Trade Liberalization and Job Flows

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First version: January 2010
This version: June 2010

Abstract

This paper presents theory and evidence of the impact of trade liberalization on job flows. Theoretically, we present a model with heterogeneous firms and heterogeneous offshoring costs that has implications for the effect of trade liberalization on both margins of employment: the extensive (due to births and deaths of firms) and the intensive (due to expansions and contractions of firms' employment). After a decrease in the cost of trading/offshoring, the model predicts job destruction along the extensive margin, but an ambiguous effect along the intensive margin. Empirically, we test the model's implications using a longitudinal database containing the entire universe of establishments in California's manufacturing industry from 1992 to 2004. We find positive association between trade costs and job creation at the intensive margin and negative association between trade costs and job destruction at both intensive and extensive margins.

Keywords: trade liberalization, offshoring, job flows, heterogeneous firms.
JEL codes: F12, F14, F16.

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1 Introduction

The study of the effects of trade liberalization on the labor market is a core topic in international trade. As mentioned by Feenstra (2010), the structure of the trade models developed to analyze these issues has evolved from a Heckscher-Ohlin framework with trade in final goods to more sophisticated structures centered on offshoring possibilities for intermediate inputs. Although both types of models have implications for employment changes, the theoretical and empirical focus of this research has been mostly related to the effects of trade liberalization on wage inequality between skilled and unskilled labor. In this paper we shift away from wage inequality issues and focus instead on the effects of trade liberalization on job flows.

First, we introduce a model of trade in intermediate inputs and job flows whose main ingredients are heterogeneous firms à la Melitz (2003) and heterogeneous offshoring costs à la Grossman and Rossi-Hansberg (2008). In this model, a change in the fixed or variable cost of importing inputs (or offshoring)[1] has an impact on the four components of job flows: job creation by *expansion* of existing firms, job creation by *birth* of firms, job destruction by *contraction* of existing firms, and job destruction by *death* of firms. Second, we test the model's implications empirically using a longitudinal database that includes the universe of establishments in California's manufacturing industry from 1992 to 2004.

Our model has two sectors: a differentiated-goods sector and a homogeneous-good sector that serves as the numeraire. Firms in the differentiated-goods sector are heterogeneous with respect to their productivity and assemble the goods using a continuum of inputs in the interval $[0, 1]$. As in Melitz (2003), in order to produce a differentiated good, a firm incurs a sunk entry cost and then draws a productivity from a distribution. If the productivity draw is good enough to cover the fixed cost of operating, then the firm undertakes production. Otherwise, it exits immediately. Moreover, after learning its productivity, a firm also has to decide what fraction of inputs it wants to produce domestically and what fraction to import (or offshore). There are both fixed and variable costs of offshoring inputs. Following Grossman and Rossi-Hansberg (2008), the inputs are ordered in the interval $[0, 1]$ so that the variable cost of offshoring is higher for higher indexed inputs—that is, the variable cost of offshoring is increasing in the interval $[0, 1]$. In this setting, we show that only some high productivity firms offshore inputs. For the offshoring firms, the fraction of inputs being offshored lies in the interval $(0, 1]$—so that if it is

[1] We use interchangeably the terms 'importing inputs' and 'offshoring' throughout the paper.

one, the firm is basically importing a finished good.

In the comparative static exercises, we find that a decrease in the variable cost of offshoring has several effects on the extensive and intensive margins of employment, where the extensive margin refers to job flows due to births and deaths of firms, while the intensive margin refers to job flows due to expansions and contractions of existing firms' employment. First, firms that were already offshoring start offshoring a greater fraction of inputs. This has two offsetting effects—along the intensive margin—on the number of workers each firm hires domestically. While the import of a greater fraction of inputs reduces the number of domestic jobs (a contraction), the increase in productivity resulting from the import of lower-cost inputs increases the market share of these firms vis-à-vis firms that procure all their inputs domestically. This business stealing effect leads to job creation (by expansion), rendering the net effect on the employment of these firms ambiguous. The same happens to those firms that switch from completely domestic procurement of inputs to offshoring. Second, among the non-offshoring firms, the firms that survive lose market share to more productive offshoring firms. This leads to job destruction on the intensive margin (by contraction). Third, some of the non-offshoring firms experience such a large loss in market share that they are forced to exit. This leads to job destruction at the extensive margin (by death). Finally, the steady state number of firms goes down as the trading cost decreases. This is an additional source of job destruction at the extensive margin.

The model can be extended to a multi-sector economy with identical results. Therefore, it has straightforward implications that we can test empirically. For the U.S., it is important to look at the manufacturing industry to understand the relationship between trade liberalization and job flows. According to data from the United States International Trade Commission (USITC), U.S. manufacturing imports accounted for about 92% of the U.S. total non-oil imports of goods for each year from 1990 to 2008. Just in 2007, the size of the U.S. manufacturing imports was 11.2% as proportion of GDP. Putting this number in perspective with respect to the three major trade partners of the U.S., 11.2% of the U.S. GDP is equivalent to 108% of Canada's GDP, 46% of China's GDP, and 151% of Mexico's GDP.[2]

Figure 1 presents more facts about the U.S. manufacturing industry. Figure 1a shows the evolution of employment and real GDP in manufacturing since 1949. The volatility of the employment level is substantial. Moreover, from 2000 to 2003 the manufacturing industry

[2]Source: World Economic Outlook (WEO) of the International Monetary Fund (IMF). The GDP of each country is measured in current U.S. dollars for 2007.

suffered its largest employment change in a three-year period, with a loss of about 2.86 million jobs.[3] Although this represents the loss of 16.4% of manufacturing jobs, the real GDP of the manufacturing industry in 2003 was only about 1.8% less than its real GDP in 2000. By 2007, even though the employment level continued to decline at a moderate pace (reaching almost its 1949 levels), the real GDP was 13.5% higher than in 2000. Therefore, the decline in the importance of manufacturing in the total U.S. GDP observed in Figure 1b does not mean that the U.S. manufacturing production is shrinking, but that it is just growing at lower rates than other sectors in the economy. What we can see from Figure 1b is that manufacturing imports increased dramatically since 1990 as proportion of U.S. GDP, reaching more than 11% by 2008 and very close to the share of manufacturing in the U.S. GDP. We proceed then by studying the relationship between job flows and trade costs in the manufacturing industry, and then relate our empirical results with the forces identified in our theoretical model.

For the empirical analysis we use an extract of the National Establishment Time Series (NETS) database that contains the entire universe of establishments in California's manufacturing industry from 1992 to 2004. As we show in the following section, California is not only interesting by itself, but is also representative of the U.S. manufacturing industry. From the NETS data, we decompose job flows at the establishment level and do a panel regression analysis using four-digit SIC industry level explanatory variables. We use tariffs as our measure of trade cost.

The key result of the empirical exercise is that a decrease in the trade costs for an industry, measured by the sum of ad valorem tariffs and ad valorem freight and insurance costs, is associated with less job creation and greater job destruction for establishments in that industry. In our empirical results, job creation is entirely driven by the expansion of existing firms, and hence the reduction in job creation induced by a reduction in trade cost is entirely at the intensive margin. Upon disaggregating job destruction into deaths and contractions we find that the impact of a decrease in the average tariff works mainly through deaths of establishments. The impact on contractions is very small. That is, in response to a decrease in trade cost, the bulk of the job destruction occurs at the extensive margin.

As far as the related literature is concerned, a host of recent papers develop theoretical models to study the impact of globalization on sectoral and aggregate unemployment.[4] The

[3] For the entire labor force there was a loss of about 1.52 million jobs during the same period.

