] The closed-economy model in Olley and Pakes (1996) also predicts faster growth for more capital intensive and productive plants.

[17] Results for regressions which adjust standard errors to allow for clustering at the industry level are similar.

[18] This dataset is publicly available at http://www.nber.org/nberces/nbprod96.htm.

[19] Numerous studies on mean reversion in plant employment growth have documented the relationship between initial size and age and subsequent changes in employment (e.g. Hall 1987 and Blonigen and Tomlin 2001). While we are not interested in testing Gibrat's law *per se*, we include the log of initial employment as well as plant age in all our specifications.

The hypotheses derived earlier from the factor proportions framework give us predictions on the coefficients for VSH_{it} and $\mathbf{X}_{ipt}$. With plant death as the dependent variable, $\beta > 0$ indicates that plant failure is positively associated with industry exposure to low-wage imports (Hypothesis 1), while $\boldsymbol{\gamma} < 0$ indicates the probability of plant death is relatively lower for more capital- and skill-intensive plants in those same industries (Hypothesis 2).

For the specifications considering plant growth, $\beta < 0$ indicates reallocation of employment and output away from industries where the United States is at a comparative disadvantage (Hypothesis 1), while $\boldsymbol{\gamma} > 0$ indicates reallocation towards more capital- and skill-intensive plants within those industries (Hypothesis 2).

Because our sample of plants includes deaths and births, we follow Davis and Haltiwanger (1992) in using a normalized growth rate in our analysis. For employment, this normalization is

$$\Delta Employment_p^{t:t+5} = \left(\frac{Employment_p^{t+5} - Employment_p^t}{\frac{1}{2}\left(Employment_p^{t+5} + Employment_p^t\right)} \right) /5. \quad (7)$$

Because we cannot observe the characteristics of plants prior to their birth, we are unable to include birth observations in our empirical specifications below.[20]

5.1. *Plant Shutdown and Exposure to Low-Wage Country Imports*

Table 4 summarizes the estimated relationship between the probability of plant death between Census years t and $t+5$ and the average industry exposure to imports from low-wage countries across years $t-5$ to $t-1$. We estimate this relationship with and without interactions of VSH and plant characteristics, as well as with and without industry fixed effects. All specifications include year fixed effects to control for aggregate variation in plant death rates.

The first two columns of Table 4 report the marginal probability of failure for specifications with levels of VSH and plant characteristics. The

[20] To the extent that employment growth due to births is lower (higher) in industries with a greater low-wage import presence, the degree of reallocation due to low-wage imports may be understated (overstated).

results indicate that plant death is more likely for smaller, younger and less productive plants. These results are consistent with earlier research by Dunne et al. (1988, 1989). We also find plant death to be inversely related to capital intensity and unrelated to our measure of skill intensity.

Consistent with the factor proportions framework, the positive and statistically significant coefficient on VSH in columns one and two indicates that the probability of plant death increases with an industry's exposure to imports from low-wage countries. Comparison of the first and second column indicates that this relationship persists with the inclusion of industry fixed effects.[21] The results in column 1 indicate that a 10 percentage point increase in VSH (roughly one standard deviation) is associated with an increase in the probability of death of 3.3 percentage points. The average probability of death in the sample is 26.6 percent.

The last two columns of Table 4 include interactions of VSH with plant capital intensity, skill intensity and productivity. VSH by itself remains positive and significant in both columns as predicted by the theory. The interaction of VSH and capital intensity is negative and significant in both specifications, indicating that capital-intensive plants within industries are relatively less like to shut down between Census years in the face of low-wage imports. The point estimates in columns three and four indicate that a one standard deviation jump in plant log capital intensity is associated with declines in the probability of death of 1.8 and 1.0 percentage points, respectively. The skill intensity interaction is negative and significant when industry fixed effects are included in the specification, but the economic magnitude of this relationship is negligible. This finding suggests that either skill-intensity is not relevant in the presence of low-wage imports or that the measure of skill intensity is a poor proxy for skills in use at the plant.[22] The coefficient on the VSH-productivity interaction is negative but statistically insignificant in both columns.

[21] It is well known that plant birth and death rates covary across industries, in large part due to variations in the sunk costs of entry. See Dunne et al (1988, 1989). We include industry fixed effects to control for any unobserved industry-specific determinants of plant failures.

[22] In results not reported here, we find more support for the importance of skill in plant outcomes when we use the log average wages for production workers and for non-production workers as alternative measures of skill.

5.2. Plant Employment Growth and Exposure to Low-Wage Country Imports

Table 5 summarizes the estimated relationship between plant employment growth and industry exposure to imports from low-wage countries. As in the previous section, we estimate this relationship with and without interactions of VSH and plant characteristics, as well as with and without industry and plant fixed effects. All specifications include year fixed effects.

The first two columns of Table 5 report results with levels of VSH and plant characteristics. The first column has year but no industry fixed effects, while the second column has both year and industry fixed effects. The results indicate that employment growth is higher for larger, older and more productive plants. Plant employment growth is also positively and significantly associated with capital intensity but unrelated to our measure of skill intensity.

As predicted by the theory, the negative and statistically significant coefficient on VSH in columns one and two indicates that plant employment falls with its industry's exposure to imports from low-wage countries. The point estimate in column one indicates that a 10 percentage point increase in VSH is associated with a 1.3 percentage point lower annual employment growth.

The final three columns of Table 5 report results including interactions of VSH with plant characteristics. The three columns differ according to their inclusion of industry and plant fixed effects. Across all three specifications, employment growth continues to be negatively and significantly related to the level of VSH. Furthermore, the positive and significant coefficient on the VSH-capital interaction indicates that higher within-industry plant capital intensity mitigates exposure to low-wage imports. The interaction of plant productivity with VSH is positive and significant only in the final specification, which includes plant fixed effects. Interactions of VSH with skill intensity are statistically insignificant.

5.3. Plant Output Growth and Exposure to Low-Wage Country Imports

The negative relationship between plant employment growth and industry exposure to imports from low-wage countries has two interpretations.

The first is that plants facing such import competition shrink (or die). The second is that plants substitute away from relatively expensive U.S. labor and towards relatively inexpensive U.S. capital. Under the second interpretation, plant employment can decline as output remains constant (or increases). To differentiate between these scenarios, we investigate the relationship between real output growth and VSH in Table 6.

The results in Table 6 indicate that output and employment respond similarly to low-wage country import exposure. The coefficient on VSH is negative and statistically significant across specifications and is the same magnitude as that in the employment regressions. Interactions of VSH and plant input intensities and productivity, shown in the final three columns, indicate reallocation of output over time to more productive and more capital-intensive plants within industries. The interaction of VSH and plant skill intensity is positive and significant in the specification containing industry fixed effects.

5.4. Robustness of Results to Trade with Other Sets of Countries

In this section we demonstrate the robustness of the relationship between plant outcomes and exposure to low-wage country imports after controlling for alternate proxies of international trade and the share of import value originating in alternate groups of countries. Robustness is reported only for the plant death and plant employment specifications to save space. Results for changes in output convey the same message. To verify robustness, we compare the point estimates on VSH after including additional controls. To simplify reporting and save space, we use the specification with plant characteristics and levels of VSH and including year and industry fixed effects.[23]

Table 7 summarizes our robustness findings for the plant death specification. The first column of the table reproduces the results of the second column of Table 4. Each subsequent column includes an additional measure of international trade. Results indicate that inclusion of these additional controls does not affect the sign or significance of the VSH coefficient; low-wage imports are associated with increased probabilities of plant death in

[23] Similar results are obtained for a specification that includes interactions of the import measures with plant characteristics.

every column. The results also indicate that, controlling for VSH, plant failure is positively and significantly associated with import penetration, and negatively and significantly associated with exposure to OECD and Tiger import shares.[24]

Table 8 summarizes the robustness results for the employment growth specification, following the format of the previous table. Here, too, the inclusion of additional control variables does not affect the sign or significance of the VSH coefficient; in all columns, higher levels of low-wage import shares are associated with lower subsequent annual plant employment growth rates. Table 8 also reveals that, controlling for VSH, plant employment is positively but not significantly related to import penetration or OECD exposure and is positively and significantly related to Tiger exposure.[25]

The results in this section emphasize that the relationship between plant outcomes and low-wage country imports persists even when controlling for aggregate import penetration or imports originating in other types of countries.

5.5. Robustness of Results to Reverse-Causality and Omitted Variables

The results of this section demonstrate a clear relationship between imports from low-wage countries and reallocation across and within U.S. manufacturing plants. The robustness tests demonstrate that this relationship survives even after controlling for other measures of international trade and the share of import value from alternate groups of countries.

There are two explanations for the negative association between plant survival and growth and industry exposure to imports from low-wage countries. The first, which guides our analysis, is that competition from low-wage countries forces U.S. plants out of product markets at odds with U.S. comparative advantage. According to this view, low-wage countries enter and the U.S. responds. Our results are consistent with this explanation:

[24] As noted above, OECD countries are the 22 members as of 1974, i.e. excluding subsequent entrants such as Mexico and Korea. Asian Tigers are Korea, Taiwan, Singapore and Hong Kong.

[25] The positive and significant relationship beween plant survival and growth and exposure to the Asian Tigers in these robustness regressions may be related to firm outsourcing. This intriguing result merits additional exploration.

U.S. manufacturing is reallocating towards a more capital-intensive mix of manufacturing and the movement is strongest where the presence of low-wage country imports is greatest in prior years.

An alternative explanation emphasizes either causality in the opposite direction or an omitted variable that affects both plant performance and the share of imports from low-wage countries. According to this view low-wage countries enter product markets being abandoned by the U.S., perhaps as a result of poor domestic productivity growth or skill-biased technological change.

We attempt to distinguish between these views by controlling for industry (and plant) fixed effects as well as by relating future plant outcomes (t to $t+5$) to prior levels of low-wage country import exposure (the average from $t-5$ to $t-1$). For our findings to be consistent with an endogenous response of low-wage countries to future changes in the U.S. industries, low-wage countries must be entering industries years before the U.S. begins to abandon them.