[4] The most prominent contributors to this literature are Carl Davidson and Steve Matusz. See Davidson,

unemployment in these papers is driven by search frictions. Mitra and Ranjan (2009) construct a theoretical model to study the impact of offshoring on unemployment. The results depend on the strength of the productivity effect of offshoring and the extent of intersectoral mobility of labor. However, empirically testing the implications of these models is difficult because constructing measures of sectoral unemployment is hard. Dutt, Mitra, and Ranjan (2009) get around this problem by studying the impact of trade liberalization on aggregate unemployment using cross-country data. They find short term spikes in unemployment following episodes of trade liberalization. However, the long run relationship between trade liberalization and unemployment is negative.

While we have created a model to study the impact of trade liberalization on job flows, Davidson and Matusz (2005) show how differential rates of job turnover across sectors can give rise to different patterns of net exports across sectors. Empirically, they find a negative relationship between net exports and job destruction and worker separation rates.

Klein, Schuh, and Triest (2003) study the impact of real exchange rate changes on job flows in the U.S. manufacturing industries from 1974 to 1993. Their key finding is that movements in trend real exchange rates significantly affect both job creation and destruction in the same direction and by similar magnitudes, thus they have large allocation effects but no effect on net employment growth. In contrast, an appreciation of the cyclical component of real exchange rates increases job destruction but has little effect on job creation, thus it reduces net employment growth but has no other allocation effects.[5]

A recent paper by Moser, Urban, and Weder di Mauro (forthcoming) studies the impact of real exchange rate changes on job flows using a sample of establishment-level data from Germany. They find evidence of net job losses in response to a real exchange rate appreciation. Their most interesting finding is that the bulk of adjustment in response to a real exchange rate appreciation occurs through less job creation than increased job destruction. They attribute this to rigid labor regulations which make job destruction costly for firms.

In contrast to the findings on the impact of an exchange rate appreciation on job flows, we find that a reduction in the industry tariff significantly reduces job creation and significantly increases job destruction. Moreover, the effect on job destruction is larger than the effect on job creation.

Martin, and Matusz (1999) for a representative work and Davidson and Matusz (2004) for a survey. Also see Moore and Ranjan (2005) and Helpman and Itskhoki (2007) for recent contributions to this literature.

[5]See Klein, Schuh, and Triest (2003) for a discussion of other studies that look at the relationship between exchange rate changes and job flows.

Also, given our theoretical predictions regarding the impacts on the intensive and extensive margins, we separate the total impact on job destruction into deaths and contractions, and find the impact of tariffs on deaths to be much more important than the impact on contractions.

Among other related papers, Bernard, Jensen, and Schott (2006) study the impact of imports from low wage countries on plant survival probabilities and employment growth. They find the plant survival rate to be negatively related with imports from low wage countries. As well, greater import penetration from low wage countries has a negative impact on employment growth; however, the effect is smaller for capital intensive plants suggesting a reallocation of labor from more labor intensive plants to more capital intensive plants. They also find evidence of firms adjusting their product mix in response to import competition from low wage countries. Another recent paper by Ebenstein, Harrison, McMillan, and Phillips (2009) looks at the impact of trade liberalization (offshoring, import penetration, export share) on wages and employment across U.S. industries. They find that offshoring to high wage countries is positively correlated with employment but offshoring to low wage countries is negatively correlated with employment. The impact on wage is qualitatively similar, but quantitatively smaller. Much of the negative effect of trade liberalization on wage operates through the departure of workers from manufacturing to agriculture and services where their wages are much lower. Unlike our paper, however, Bernard, Jensen, and Schott (2006) and Ebenstein, Harrison, McMillan, and Phillips (2009) do not look at the impact of globalization on gross job flows.

The paper is organized as follows. Section 2 presents an overview of the data, including patterns of job creation and job destruction at the intensive and extensive margins in California's manufacturing industry. In section 3 we introduce our model with heterogeneous firms and heterogeneous offshoring costs. Section 4 presents our theoretical model implications for each of the components of job creation and job destruction. In section 5 we estimate the effects of trade liberalization on the job flows' components using the NETS's establishment data for California. Finally, section 6 concludes.

2 Job Flows in California's Manufacturing Industry

In this section we take a first look at the four components of job flows in the manufacturing industry. As mentioned before, we have access to a subset of the NETS database that includes every establishment that was located in California in any year between 1992 and 2004.[6] Therefore, we begin by describing some facts about California in comparison to the entire country.

According to the Bureau of Economic Analysis (BEA) and the Census Bureau, in 2007 California—the largest state in the country in economic and population terms—accounted for 13.1% of the U.S. GDP and 12% of the country's population.[7] In manufacturing, California accounted for 11.3% of domestic production in 1990 and 11% by 2008. But what about manufacturing employment? In order for our analysis on job flows to be representative for the entire U.S. economy, we must show some evidence that California's manufacturing employment is highly correlated with national manufacturing employment. Figure 2a presents the national and California's manufacturing employment from 1990 to 2008 obtained from the Quarterly Census of Employment and Wages (QCEW) program of the Bureau of Labor Statistics (BLS). California's share in the U.S. manufacturing employment was about 11.6% in 1990 and 10.6% by 2008. The correlation coefficient between the two employment series is 0.93. Moreover, the correlation between the series first differences—the employment change from year to year—is 0.81. Thus, we conclude that employment levels and changes in California's manufacturing industry track very well the national manufacturing employment. Given this close relationship, we have no reason to suspect that the job flows behavior for the rest of the country is different from California.

We now compare the QCEW employment for California and the NETS data. Figure 2b shows the two series from 1992 to 2004. The correlation is 0.82 for the employment levels and 0.68 for the first differences. Although they are highly correlated, it is important to mention that there is a substantial difference between the total levels of employment in the two series. The NETS data reports on average 73% more employees than the QCEW data. Neumark, Zhang, and Wall (2007) and Neumark, Wall, and Zhang (forthcoming) provide an assessment of the NETS database and investigate, among other things, the difference in total employment levels between the NETS and two databases obtained from the BLS's ES-202 data: the QCEW and the Survey of Business (SOB). They report that part of the difference is due to the fact that 1) the ES-202 data excludes self-employed and proprietors, and 2) the NETS has a better coverage of

[6] In our dataset, a establishment is tracked all the years it is active as long as it was located in California for one or more years.

[7] According to the IMF's WEO database, the size of California's economy in 2007 (in nominal U.S. dollars) would place it as the eight largest economy in the world—just below Italy and above Spain, Canada, Brazil and Russia.

small establishments. With respect to the lower correlation for employment changes, Neumark et al. (forthcoming) find that there is some stickiness in the NETS data and this is reflected in year-to-year changes. For three-year windows, they find that the correlation in employment changes between NETS and QCEW—for total employment changes in California—is 0.86. To sum up, we believe that the NETS database for California is a reliable source for the analysis of job flows in the U.S. manufacturing industry.

Table 1 presents the decomposition of job flows in California's manufacturing industry in three-year windows. As is well known since the work of Davis and Haltiwanger (1992), net employment changes conceal substantial gross job flows in both the intensive margin of employment (due to expansions and contractions of existing establishments) and the extensive margin of employment (due to births and deaths of establishments). Figures 3 and 4 summarize these results.

Figure 3a presents the sources of job creation. We observe that job creation reached its peak in the period 1997-2000 and then started an important decline, driven mostly by the decrease in births. Moreover, Figure 3b shows that expansions of existing establishments were the principal source of job creation from 1992 to 2004, with an average share of 57%. On the other hand, Figure 3c shows that job destruction declined towards the second half of the 1990s and then increased substantially during the 2000s. In Figure 3d we obtain that on average, 57% of the job destruction is accounted for by the death of firms. Therefore, we can write our first stylized fact about job flows in the manufacturing industry:

> **Stylized fact 1**: From 1992 to 2004, the intensive margin of employment dominates in job creation, while the extensive margin dominates in job destruction.

Finally, Figure 4 shows the net employment changes. Note first that the net effect of the intensive margin employment changes (expansions-contractions) was positive up to the period 1998-2001 and became negative since then. On the other hand, the net effect of the extensive margin was negative throughout our three-year windows, with the exception of the period 1998-2001 when it was very close to zero. With respect to net employment changes, we observe that the period of net job creation in the last part of the 1990s was driven by the intensive margin (expansions), while the periods of net job destruction were dominated by the extensive margin (deaths). Therefore, we can write our second and third stylized facts as:

Stylized fact 2: The period of net job creation during the *dot-com bubble* was driven by the intensive margin of employment—that is, the expansion of existing establishments.

Stylized fact 3: The most important period of net job destruction in the history of the manufacturing industry (at the beginning of the 2000s) was mostly driven by the extensive margin of employment—that is, the death of establishments.

After this introduction to job flows in the manufacturing industry, we can now analyze how trade liberalization—and the corresponding surge in manufacturing imports—affects the response of each of the components of the intensive and extensive margins of employment. In the next section we present a theoretical framework to identify some of the forces at work.

3 The Model

3.1 Preferences and Production Structure

Consumers define their preferences over a continuum of differentiated goods in the set Ω and a homogeneous good. In particular, let us assume that the utility function for the representative consumer has the quasi-linear form:

$$U = \mu \ln Z + x, \tag{1}$$

where $Z = \left(\int_{\omega \in \Omega} z^c(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}$ is an aggregator of differentiated goods and x represents the consumption of the homogeneous—and numeraire—good. In Z, $z^c(\omega)$ denotes the consumption of variety ω and $\sigma > 1$ represents the elasticity of substitution between differentiated goods. In equation (1), μ captures the intensity of preference for differentiated goods and, given quasi-linear preferences, is also the amount of expenditure on these goods.

From the above utility function, the representative consumer's demand function for good ω is given by

$$z^c(\omega) = \frac{p(\omega)^{-\sigma}}{P_Z^{1-\sigma}} \mu, \tag{2}$$

where $p(\omega)$ is the price of variety ω and $P_Z = \left(\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \right)^{\frac{1}{1-\sigma}}$ is the price of the basket of differentiated goods, Z.

Labor is the only factor of production. Each worker-consumer has one unit of labor to devote to production activities at every instant of time. The total size of the workforce is L. The production function for the numeraire good is very simple: one unit of labor is required to produce one unit of the good. Therefore—assuming that the market for the numeraire good is perfectly competitive—the domestic wage equals 1. Since each worker spends μ on differentiated goods, we assume $0 < \mu < 1$. Therefore, the total expenditure on differentiated goods is μL. Thus, the market demand for differentiated good ω is

$$z^D(\omega) = \frac{p(\omega)^{-\sigma}}{P_Z^{1-\sigma}} \mu L. \tag{3}$$

Firms in the differentiated-goods sector are heterogeneous. The productivity of a producer is denoted by α, and the distribution of the productivity levels of all differentiated-good producers is given by $K(\alpha)$, where $\alpha \in [\alpha_{\min}, \infty)$. As in Melitz (2003), each entering firm must pay a sunk cost equal to F_e in terms of the numeraire good, after which it will observe its realization of productivity drawn from $K(\alpha)$.

Each differentiated good is produced using a continuum of inputs in the interval $[0, 1]$. A firm with productivity can decide whether or not to offshore its inputs below $t(\alpha)$, where $t(\alpha) \in [0, 1]$.[8] In particular, the production function for a firm with productivity α is given by $z(\alpha) = \alpha Y(\alpha)$, where

$$Y(\alpha) = \exp\left(\int_0^{t(\alpha)} \ln y_f(t)dt + \int_{t(\alpha)}^1 \ln y_d(t)dt\right)$$

is an inputs' aggregator, with $y_f(t)$ denoting the firm's requirement of foreign input t, and $y_d(t)$ denoting the firm's requirement of domestic input t.

There are fixed and variable costs of offshoring. If the firm decides to offshore, it must pay a fixed offshoring cost of F_o units of the numeraire good. Assume that the foreign wage is w (also in terms of the numeraire). Moreover, foreign labor is not a perfect substitute for domestic labor. In particular, the production function for input t with country of origin r, for $r \in \{d, f\}$, is given by

$$y_r(t) = \begin{cases} \ell_d(t) & \text{if } r = d \\ \frac{1}{\phi h(t)} \ell_f(t) & \text{if } r = f, \end{cases}$$

[8] Note that if $t(\alpha) = 1$, the firm is producing its good only with foreign labor—after covering any type of fixed cost. This is equivalent to the import of a finished good.

where $\ell_r(t)$ denotes the amount of domestic (d) or foreign (f) labor devoted to the production of input t and, as in the model of Grossman and Rossi-Hansberg (2008), $\phi h(t)$ accounts for additional costs of making foreign produced input t compatible with domestic inputs. Here, $h(t)$ accounts for the input specific cost of offshoring and ϕ accounts for a general variable cost of offshoring. The inputs are ordered by its offshoring cost so that $h(t)$ is increasing in t.

Let $L_r(\alpha)$ denote the amount of labor from country r hired by a domestic firm with productivity α—so that, for example, if it does not offshore $L_f(\alpha) = 0$. If it offshores, it employs $\frac{L_f(\alpha)}{t(\alpha)}$ in the production of each offshored input and $\frac{L_d(\alpha)}{1-t(\alpha)}$ in the production of each domestic input. Therefore, rewriting the production function in terms of domestic and foreign labor we obtain

$$z(\alpha) = \alpha \left(\frac{g(t(\alpha))}{\phi^{t(\alpha)}} \right) \left(\frac{L_f(\alpha)}{t(\alpha)} \right)^{t(\alpha)} \left(\frac{L_d(\alpha)}{1 - t(\alpha)} \right)^{1-t(\alpha)}, \tag{4}$$

where

$$g(t(\alpha)) = \exp \left(- \int_0^{t(\alpha)} \ln h(t) dt \right). \tag{5}$$

Note that if the firm does not offshore, so that $t(\alpha) = 0$ and $g(t(\alpha)) = 1$, $z(\alpha)$ is just $\alpha L_d(\alpha)$.

3.2 The Firm's Offshoring Decision

The offshoring decision problem for the firm with productivity α is solved in two stages. In the first stage the firm decides $t(\alpha)$. Given $t(\alpha)$, in the second stage the firm decides $L_d(\alpha)$ and $L_f(\alpha)$—the amount of domestic and foreign labor to hire, respectively. As usual, the firm's problem is solved backwards. In this section we present the most important results and leave the details of the solution for section A.1 in the Appendix.

Given the fixed cost of offshoring, F_o, there exists an offshoring cutoff productivity level, α_o^*, that divides the existing firms in offshoring and not-offshoring firms: a firm offshores if and only if its productivity is no less than α_o^*. With reference to this cutoff level, we obtain from the first-stage solution that $t(\alpha)$ is given by

$$t(\alpha) = \begin{cases} 0 & \text{if } \alpha < \alpha_o^* \\ t^* & \text{if } \alpha \geq \alpha_o^*, \end{cases} \tag{6}$$

where $t^* = h^{-1}\left(\frac{1}{w\phi}\right)$. Note that t^* does not depend on the firm's productivity, α; that is, the proportion of inputs being offshored is the same for all the firms whose productivity is no less than α_o^*.