As a further check, we estimate whether future levels of VSH are associated with prior changes in industry employment. Table 9 reports industry-level OLS results of regressing either the t+5 level of VSH or the change in VSH between years t and $t+5$ on prior ($t-5$ to t) changes in industry employment and additional control variables. These controls mirror those included above. Evidence that U.S. movement out of certain manufacturing industries creates a vacuum subsequently filled by low-wage countries implies a negative relationship between past employment changes and future VSH. No such relationship is evident. Table 9 indicates that the coefficients on prior employment changes are positive and statistically insignificant.

To check whether our results are driven by omitted variables that affect both plant performance and VSH, we report in Table 10 the results of adding additional industry characteristics to our plant-level regressions. While there are numerous possible candidate theories to explain relative performance across industries, we focus on prior ($t-5$ to t) growth in industry productivity, employment, and skill-biased technological change (via the non-production to production worker relative wage). As indicated in Table 10, the coefficient on VSH remains unchanged in sign, level and significance for both the plant death and employment growth specifications.

Even in the presence of these additional controls, low-wage import shares continue to be strongly negatively correlated with plant outcomes.

Based on the robustness of the relationship between low-wage import shares and plant performance, we conclude that our results are not driven by reverse causation or omitted variables.

6. Empirical Results: Industry Switching

In this section, we provide the first evidence that firms systematically adjust their product mix in response to pressure from international trade. Specifically, we investigate the third implication of plant behavior motivated by the factor proportions framework: that plants change their product mix toward more capital and skill-intensive industries as low-wage imports increase (Hypothesis 3).

The LRD tracks plant output according to the primary industry of the plant. Plants whose production spans four-digit industries are assigned the industry of their predominant products.[26] It is reasonable to assume that a large fraction of product mix changes by a plant occur within four-digit industries, and therefore will not affect the assigned industry code. On the other hand, some of these changes may occur across four-digit industries. In this section, we analyze these observable switches in product mix to determine if they are related to industry exposure to imports from low-wage countries.[27] Though plants producing roughly equal amounts of two industries may "switch industries" spuriously, this random variation should bias us against finding any systematic changes in the capital- and skill-intensity of a plant's old and new industries.

Roughly 25,000 U.S. manufacturing plants switch industries in our four panels, an average of 7.8 percent of surviving plants in each five-year period. Table 11 compares the industry capital intensity, skill intensity and VSH across these plants' old and new industries using t-tests. For each switch

[26] For a multi-product plant that produces in more than one SIC4 industry, its primary SIC4 industry is given by the industry that represents the greatest share of plant output. Some plants may have less than 50% of total output in their primary industry category.

[27] Bernard and Jensen (2004) find that plants that switch industries have a higher probability of becoming exporters. This movement into more viable products is consistent with the view that plants escape low wage country competition by upgrading their product mix.

occurring between years t and $t+5$, we compare contemporaneous industry characteristics, i.e. the characteristics that the old and new industries have in year t. Results indicate that destination industries are 2.1 percent more capital intensive, 6.8 percent more skill intensive, and face lower shares of low-wage country imports (2.1 percentage points) than the industries left behind. These differences are statistically significant at the 1 percent level for input intensities and at the 10 percent level for VSH.

Table 12 addresses whether the probability of switching and the magnitude of changes in old versus new industry capital and skill intensity are related to VSH. The first column reports probit results using plant controls and interactions with VSH identical to those used earlier. The results indicate that the probability of switching is positively associated with exposure to low-wage country imports. Within industries, however, plant capital intensity is negatively associated with industry switching. These results are consistent with the factor proportions framework: plants in industries subject to intense competition from low-wage countries are more likely to re-orient production away from this competition, but are less likely to do so if their output within that industry faces less direct competition.

The second and third columns of Table 12 regress the percent difference in industry factor intensity for switching plants on plant characteristics and VSH. Results in column two indicate that plants leaving industries with high VSH move to industries with higher capital intensity than the average switching plant. The third column indicates no statistically significant relationship between changes in industry skill intensity and VSH.

The evidence presented in this section suggests that U.S. manufacturing plants adjust to competition from low-wage countries by altering the mix of goods they produce.

7. Conclusions

Imports from low-income countries were the fastest growing component of U.S. trade from 1972 to 1997, increasing far more rapidly than aggregate imports. This paper considers the role of imports from low-wage countries in U.S. manufacturing plant outcomes over time.

Across industries, we find that plant survival, employment growth and output growth are disproportionately lower in industries with higher exposure to imports from low-wage countries. Within industries, we demonstrate that capital-intensive plants – i.e. the plants most likely to be producing goods in line with U.S. relative endowments – are more likely to survive and grow than labor-intensive plants. Finally, we show that some U.S. manufacturing plants adjust their product mix in response to competition from low-wage countries. Plants facing higher shares of low-wage imports are more likely to switch industries. When plants do switch, they jump towards industries that are on average less exposed to low-wage countries, and more capital and skill intensive, than the industries they left behind.

Each of these results supports the view that the U.S. manufacturing resources are moving away from activities that overlap with low-wage countries and towards activities that are more consistent with U.S. comparative advantage. They also suggest that trade with low-wage countries has accelerated U.S. capital deepening across and within manufacturing industries over time.