Given $t(\alpha)$, the second-stage solution for the domestic and foreign labor demands of a firm with productivity α is given by

$$L_d(\alpha) = \gamma(t(\alpha))(1 - t(\alpha)) \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma} (\alpha P_Z)^{\sigma-1} \mu L \tag{7}$$

$$L_f(\alpha) = \gamma(t(\alpha))t(\alpha) \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma} (\alpha P_Z)^{\sigma-1} \left(\frac{\mu L}{w}\right), \tag{8}$$

where $\gamma(t(\alpha)) = \left[\frac{g(t(\alpha))}{(w\phi)^{t(\alpha)}}\right]^{\sigma-1}$. From equations (5) and (6), we can rewrite $\gamma(t(\alpha))$ as

$$\gamma(t(\alpha)) = \begin{cases} 1 & \text{if } \alpha < \alpha_o^* \\ \gamma(t^*) & \text{if } \alpha \geq \alpha_o^*, \end{cases} \tag{9}$$

where $\gamma(t^*) = \left[\frac{g(t^*)}{(w\phi)^{t^*}}\right]^{\sigma-1} \geq 1$ accounts for the offshoring productivity effect first identified by Grossman and Rossi-Hansberg (2008).

In the solution of the two-stage offshoring decision problem, we also derive an expression for the gross profit (before any type of fixed costs) of a firm with productivity α, which is given by

$$\pi(\alpha) = \gamma(t(\alpha)) \frac{[(\sigma - 1)\alpha P_Z]^{\sigma-1}}{\sigma^{\sigma}} \mu L, \tag{10}$$

and show that α_o^* satisfies the condition

$$\left[1 - \frac{1}{\gamma(t^*)}\right] \pi(\alpha_o^*) = F_o. \tag{11}$$

3.3 The Zero-Profit Condition

Besides the fixed cost of offshoring, let us assume that there is a fixed cost of operation, F. Therefore, we can define the zero-profit cutoff productivity level α^* as the level of productivity such that

$$\pi(\alpha^*) = F. \tag{12}$$

Firms with productivity below α^* do not produce and exit immediately.

Assuming that $\alpha^* < \alpha_o^*$, so that there is a set of firms with productivities between α^* and

α_o^* that produce but do not offshore, we divide equations (11) and (12) to obtain the following expression that establishes a direct relationship between the cutoff rules α_o^* and α^*:

$$\alpha_o^* = \Gamma(t^*)\alpha^*, \tag{13}$$

where

$$\Gamma(t^*) = \left[\frac{F_o}{F(\gamma(t^*) - 1)}\right]^{\frac{1}{\sigma-1}} > 1. \tag{14}$$

Note that in order for $\alpha^* < \alpha_o^*$, we need to satisfy $F_o > F(\gamma(t^*) - 1)$.

3.4 Prices, Average Productivity, and the Mass of Firms

As usual in heterogeneous-firm models, let us assume that the productivity of firms is Pareto distributed in the interval $[\alpha_{\min}, \infty)$.[9] That is, the cumulative distribution function is $K(\alpha) = 1 - \left(\frac{\alpha_{\min}}{\alpha}\right)^{\eta}$, and the probability density function is given by $k(\alpha) = \eta\frac{\alpha_{\min}^{\eta}}{\alpha^{\eta+1}}$, where η is the parameter of productivity dispersion (a higher η implies less heterogeneity). As in Ghironi and Melitz (2005) and Chaney (2008), the model requires that $\eta > \sigma - 1$ for a solution to exist.

With CES preferences, firm-level prices are just a fixed markup over the firm marginal cost. From equation (A-5) in Appendix A.1.1, we obtain that the price of the firm with productivity α is given by

$$p(\alpha) = \frac{\sigma}{\sigma - 1}\left[\frac{1}{\gamma(t(\alpha))^{\frac{1}{\sigma-1}}\alpha}\right]. \tag{15}$$

The aggregate price P_Z for the basket of differentiated goods Z is then given by

$$P_Z = \left[N\int_{\alpha^*}^{\infty} p(\alpha)^{1-\sigma} k(\alpha \mid \alpha \geq \alpha^*) d\alpha\right]^{\frac{1}{1-\sigma}}, \tag{16}$$

where N denotes the mass of active firms, and $k(\alpha \mid \alpha \geq \alpha^*)$ is the productivity distribution of firms conditional on successful entry, that is

$$k(\alpha \mid \alpha \geq \alpha^*) = \frac{k(\alpha)}{1 - K(\alpha^*)} = \eta\frac{\alpha^{*\eta}}{\alpha^{\eta+1}}. \tag{17}$$

Substituting equations (9) and (15) into equation (16), we can rewrite the aggregate price

[9] See, for example, Melitz and Ottaviano (2008) and Helpman, Itskhoki, and Redding (2008).

as

$$P_Z = N^{\frac{1}{1-\sigma}} \frac{\sigma}{\sigma - 1} \left[\frac{1}{\bar{\alpha}}\right], \tag{18}$$

where

$$\bar{\alpha} = \left[\int_{\alpha^*}^{\alpha_o^*} \alpha^{\sigma-1} k(\alpha \mid \alpha \geq \alpha^*) d\alpha + \gamma(t^*) \int_{\alpha_o^*}^{\infty} \alpha^{\sigma-1} k(\alpha \mid \alpha \geq \alpha^*) d\alpha\right]^{\frac{1}{\sigma-1}}$$

is a measure of (offshoring-augmented) average productivity of domestic successful producers. Using equations (13) and (17) in the previous equation, we obtain

$$\bar{\alpha} = \left[\frac{\eta}{\eta - \sigma + 1} \left(\frac{\Gamma(t^*)^{\eta-\sigma+1} + \gamma(t^*) - 1}{\Gamma(t^*)^{\eta-\sigma+1}}\right)\right]^{\frac{1}{\sigma-1}} \alpha^*. \tag{19}$$

We can also derive an expression for the mass of firms, N. Substituting first equation (18) into (10), we rewrite $\pi(\alpha)$ as

$$\pi(\alpha) = \gamma(t(\alpha)) \frac{\mu L}{N\sigma} \left[\frac{\alpha}{\bar{\alpha}}\right]^{\sigma-1}. \tag{20}$$

Hence, the zero-cutoff-profit condition in equation (12) is equivalent to

$$\frac{\mu L}{N\sigma} \left[\frac{\alpha^*}{\bar{\alpha}}\right]^{\sigma-1} = F, \tag{21}$$

because $\gamma(t(\alpha^*)) = 1$ (as $\alpha^* < \alpha_o^*$). Solving for $\frac{\alpha^*}{\bar{\alpha}}$ in equation (19) and plugging in the result in (21), we solve for N as

$$N = \frac{\eta - \sigma + 1}{\eta} \left(\frac{\Gamma(t^*)^{\eta-\sigma+1}}{\Gamma(t^*)^{\eta-\sigma+1} + \gamma(t^*) - 1}\right) \frac{\mu L}{F\sigma}. \tag{22}$$

Note that N is independent of α^*.

3.5 The Free-Entry Condition and Equilibrium

As in Melitz (2003), entry is unbounded. Every period, a potential firm will enter if the value of entry is no less that the required sunk entry cost, F_e. Given that the potential entrant knows its productivity only after entry, the pre-entry expected profit for each period is given by

$$\bar{\pi}_{PE} = \int_{\alpha^*}^{\alpha_o^*} [\pi(\alpha) - F] k(\alpha) d\alpha + \int_{\alpha_o^*}^{\infty} [\pi(\alpha) - F - F_o] k(\alpha) d\alpha,$$

which, using equation (20) and the Pareto distribution for productivity, can be written as

$$\bar{\pi}_{PE} = \left[\frac{\alpha_{\min}}{\alpha^*}\right]^{\eta} \left[\frac{\mu L}{N\sigma} - F - \frac{F_o}{\Gamma(t^*)^{\eta}}\right]. \tag{23}$$

At the end of every period, there is an exogenous death shock that hits a fraction δ of the existing firms. Therefore, the value of entry is given by $\frac{\bar{\pi}_{PE}}{\delta}$. Given unbounded entry, the free-entry condition is given by

$$\frac{\bar{\pi}_{PE}}{\delta} = F_e. \tag{24}$$

Finally, substituting equation (23) into (24) and replacing N by its equilibrium value in (22), we can solve for the cutoff productivity level, α^*:

$$\alpha^* = \alpha_{\min} \left[\frac{\sigma - 1}{\delta F_e(\eta - \sigma + 1)} \left(F + \frac{F_o}{\Gamma(t^*)^{\eta}}\right)\right]^{\frac{1}{\eta}}. \tag{25}$$

4 Trade liberalization and Job Flows: Theory

Let us now look at the impact of trade liberalization on the intensive and extensive margins of employment. In this section we focus on the impact of a change in the variable trade cost, ϕ.

Substituting equation (18) into (7), and then using (21), we can rewrite the demand for domestic labor of a firm with productivity α as

$$L_d(\alpha) = \gamma(t(\alpha))(1 - t(\alpha))(\sigma - 1)F\left[\frac{\alpha}{\alpha^*}\right]^{\sigma-1}. \tag{26}$$

where $t(\alpha)$ and $\gamma(t(\alpha))$ are given as in equations (6) and (9), respectively. Hence, the elasticity of demand for domestic labor with respect to the offshoring variable cost, ϕ, of a firm with productivity α is given by

$$\zeta_{L_D(\alpha),\phi} = \begin{cases} -(\sigma-1)\zeta_{\alpha^*,\phi} & \text{if } \alpha < \alpha_o^* \\ \zeta_{\gamma(t^*),\phi} - \frac{t^*}{1-t^*}\zeta_{t^*,\phi} - (\sigma-1)\zeta_{\alpha^*,\phi} & \text{if } \alpha \geq \alpha_o^*, \end{cases} \tag{27}$$

where $\zeta_{x,\phi} = \frac{dx}{d\phi}\frac{\phi}{x}$ is the elasticity of variable x with respect to ϕ. Therefore, at the intensive margin, we can identify three different effects on the demand for domestic labor when the offshoring cost, ϕ, changes: a *market share effect* (driven by $\zeta_{\alpha^*,\phi}$), an *offshoring productivity* *effect* (driven by $\zeta_{\gamma(t^*),\phi}$), and a *input cutoff effect* (driven by $\zeta_{t^*,\phi}$). The following lemma describes the drivers of these effects.

Lemma 1 *Market share effect:* $\zeta_{\alpha^*,\phi} = -\frac{F_o}{\Gamma(t^*)^\eta F + F_o}\left[\frac{t^*\gamma(t^*)}{\gamma(t^*)-1}\right] < 0$*; offshoring productivity effect:* $\zeta_{\gamma(t^*),\phi} = -(\sigma-1)t^* < 0$*; and input cutoff effect:* $\zeta_{t^*,\phi} = -\frac{h(t^*)}{t^* h'(t^*)} < 0$*.*

In our set up, a decrease in the offshoring cost improves the productivity of firms engaged in offshoring (as they can offshore a particular input with a lower cost). Thereby, $\gamma(t^*)$ increases as ϕ declines, that is, $\zeta_{\gamma(t^*),\phi} < 0$. The increased productivity of offshoring firms allows them to steal market share away from non-offshoring firms. The lost market share for non-offshoring firms implies that their productivity must be higher to meet the fixed cost of production. Therefore, the cutoff productivity below which firms exit, α^* rises (that is, $\zeta_{\alpha^*,\phi} < 0$). And finally, a decrease in the variable cost of offshoring leads to a greater fraction of inputs being offshored, that is, $\zeta_{t^*,\phi} < 0$. From equation (27) and using Lemma 1, we can write the following proposition for the effect of a change in the cost of offshoring on the domestic demand for labor.

Proposition 1 ***(Trade liberalization and the intensive margin of employment)***

After a decline in the cost of offshoring, ϕ, the demand for domestic labor of a firm with productivity α declines if $\alpha < \alpha_o^*$, and has an ambiguous response if $\alpha \geq \alpha_o^*$.

In the first case of the previous proposition, only the market share effect matters after a decline in ϕ. Given that a firm with productivity below α_o^* does not offshore, it releases labor as it loses market share to more productive offshoring firms. In the second case, the offshoring productivity effect generates an increase in the demand for domestic labor after a decline in ϕ. This effect dominates the contraction in domestic labor implied by the market share effect (please see proof in the Appendix). However, the fraction of inputs being offshored increases, so that offshoring firms release domestic labor employed in the production of inputs between the old and new t^*. At the end, the final effect on the demand for domestic labor is ambiguous for firms with productivities that are no less than α_o^*.

With respect to the response of employment at the extensive margin after a decline in ϕ, we present the following proposition:

Proposition 2 ***(Trade liberalization and the extensive margin of employment)***

The mass of firms, N, declines after a decrease in the cost of offshoring, ϕ. That is, a decline in trade costs generates net job destruction at the extensive margin.

With respect to the aggregate level of employment in the differentiated-good sector, L_Z, we can write it as

$$L_Z = N\left[\int_{\alpha^*}^{\alpha_o^*} L_d(\alpha)k(\alpha \mid \alpha \geq \alpha^*)d\alpha + \int_{\alpha_o^*}^{\infty} L_d(\alpha)k(\alpha \mid \alpha \geq \alpha^*)d\alpha\right]. \tag{28}$$

From this equation, note that L_Z will expand after a decline in ϕ only if the job expansion implied by the offshoring productivity effect is strong enough to dominate not only the market share and input cutoff effects (so that $L_d(\alpha)$ increases for $\alpha \geq \alpha_o^*$), but also the job destruction by death of firms. While an increase in L_Z following a decrease in trade cost does not seem very likely, the effect is theoretically ambiguous.

This model can be generalized to a multi-industry framework. As mentioned above, while in the model presented above trade liberalization takes the form of imports of inputs (or offshoring), we view the possibility of $t^* \approx 1$ as the case of importing finished or almost finished goods. In terms of the model parameters, differences in the $h(t)$ function across industries will generate different cutoffs t^* for different industries. Since t^* in our model is independent of the firm productivity α, this means that in some industries firms could be importing finished goods. Moreover, if the fixed cost associated with offshoring (F_o) is sufficiently high in an industry, firms that are completely domestic co-exist with firms that are virtually importers of finished products. In these industries, a decrease in the marginal cost of offshoring, ϕ, raises the profitability of importing firms. Therefore, for a given F_o, more firms become importers, which reduces their domestic employment—that is, some firms replace their domestic production with imports of finished goods. Unlike the case of $t^* \in (0, 1)$, there is no adjustment in the domestic employment of firms that were already importing if $t^* = 1$. Therefore, a high value of t^* in an industry captures the import of finished or almost finished goods. It is important to point this out because the measures of trade we are using in the empirical section do not make a distinction between the import of inputs and the import of final goods.

To sum up, Propositions 1 and 2 provide us with our estimating equations for the empirical exercise. The key empirical prediction that we take to data is that a reduction in trade costs has an ambiguous effect on the intensive margin of job flows. There should be job destruction for non-offshoring firms, but ambiguous effect for offshoring firms. More importantly, higher productivity firms ($\alpha \geq \alpha_o^*$) are more likely to offshore and hence are a prime candidate for experiencing increased net job creation due to the productivity effect of trade liberalization. We capture this in our empirical exercise by interacting trade cost with establishment productivity. Finally, Proposition 2 provides us with another testable prediction that a reduction in trade costs leads to job destruction at the extensive margin.