Our results also raise a number of interesting questions worthy of further inquiry. High productivity, for example, does not appear to insulate plants from exposure to low-wage country imports. This result may reveal that the productivity required to overcome competition from the world's lowest wage countries is very high, particularly for the most labor-intensive plants and industries. We also find that skill intensity does not mitigate low-wage country competition, which is more puzzling. Finally, it would be useful to examine the relationship between firm profitability and low-wage country competition to determine whether the reallocation documented here is also accompanied by greater firm flexibility in terms of outsourcing.

This paper only begins to examine the role of increased trade with low-income countries on firms and industries in the United States Additional theoretical and empirical progress is needed on the menu of responses available to firms, including investment, workforce upgrading, and product switching and innovation. To the extent that manufacturing output is not uniform across regions within the United States, our results also suggest significant variation in the regional effects of low-wage country competition in terms of industry structure, wage levels and income inequality.

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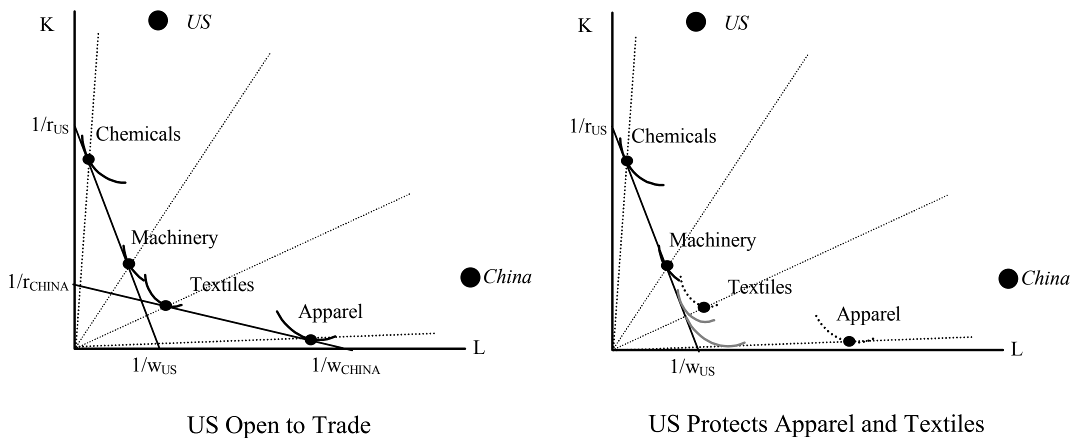

Figure 1: Industry Specialization in the Factor Proportions Framework

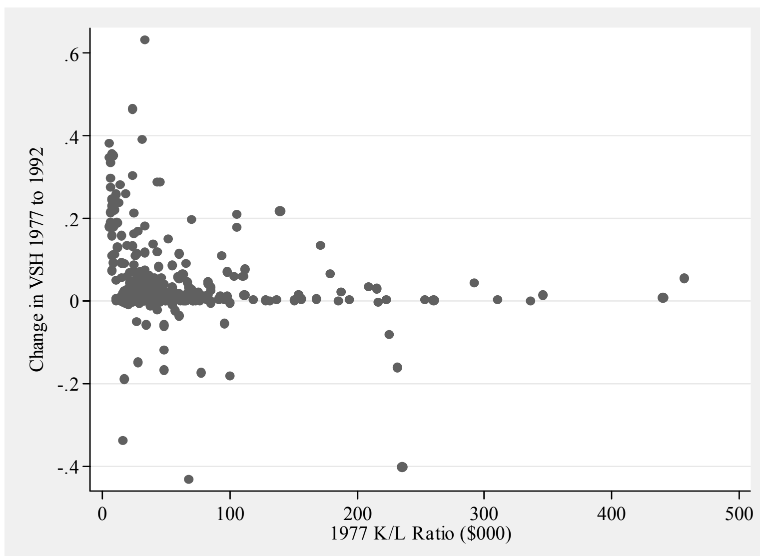

Figure 2: Changes in Low-Wage Import Shares by Industry Capital Intensity, 1977-1992

Afghanistan	China	India	Pakistan
Albania	Comoros	Kenya	Rwanda
Angola	Congo	Lao PDR	Samoa
Armenia	Equatorial Guinea	Lesotho	Sao Tome
Azerbaijan	Eritrea	Madagascar	Sierra Leone
Bangladesh	Ethiopia	Malawi	Somalia
Benin	Gambia	Maldives	Sri Lanka
Bhutan	Georgia	Mali	St. Vincent
Burkina Faso	Ghana	Mauritania	Sudan
Burundi	Guinea	Moldova	Togo
Cambodia	Guinea-Bissau	Mozambique	Uganda
Central African Rep	Guyana	Nepal	Vietnam
Chad	Haiti	Niger	Yemen