5 Trade Liberalization and Job Flows: Evidence

5.1 Data

5.1.1 Establishment-Level Data

We use longitudinal establishment-level data from the National Establishment Time Series (NETS) database developed by Walls & Associates under agreement with Dun & Bradstreet (D&B). We have access to an extract of the NETS that contains annual data for all the active establishments in California from 1992 to 2004. Each establishment has a unique identifier (the D&B number) and is carefully followed throughout the years. A distinguishing feature of the NETS compared to other available datasets is that the NETS is not a representative sample of business establishments but the universe of them.

The dataset contains information regarding the first year the establishment was active and the last year of activity. When a given establishment is born before 1990, the NETS reports the year when the establishment started. Every single establishment is classified by NETS according to its primary, secondary and tertiary Standard Industrial Classification (SIC) code at the eight-digit level of disaggregation. We select the first primary code to match each establishment to a unique industrial sector. For reasons mentioned in section 2, we focus on the manufacturing industry and drop from our database all the non-manufacturing establishments.[10] Therefore, each of the manufacturing establishments used in the paper belongs to a four-digit level SIC code in the range 2011-3099.

Following Davis, Haltiwanger, and Schuh (1998), we calculate establishment-level growth rates of employment using a midpoint-method formula.[11] Denote the employment level of a

[10]Obviously, employment changes in the traded-sector of the economy have a counterpart in the non-traded sector. We leave the study of this relationship for a future project. As mentioned in section 1, Ebenstein, Harrison, McMillan, and Phillips (2009) explore the mechanism of labor migration from the traded to the non-traded sector and its impact on wages.

[11]We cannot use the conventional methods to compute growth rates for births and deaths. For example, the growth employment rate for a birth using a conventional method would be infinity. The midpoint-method suggested by Davis, Haltiwanger, and Schuh (1998) is the simplest way to circumvent this problem.

given establishment i in industry j in year t by E_{ijt}. Then, the employment growth for this establishment is given by

$$e_{ijt} = \frac{E_{ijt} - E_{ijt-s}}{\overline{E}_{ijt}} \tag{29}$$

where $\overline{E}_{ijt} = \frac{1}{2}(E_{ijt} + E_{ijt-s})$, and $s \geq 1$ allows us to describe job flows over different time intervals. This measure is symmetric and is bounded in the interval $[-2, 2]$. Note that $e_{ijt} = -2$ reflects job destruction by death of establishment i at year t, while $e_{ijt} = 2$ reflects job creation by birth of establishment i at year t.

Let jc_{ijt} and jd_{ijt} represent the rates of job creation and destruction, respectively, for establishment i at year t. Given e_{ijt}, we can define them as

$$\begin{aligned} jc_{ijt} &= \max(e_{ijt}, 0) \\ jd_{ijt} &= \max(-e_{ijt}, 0). \end{aligned}$$

Decomposing further the previous expressions into the four components of job flows—births and deaths of establishments (the extensive margin), and expansions and contractions of establishments (the intensive margin)—we define

$$\begin{aligned} &birth_{ijt} = jc_{ijt} \text{ if } jc_{ijt} = 2 \\ &expan_{ijt} = jc_{ijt} \text{ if } jc_{ijt} < 2 \\ &death_{ijt} = jd_{ijt} \text{ if } jd_{ijt} = 2 \\ &contr_{ijt} = jd_{ijt} \text{ if } jd_{ijt} < 2. \end{aligned}$$

Note that the following equations always hold: $e_{ijt} = jc_{ijt} - jd_{ijt}$, $jc_{ijt} = birth_{ijt} + expan_{ijt}$, and $jd_{ijt} = death_{ijt} + contr_{ijt}$.

In addition to job flows, NETS also allows us to compute sales per worker in each establishment in each year. We use this as our measure of establishment productivity.

5.1.2 Industry-Level Data

We use industry-data at the four-digit SIC level. In particular, we include in our regressions the following industry characteristics: trade costs, value of shipments, price of shipments, price of energy, price of materials, and industry employment. Our industry variables, except for trade costs, are obtained from the updated version of the NBER productivity database (Bartelsman and Gray (1996)) through 2004.

Our measure of trade cost follows Bernard, Jensen, and Schott (2006). Trade cost for industry j in year t is defined as the sum of ad valorem tariff, λ_{jt}, and ad valorem freight and insurance rates, f_{jt}. Therefore, our measure of trade cost for industry j in year t is simply

$$\tau_{jt} = \lambda_{jt} + f_{jt}$$

We collected the data on tariffs (collected duties and imports) and freight and insurance from an updated version of the database of Feenstra, Romalis, and Schott (2002). Since we expect changes in trade costs to affect job flows with some lag, we define our trade liberalization variable as the last three periods average of the trade cost, that is

$$\bar{\tau}_{jt} = \frac{\sum_{s=t-2}^{t} \tau_{js}}{3}.$$

Table 2 provides changes in the average tariff, freight and total trade costs for all the two-digit SIC industries from 1992 to 2005. Its is noticeable that there has been a reduction in ad valorem tariffs across all the industries. The pattern of trade liberalization reveals that the highest reduction in the ad valorem tariff rate takes place in apparel and textile industries (labor-intensive industries) while the lowest reduction affects paper and transportation (capital-intensive industries).

From NETS, we have around 76,000 active establishments in 1992 and about 94,000 by 2004. After merging the NETS data with the trade and productivity industry data, we end up in the most restrictive specification with a coverage up to 124,949 establishments and with a minimum of 428 four-digit SIC industries.

5.2 Establishment-Level Estimation

We start with an establishment-level estimation of the relationship between trade liberalization and job flows. The equation to estimate is given by

$$y_{ijt} = \beta \triangle \bar{\tau}_{jt-1} + \rho \triangle \bar{\tau}_{jt-1} \times \Psi_{ijt-1} + \theta Z_{ijt-1} + \vartheta X_{jt-1} + v_t + \varepsilon_{ijt}, \tag{30}$$

where y_{ijt} is our job flow measure, $\triangle\bar{\tau}_{jt-1} = \bar{\tau}_{jt-1} - \bar{\tau}_{jt-2}$ is the change in the average trade cost, Ψ_{ijt-1} is the relative productivity of establishment i at $t-1$, Z_{ijt-1} is a vector of lagged establishment characteristics, X_{jt-1} is a vector of lagged industry characteristics, v_t accounts for time fixed effects, and ε_{ijt} represents an error term.

For y_{ijt} we use e_{ijt}, jd_{ijt}, $expan_{ijt}$, $contr_{ijt}$, and $death_{ijt}$.[12] The measure of relative productivity, Ψ_{ijt-1}, is calculated as the ratio of the sales per worker of establishment i in industry j in year $t-1$ relative to the sales per worker of the median establishment in industry j in year $t-1$. Hence, ρ captures the implications of firm heterogeneity for job flows. Since more productive firms are more likely to offshore and experience the positive productivity effect of offshoring, we expect $\rho < 0$. Our vector of establishment characteristics, Z_{ijt-1}, includes lagged job flow measures jc_{ijt-1}, jd_{ijt-1} to account for adjustment costs (as in Klein, Schuh, and Triest (2003) and Moser, Urban, and Weder di Mauro (forthcoming)), the lagged age of the establishment, and the lagged change in log sales per worker (to capture establishment specific idiosyncratic shock to productivity). The vector of industry characteristics, X_{jt-1}, includes (four-digit SIC level) lagged changes in value of shipments, price of shipments, price of energy, price of materials, industry employment, and the level of the industry wage.