Table 1: Low-Wage Countries 1972 to 1992

	Imports from Low-Wage Countries (%)				ΔEmployment
Two-Digit SIC Industry	1977	1982	1987	1992	1972-1997
20 Food	8.7	3.6	5.6	8.8	-3.4
21 Tobacco	6.2	1.2	14.6	14.5	-45.3
22 Textile	10.5	13.3	17.7	19.0	-37.5
23 Apparel	7.6	11.0	19.7	31.9	-40.4
24 Lumber	3.7	2.8	7.6	8.6	7.6
25 Furniture	1.1	2.3	3.3	4.7	6.0
26 Paper	0.0	0.1	0.2	0.5	0.6
27 Printing	0.2	0.5	0.5	2.9	41.9
28 Chemicals	0.9	1.6	2.1	1.8	2.7
29 Petroleum	1.5	3.6	5.3	6.8	-27.7
30 Rubber & Plastic	0.3	0.6	1.4	12.6	49.3
31 Leather	3.6	4.3	6.4	19.7	-69.3
32 Stone	0.7	1.2	1.6	4.0	-14.4
33 Primary Metal	1.4	2.2	2.6	3.6	-39.4
34 Fabricated Metal	0.5	1.1	1.5	3.6	-4.0
35 Industrial Machinery	0.2	0.3	0.4	0.9	13.6
36 Electronic	0.6	1.9	3.2	5.0	10.0
37 Transportation	0.0	0.0	0.0	0.1	3.8
38 Instruments	0.3	0.4	0.7	2.8	10.2
39 Miscellaneous	5.7	6.4	9.4	19.2	-9.5
Average	1.9	2.2	3.2	5.7	-2.5
Standard Deviation	5.1	4.2	6.4	10.1	

Notes: Columns two through five report low-wage country import shares (VSH) across two-digit SIC manufacturing industries. The VSH reported for each census year is the average import share across the preceding five years (e.g. the 1977 value is the average of all import shares from 1972 to 1976). Column six reports the change in two-digit SIC employment over the sample period using Bureau of Labor Statistics data (www.bls.gov). The final two rows of the table report the import-value weighted average and standard deviation of VSH, and the empolyment-weighted average employment growth, across four-digit SIC manufacturing industries.

Table 2: Low-Wage Import Share Across Two-Digit SIC Manufacturing Industries and Time

Measure of Import Exposure	Correlation with Low-Wage Country Import Value Share (VSH)	Observations
Import Penetration	0.14 ***	1282
Change in Real Import Price Index	-0.09	93
OECD Value Share	-0.61 ***	1282
Tiger Value Share	0.19 ***	1282

Notes: Correlations are computed across industries and Census years (1977, 1982, 1987 and 1992) and control for time effects. All correlations except for real import price changes are across four-digit SIC industries; import price correlation is across three-digit SIC industries. OECD and Tiger value shares are the share of industry imports originating in OECD countries (except Mexico, Korea and newer entrants) and Asian Tigers (Korea, Taiwan, Singapore and Hong Kong), respectively. Three-digit SIC import price indexes are from Feenstra (1996) and are deflated by the U.S. PPI. Import price changes are computed as the average annual change in the real index across Census years. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 3: Correlation of Low-Wage Country Value Share with Other Measures of Import Exposure

Independent Variables	Plant Death$_{t:t+5}$	Plant Death$_{t:t+5}$	Plant Death$_{t:t+5}$	Plant Death$_{t:t+5}$
log(Employment$_{pt}$)	-0.044 ***	-0.058 ***	-0.044 ***	-0.058 ***
	(0.001)	(0.001)	(0.001)	(0.001)
Age$_{pt}$	-0.005 ***	-0.004 ***	-0.005 ***	-0.004 ***
	(0.000)	(0.000)	(0.000)	(0.000)
log(TFP$_{pt}$)	-0.073 ***	-0.074 ***	-0.072 ***	-0.073 ***
	(0.002)	(0.002)	(0.003)	(0.003)
log(K/P$_{pt}$)	-0.024 ***	-0.013 ***	-0.016 ***	-0.010 ***
	(0.001)	(0.001)	(0.001)	(0.001)
N/P Wagebill Ratio$_{pt}$	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000
Low Wage Value Share (VSH$_{it}$)	0.321 ***	0.163 ***	0.687 ***	0.344 ***
	(0.009)	(0.022)	(0.020)	(0.030)
x log(TFP$_{pt}$)			-0.030	-0.036
			(0.027)	(0.027)
x log(K/P$_{pt}$)			-0.141 ***	-0.073 ***
			(0.007)	(0.008)
x N/P Wagebill Ratio$_{pt}$			0.000	-0.001 **
			(0.000)	-(0.001)
Industry Fixed Effects	None	SIC4	None	SIC4
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	443,755	443,756	443,757	443,757
Log Likelihood	-245,466	-239,976	-245,231	-239,936

Notes: Plant-level probit regression results where the reported coefficients represent the change the marginal probability of plant death at the mean of the regressors. Robust standard errors adjusted for clustering at the plant level are in parentheses. Dependent variable indicates plant death between years t and t+5. N/P Wagebill Ratio is total plant wages paid to non-production workers (N) divided by total plant wages paid to production workers (P). VSH is the share of U.S. import value originating in countries with less than 5% of U.S. per capita GDP. Final three control variables are interactions with VSH. Regressions cover four panels: 1977-82, 1982-87, 1987-92 and 1992-97. Coefficients for the regression constant and dummy variables are suppressed. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 4: Plant Death and Exposure to Imports from Low-Wage Countries

Independent Variables	$\Delta Emp_{t:t+5}$	$\Delta Emp_{t:t+5}$	$\Delta Emp_{t:t+5}$	$\Delta Emp_{t:t+5}$	$\Delta Emp_{t:t+5}$
log(Employment$_{pt}$)	0.010 ***	0.013 ***	0.010 ***	0.013 ***	-0.096 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Age$_{pt}$	0.001 ***	0.001 ***	0.001 ***	0.001 ***	-0.011 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
log(TFP$_{pt}$)	0.050 ***	0.050 ***	0.050 ***	0.050 ***	0.033 ***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
log(K/P$_{pt}$)	0.018 ***	0.016 ***	0.014 ***	0.015 ***	0.008 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
N/P Wagebill Ratio$_{pt}$	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000
Low Wage Value Share (VSH$_{it}$)	-0.125 ***	-0.071 ***	-0.310 ***	-0.149 ***	-0.467 ***
	(0.005)	(0.009)	(0.009)	(0.014)	(0.031)
x log(TFP$_{pt}$)			-0.003	-0.002	0.049 ***
			(0.013)	(0.012)	(0.027)
x log(K/P$_{pt}$)			0.069 ***	0.030 ***	0.094 ***
			(0.003)	(0.004)	(0.009)
x N/P Wagebill Ratio$_{pt}$			0.000	0.000	-0.008
			(0.000)	(0.000)	-(0.008)
Industry/Plant Fixed Effects	None	SIC4	None	SIC4	Plant
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	443,755	443,756	443,757	443,757	443,757
R^2	0.04	0.06	0.04	0.06	0.77

Notes: Plant-level OLS regression results. Robust standard errors adjusted for clustering at the plant level are in parentheses. Dependent variable is normalized plant employment growth between years t and t+5 (see text for normalization). N/P Wagebill Ratio is total plant wages paid to non-production workers (N) divided by total plant wages paid to production workers (P). VSH is the share of U.S. import value originating in countries with less than 5% of U.S. per capita GDP. Final three control variables are interactions with VSH. Regressions cover four panels: 1977-82, 1982-87, 1987-92 and 1992-97. Coefficients for the regression constant and dummy variables are suppressed. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5: Plant Employment Growth and Exposure to Imports from Low-Wage Countries

Independent Variables	$\Delta Output_{t:t+5}$	$\Delta Output_{t:t+5}$	$\Delta Output_{t:t+5}$	$\Delta Output_{t:t+5}$	$\Delta Output_{t:t+5}$
log($Employment_{pt}$)	0.016 ***	0.017 ***	0.016 ***	0.017 ***	-0.073 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Age_{pt}	0.001 ***	0.001 ***	0.001 ***	0.001 ***	-0.008 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
log(TFP_{pt})	-0.007 ***	-0.006 ***	-0.009 ***	-0.009 ***	-0.100 ***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)
log(K/P_{pt})	0.010 ***	0.003 ***	0.005 ***	0.001 ***	-0.026 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
N/P Wagebill $Ratio_{pt}$	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Low Wage Value Share (VSH_{it})	-0.133 ***	-0.055 ***	-0.378 ***	-0.174 ***	-0.448 ***
	(0.005)	(0.010)	(0.010)	(0.015)	(0.033)
x log(TFP_{pt})			0.060 ***	0.061 ***	0.085 ***
			(0.014)	(0.013)	(0.032)
x log(K/P_{pt})			0.092 ***	0.045 ***	0.093 ***
			(0.003)	(0.004)	(0.009)
x N/P Wagebill $Ratio_{pt}$			0.000	0.001 ***	-0.004
			(0.000)	(0.001)	-(0.004)
Industry/Plant Fixed Effects	None	SIC4	None	SIC4	Plant
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	443,755	443,756	443,757	443,757	443,757
R^2	0.04	0.06	0.04	0.06	0.74

Notes: Plant-level OLS regression results. Robust standard errors adjusted for clustering at the plant level are in parentheses. Dependent variable is normalized plant real output growth between years t and t+5 (see text for normalization). N/P Wagebill Ratio is total plant wages paid to non-production workers (N) divided by total plant wages paid to production workers (P). VSH is the share of U.S. import value originating in countries with less than 5% of U.S. per capita GDP. Final three control variables are interactions with VSH. Regressions cover four panels: 1977-82, 1982-87, 1987-92 and 1992-97. Coefficients for the regression constant and dummy variables are suppressed. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 6: Plant Real Output Growth and Exposure to Imports from Low-Wage Countries