We estimate equation (30) by ordinary least squares and compute robust standard errors clustered by four-digit SIC industry. We report the estimation results of equation (30) in columns (1)-(5) in Table 3. The first column displays the effect of trade costs on net employment growth. The coefficients β and ρ are roughly equal in magnitude and opposite in sign. Recall that our construction of Ψ_{ijt-1} implies that it takes the value 1 for the firm with median productivity in industry j in year $t-1$. Therefore, the estimates of β and ρ in column (1) suggest that a decrease in trade cost has no effect on the employment growth in the median firm. However, firms with productivity higher than the median firm experience an increase in employment growth as a result of a reduction in trade cost. Firms below median productivity experience a decrease in employment growth. Column (2) presents the results on job expansion and it is similar to the results on net employment growth. Column (3) presents results on job destruction. The estimates suggest that for a firm with median productivity, a decrease in trade cost increases job destruction. For firms with higher productivity the impact on job destruction is less while for firms with lower productivity the impact on job destruction is even greater. Columns (4)

[12] Note that y_{ijt} does not include jc_{ijt} because it is not possible to estimate establishment-level regressions for $birth_{ijt}$ because there are no establishment-level characteristics for unborn firms.

and (5) provide results on the two separate sources of job destruction: deaths and contractions. The results with $death_{ijt}$ as the dependent variable are presented in column (4) and those with $contr_{ijt}$ as the dependent variable are presented in column (5). Comparing the results in these two columns we find that changes in trade costs have very little effect on job contractions. Virtually all the effects of changes in trade costs on job destruction come through the exit of firms (extensive margin).

While the estimation in columns (1)-(5) provide estimates of the relationship between trade liberalization and job flows, we can also provide estimates of the effects of trade liberalization on the probabilities of death, expansion, and contraction for a given establishment. Unlike the regressions in columns (1)-(5), where the dependent variables are continuous, we now use binary dependent variables. We estimate the following linear probability model:

$$Pr(d_{ijt} = 1) = \beta \triangle \bar{\tau}_{jt-1} + \rho \triangle \bar{\tau}_{jt-1} \times \Psi_{ijt-1} + \theta Z_{ijt-1} + \vartheta X_{jt-1} + v_t + \varepsilon_{ijt}, , \tag{31}$$

where the right-hand side variables are as defined above. The dependent variable d_{ijt} takes the value of 1 when the event of interest happens and 0 otherwise. The events of interest are expansions, deaths and contractions.[13]

Estimates of equation (31) are presented in columns (6) and (7) of Table 3. Column (6) presents results on the probability of expansion. The coefficient on trade cost is positive and significant while the coefficient on the interaction term is negative and significant. Again, for a firm with median productivity, a decrease in trade cost has no impact on the probability of expansion. For firms with higher productivity, a decrease in trade cost increases the probability of expansion, while the opposite is true for lower productivity firms. Note that since $death_{ijt} = 2$ when there is an exit, estimating a probability model with death will simply replicate the estimates in column (4) with all coefficients being doubled. Therefore, we present the results for contractions in column (7). The estimates here suggest that a reduction in trade costs affects contractions in the same way as it affects expansion. This was true of the estimates in column (5) as well, however, the coefficients were statistically insignificant. In the linear probability model, the coefficients are statistically significant. They imply that a reduction in trade cost reduces the probability of contraction for low productivity firms and increases the probability of

[13] The model should not be estimated by probit with fixed effects because it yields inconsistent estimates due to the so-called called incidental parameters problem. The model can be estimated by panel logit methods, but we decide to present the linear probability model results for ease of interpretation.

contraction for high productivity firms. So, the estimates in columns (6) and (7) together imply that a reduction in trade cost increases the probabilities of both expansions and contractions at high productivity firms.

The other controls reported in the regression are similar to those in Klein, Schuh, and Triest (2003). The inclusion of these controls does not change the sign and significance of our key coefficients β and ρ. To conserve space we do not report our estimates without these controls.

Thus, we have found that at the establishment level, there is a negative relationship between job destruction and trade costs and a positive relationship between job expansions and trade costs. In terms of magnitude, job destruction by deaths is the most responsive of the job flows to changes in trade costs.

6 Conclusions

We presented a theoretical model to understand how a decrease in the cost of offshoring/importing inputs can affect job flows at the extensive and intensive margins. The results suggest job destruction along the extensive margin, but an ambiguous effect along the intensive margin. The ambiguity along the intensive margin is a result of the positive productivity effect of offshoring. While increased offshoring of inputs reduces the amount of domestic labor hired by an offshoring firm, the resulting increase in productivity increases its market share and the resulting larger scale of production may very well involve hiring more domestic labor than before. Empirically, we test the model's implications using a longitudinal database containing the entire universe of establishments in California's manufacturing industry from 1992 to 2004. We find positive association between trade costs and job creation at the intensive margin and negative association between trade costs and job destruction at both intensive and extensive margins. Quantitatively, the impact of trade costs on job destruction at the extensive margin is the largest. To sum up, the paper contributes to our understanding of the implications of globalization for job flows.

A Appendix

A.1 Solution to the Firm's Offshoring Decision Problem

A.1.1 Second Stage

The firm with productivity α's second stage maximization problem for the optimal choice of $L_d(\alpha)$ and $L_f(\alpha)$ can be written as

$$\Upsilon = p(\alpha)z(\alpha) - L_d(\alpha) - wL_f(\alpha) + \xi \left[\alpha \left(\frac{g(t(\alpha))}{\phi^{t(\alpha)}} \right) \left(\frac{L_f(\alpha)}{t(\alpha)} \right)^{t(\alpha)} \left(\frac{L_d(\alpha)}{1-t(\alpha)} \right)^{1-t(\alpha)} - z(\alpha) \right].$$

The first-order conditions are

$$\begin{aligned} z(\alpha): &\quad p(\alpha) + z(\alpha)\tfrac{dp(\alpha)}{dz(\alpha)} &&= \xi && \text{(A-1)} \\ L_f(\alpha): &\quad \xi\alpha \left(\tfrac{g(t(\alpha))}{\phi^{t(\alpha)}} \right) \left(\tfrac{t(\alpha)}{1-t(\alpha)} \tfrac{L_d(\alpha)}{L_f(\alpha)} \right)^{1-t(\alpha)} &&= w && \text{(A-2)} \\ L_d(\alpha): &\quad \xi\alpha \left(\tfrac{g(t(\alpha))}{\phi^{t(\alpha)}} \right) \left(\tfrac{t(\alpha)}{1-t(\alpha)} \tfrac{L_d(\alpha)}{L_f(\alpha)} \right)^{-t(\alpha)} &&= 1 && \text{(A-3)} \end{aligned}$$

From (A-2) and (A-3) we get

$$\frac{L_d(\alpha)}{L_f(\alpha)} = \frac{(1-t(\alpha))w}{t(\alpha)}. \tag{A-4}$$

Given the constant elasticity substitution, we can rewrite equation (A-1) as $\frac{\sigma-1}{\sigma}p(\alpha) = \xi$. Substituting this expression and equation (A-4) into equation (A-2), we obtain that

$$\left(\frac{\sigma-1}{\sigma} p(\alpha) \right) \left(\alpha \frac{g(t(\alpha))}{\phi^{t(\alpha)}} \right) = w^{t(\alpha)}. \tag{A-5}$$

Finally, using the market demand function in equation (3) to replace $p(\alpha)$ along with equations (4) and (A-4), we solve for the equilibrium levels of domestic and foreign labor hired by a firm with productivity α:

$$\begin{aligned} L_d(\alpha) =& \gamma(t(\alpha))(1-t(\alpha)) \left(\frac{\sigma-1}{\sigma} \right)^{\sigma} (\alpha P_Z)^{\sigma-1} \mu L && \text{(A-6)} \\ L_f(\alpha) =& \gamma(t(\alpha))t(\alpha) \left(\frac{\sigma-1}{\sigma} \right)^{\sigma} (\alpha P_Z)^{\sigma-1} \left(\frac{\mu L}{w} \right), && \text{(A-7)} \end{aligned}$$

where $\gamma(t(\alpha)) = \left[\frac{g(t(\alpha))}{(w\phi)^{t(\alpha)}} \right]^{\sigma-1}$. Note that if the firm does not offshore, so that $t(\alpha) = 0$, $g(0) = 1$ and $\gamma(0) = 1$.