Independent Variables	Plant Death$_{t:t+5}$	Plant Death$_{t:t+5}$	Plant Death$_{t:t+5}$	Plant Death$_{t:t+5}$
log(Employment$_{pt}$)	-0.058 ***	-0.057 ***	-0.057 ***	-0.057 ***
	(0.001)	(0.001)	(0.001)	(0.001)
Age$_{pt}$	-0.004 ***	-0.004 ***	-0.004 ***	-0.004 ***
	(0.000)	(0.000)	(0.000)	(0.000)
log(TFP$_{pt}$)	-0.074 ***	-0.073 ***	-0.074 ***	-0.074 ***
	(0.002)	(0.002)	(0.002)	(0.002)
log(K/P$_{pt}$)	-0.013 ***	-0.013 ***	-0.013 ***	-0.013 ***
	(0.001)	(0.001)	(0.001)	(0.001)
N/P Wagebill Ratio$_{pt}$	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Low Wage Value Share (VSH$_{it}$)	0.163 ***	0.122 ***	0.147 ***	0.116 **
	(0.022)	(0.024)	(0.022)	(0.025)
Import Penetration$_{it}$		0.052 **		
		(0.021)		
OECD Value Share$_{it}$			-0.031 ***	
			(0.010)	
Tiger Value Share$_{it}$				-0.048 ***
				(0.014)
Industry Fixed Effects	SIC4	SIC4	SIC4	SIC4
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	443,757	418,826	443,757	443,757
Log Likelihood	-239,976	-226,705	-241,684	-241,683

Notes: Plant-level probit regression results where the reported coefficients represent the change the marginal probability of plant death at the mean of the regressors. Robust standard errors adjusted for clustering at the plant level are in parentheses. Dependent variable indicates plant death between years t and t+5. N/P Wagebill Ratio is total plant wages paid to non-production workers (N) divided by total plant wages paid to production workers (P). VSH is the share of U.S. import value originating in countries with less than 5% of U.S. per capita GDP. Import penetration is total imports divided by domestic absorption. OECD and Tiger value shares are share of imports originating in the OECD (1974 definition; see text) and Korea, Taiwan, Singapore and Hong Kong, respectively. Regressions cover four panels: 1977-82, 1982-87, 1987-92 and 1992-97. Coefficients for the regression constant and dummy variables are suppressed. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7: Robustness of Plant Death Results to Alternate Measures of Import Exposure

Independent Variables	$\Delta Emp_{t:t+5}$	$\Delta Emp_{t:t+5}$	$\Delta Emp_{t:t+5}$	$\Delta Emp_{t:t+5}$
log($Employment_{pt}$)	0.013 ***	0.012 ***	0.013 ***	0.013 ***
	(0.000)	(0.000)	(0.000)	(0.000)
Age_{pt}	0.001 ***	0.001 ***	0.001 ***	0.001 ***
	(0.000)	(0.000)	(0.000)	(0.000)
log(TFP_{pt})	0.050 ***	0.049 ***	0.050 ***	0.050 ***
	(0.001)	(0.001)	(0.001)	(0.001)
log(K/P_{pt})	0.016 ***	0.017 ***	0.016 ***	0.016 ***
	(0.000)	(0.000)	(0.000)	(0.000)
N/P Wagebill $Ratio_{pt}$	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Low Wage Value Share (VSH_{it})	-0.071 ***	-0.067 ***	-0.069 ***	-0.050 ***
	(0.009)	(0.010)	(0.010)	(0.010)
Import $Penetration_{it}$		0.012		
		(0.009)		
OECD Value $Share_{it}$			0.003	
			(0.004)	
Tiger Value $Share_{it}$				0.082 ***
				(0.006)
Industry Fixed Effects	SIC4	SIC4	SIC4	SIC4
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	443,757	418,826	443,757	443,757
R^2	0.04	0.06	0.06	0.06

Notes: Plant-level OLS regression results. Robust standard errors adjusted for clustering at the plant level are in parentheses. Dependent variable is normalized plant employment growth between years t and t+5 (see text for normalization). N/P Wagebill Ratio is total plant wages paid to non-production workers (N) divided by total plant wages paid to production workers (P). VSH is the share of U.S. import value originating in countries with less than 5% of U.S. per capita GDP. Import penetration is total imports divided by domestic absorption. OECD and Tiger value shares are share of imports originating in the OECD (1974 definition; see text) and Korea, Taiwan, Singapore and Hong Kong, respectively. Regressions cover four panels: 1977-82, 1982-87, 1987-92 and 1992-97. Coefficients for the regression constant and dummy variables are suppressed. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8: Robustness of Plant Employment Growth Results to Alternate Measures of Import Exposure

Independent Variables	VSH_{t+5}	$\Delta VSH_{t:t+5}$
$Employment_t$	-0.117 ***	-0.007 **
	0.028	0.003
$log(TFP_t)$	0.018	-0.002
	0.019	0.002
$log(K/P_t)$	-0.041	-0.001 ***
	0.027	0.003
N/P Wagebill $Ratio_t$	0.070 ***	0.007 **
	0.021	0.003
$\Delta Employment_{t-5:t}$	0.100	0.005
	0.114	0.016
Industry Fixed Effects	SIC4	SIC4
Year Fixed Effects	Yes	Yes
Observations	1,531	1,531
R^2	0.73	0.38

Notes: Industry-level OLS regression results. Dependent variable is either level of low-wage import share five years ahead or change in the value share between years t and t+5. N/P Wagebill Ratio is total plant wages paid to non-production workers (N) divided by total plant wages paid to production workers (P). Regressions cover four panels: 1977-82, 1982-87, 1987-92 and 1992-97. Coefficients for the regression constant and dummy variables are suppressed. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 9: Industry Employment Changes Do Not Precede Changes in the Share of Imports Originating in Low-Wage Countries

Independent Variables	Plant Death$_{t:t+5}$	ΔEmp$_{t:t+5}$
log(Employment$_{pt}$)	-0.058 ***	0.013 ***
	(0.001)	(0.000)
Age$_{pt}$	-0.004 ***	0.001 ***
	(0.000)	(0.000)
log(TFP$_{pt}$)	-0.074 ***	0.050 ***
	(0.002)	(0.001)
log(K/P$_{pt}$)	-0.013 ***	0.016 ***
	(0.001)	(0.000)
N/P Wagebill Ratio$_{pt}$	0.000	0.000
	(0.000)	(0.000)
Low Wage Value Share (VSH$_{it}$)	0.162 ***	-0.072 ***
	(0.022)	(0.009)
ΔEmployment$_{i,t-5:t}$	-0.106 ***	-0.079 ***
	(0.024)	(0.011)
ΔTFP$_{i,t-5:t}$	0.097 ***	0.026 **
	(0.025)	(0.011)
ΔRelative Wage$_{i,t-5:t}$	-0.068	-0.051 ***
	(0.043)	(0.019)
Industry Fixed Effects	SIC4	SIC4
Year Fixed Effects	Yes	Yes
Observations	443,757	443,757
Log Likelihood/ R^2	-239,962	0.06

Notes: First column is plant-level probit regression results where the reported coefficients represent the change the marginal probability of plant death at the mean of the regressors. Second column reports OLS regression results. Robust standard errors adjusted for clustering at the plant level are in parentheses. Dependent variable indicates plant outcomes between years t and t+5. N/P Wagebill Ratio is total plant wages paid to non-production workers (N) divided by total plant wages paid to production workers (P). VSH is the share of U.S. import value originating in countries with less than 5% of U.S. per capita GDP. Final three control variables are log differences from t-5 to t in industry employment, TFP and non-production to production-worker wage. Regressions cover four panels: 1977-82, 1982-87, 1987-92 and 1992-97. Coefficients for the regression constant and dummy variables are suppressed. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 10: Robustness to The Inclusion of Additional Industry Controls

Characteristic	Mean Difference Across Plants Between New and Old Industries	T Statistic (Mean=0)	P Value
Plant Capital Intensity (K/P)	2.1%	5.8	0.00
Plant N/P Wagebill Ratio	6.8%	9.1	0.00
Industry Low Wage Value Share (VSH)	-2.1%	1.6	0.09

Notes: Calculations based upon a sample of 25,423 plants that switched their four-digit SIC industry between at least one of four five-year panels: 1977-82, 1982-87, 1987-92 and 1992-97.

Table 11: Characteristics of Old and New Industries for Plants that Switch Industries

Independent Variables	Pr(ΔIndustry$_{t:t+5}$)	ΔK/P$_{t:t+5}$	ΔN/P Wagebill Ratio$_{t:t+5}$
log(Employment$_{pt}$)	0.051 ***	0.000	-0.016 ***
	(0.003)	(0.003)	(0.008)
Age$_{pt}$	-0.012 ***	0.000	-0.003 ***
	(0.000)	(0.000)	(0.001)
log(TFP$_{pt}$)	-0.011	0.055 ***	0.250 ***
	(0.014)	(0.012)	(0.031)
log(K/P$_{pt}$)	-0.021 ***	-0.035 ***	0.018 *
	(0.004)	(0.004)	(0.010)
N/P Wagebill Ratio$_{pt}$	0.000	0.002	-0.001
	(0.000)	(0.001)	(0.005)
Low Wage Value Share (VSH$_{it}$)	0.363 ***	0.564 ***	0.016
	(0.110)	(0.059)	(0.093)
x log(TFP$_{pt}$)	-0.190		
	(0.157)		
x log(K/P$_{pt}$)	-0.177 ***		
	(0.036)		
x N/P Wagebill Ratio$_{pt}$	0.000		
	(0.002)		
Observations	325,502	25,423	25,423
R^2	na	0.01	0.00
Log Likelihood	-89,684	na	na

Notes: First column is plant-level probit regression results where the reported coefficients represent the change the marginal probability of industry switch at the mean of the regressors. Second and third columns are OLS regression results. Robust standard errors adjusted for clustering at the plant level are in parentheses. Dependent variable in first column indicates plant changes four-digit SIC manufacturing industry between years t and t+5. Dependent variables in second and third columns are log difference of plant capital (K/P) and skill (N/P Wagebill Ratio) intensity, respectively, between years t and t+5. N/P Wagebill Ratio is total plant wages paid to non-production workers (N) divided by total plant wages paid to production workers (P). VSH is the share of U.S. import value originating in countries with less than 5% of U.S. per capita GDP. Final three control variables are interactions with VSH. Regressions cover four panels: 1977-82, 1982-87, 1987-92 and 1992-97. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 12: Industry Switching and Exposure to Imports from Low-Wage Countries