A.1.2 First Stage

The profit function (before any type of fixed costs) for a firm with productivity α is given by $\pi(\alpha) = p(\alpha)z(\alpha) - L_d(\alpha) - wL_f(\alpha)$. Now, using equation (A-5) and substituting equation (A-4) into (4), we obtain that

$$p(\alpha)z(\alpha) = \frac{\sigma}{(\sigma-1)(1-t(\alpha))} L_d(\alpha). \tag{A-8}$$

Using this expression and equation (A-4) to substitute $L_f(\alpha)$ in the profit function, we get

$$\pi(\alpha) = \frac{L_d(\alpha)}{(\sigma-1)(1-t(\alpha))}. \tag{A-9}$$

Hence, plugging in equation (A-6) into (A-9) we obtain

$$\pi(\alpha) = \gamma(t(\alpha)) \frac{[(\sigma-1)\alpha P_Z]^{\sigma-1}}{\sigma^\sigma} \mu L. \tag{A-10}$$

If the firm with productivity α decides to offshore, it will choose the $t(\alpha)$ that maximizes $\pi(\alpha)$. That is, the optimal $t(\alpha)$ can be defined as

$$t^*(\alpha) = \underset{t(\alpha)}{\operatorname{argmax}}\ \pi(\alpha).$$

Taking the logarithm of equation (A-10) and given that each firm takes the aggregate price, P_Z, as given, we can redefine $t^*(\alpha)$ as

$$t^*(\alpha) = \underset{t(\alpha)}{\operatorname{argmax}}\ \ln\gamma(t(\alpha)).$$

Deriving and using Leibnitz's rule, we obtain the optimality condition $w\phi h(t^*(\alpha)) = 1$, so that the marginal cost of hiring a unit of foreign labor equals the cost of hiring a unit of domestic labor. Hence, we obtain

$$t^* = h^{-1}\left(\frac{1}{w\phi}\right), \tag{A-11}$$

which is independent of α. It is possible, however, to get a corner solution. If $w\phi h(0) > 1$, then $t^* = 0$; similarly, if $w\phi h(1) \leq 1$, then $t^* = 1$.

Given that $h(t)$ is increasing in t and $w\phi h(t^*) = 1$, it must be the case that $w\phi h(t) \leq 1$ if $t \leq t^*$. Therefore $\ln(w\phi) \leq -\ln h(t)$ if $t \leq t^*$. Thus, it is always true that $t^* \ln(w\phi) \leq -\int_0^{t^*} \ln h(t)dt =$

$\ln g(t^*)$, so that $g(t^*) \geq (w\phi)^{t^*}$ always holds. Therefore, $\gamma(t^*) = \left[\frac{g(t^*)}{(w\phi)^{t^*}}\right]^{\sigma-1} \geq \gamma(0) = 1$. Looking at equation (A-10), this result implies that the gross (before fixed costs) profit for a firm with productivity α that offshores cannot be less that the profit it gets if it does not offshore. Nevertheless, because of the existence of fixed costs of offshoring, not every firm decides to offshore. In particular, there exists a productivity level α_o^* that divides the set of existing firms in offshoring and not-offshoring firms: those firms with productivities above α_o^* will offshore, and those firms with productivities below α_o^* will not offshore. For a firm with productivity α_o^*, the difference between its offshoring and not-offshoring gross profits is identical to the fixed cost of offshoring, F_o. That is, using equation (A-10), α_o^* satisfies

$$\left[1 - \frac{1}{\gamma(t^*)}\right] \pi(\alpha_o^*) = F_o. \tag{A-12}$$

Thus, we can write $t(\alpha)$ and $\gamma(t(\alpha))$ with respect to the offshoring cutoff productivity level, α_o^*, as

$$t(\alpha) = \begin{cases} 0 & \text{if } \alpha < \alpha_o^* \\ t^* & \text{if } \alpha \geq \alpha_o^* \end{cases} \tag{A-13}$$

and

$$\gamma(t(\alpha)) = \begin{cases} 1 & \text{if } \alpha < \alpha_o^* \\ \gamma(t^*) & \text{if } \alpha \geq \alpha_o^*. \end{cases} \tag{A-14}$$

A.2 Proofs of Lemmas and Propositions

Proof of Lemma 1. Let us obtain first $\zeta_{\gamma(t^*),\phi}$. Note that

$$\zeta_{\gamma(t^*),\phi} = \frac{d\ln\gamma(t^*)}{d\ln\phi} = \frac{\partial\ln\gamma(t^*)}{\partial t^*}\frac{\partial t^*}{\partial\ln\phi} + \frac{\partial\ln\gamma(t^*)}{\partial\ln\phi}.$$

Using the envelope theorem, we get that $\zeta_{\gamma(t^*),\phi} = \frac{\partial\ln\gamma(t^*)}{\partial\ln\phi}$, as $\frac{\partial\ln\gamma(t^*)}{\partial t^*} = 0$. Now, given that $\gamma(t^*) = \left[\frac{g(t^*)}{(w\phi)^{t^*}}\right]^{\sigma-1}$, we obtain

$$\zeta_{\gamma(t^*),\phi} = \frac{\partial\ln\gamma(t^*)}{\partial\ln\phi} = -(\sigma-1)t^* < 0. \tag{A-15}$$

For $\zeta_{\alpha^*,\phi}$, we use equation (25) to obtain

$$\zeta_{\alpha^*,\phi} = \frac{d\ln\alpha^*}{d\ln\phi} = -\frac{F_o}{\Gamma(t^*)^\eta F + F_o}\frac{d\ln\Gamma(t^*)}{d\ln\phi}. \tag{A-16}$$

Now, using the expression for $\Gamma(t^*)$ in equation (14), we get $\frac{d\ln\Gamma(t^*)}{d\ln\phi} = -\frac{\gamma(t^*)}{(\sigma-1)(\gamma(t^*)-1)}\zeta_{\gamma(t^*),\phi} = \frac{t^*\gamma(t^*)}{\gamma(t^*)-1}$. Plugging in this expression into equation (A-16) and using (A-15), we get

$$\zeta_{\alpha^*,\phi} = -\frac{F_o}{\Gamma(t^*)^\eta F + F_o}\left[\frac{t^*\gamma(t^*)}{\gamma(t^*)-1}\right] < 0. \tag{A-17}$$

For $\zeta_{t^*,\phi}$, note from the optimality condition for t^*, $w\phi h(t^*) = 1$, that $\frac{d\ln(w\phi h(t^*))}{d\ln\phi} = 0$. The last expression can be rewritten as $1 + \frac{d\ln h(t^*)}{d\ln t^*}\frac{d\ln t^*}{d\ln\phi} = 0$, and given that $\frac{d\ln h(t^*)}{d\ln t^*} = h'(t^*)\frac{t^*}{h(t^*)}$, we can solve for $\zeta_{t^*,\phi}$ as

$$\zeta_{t^*,\phi} = \frac{d\ln t^*}{d\ln\phi} = -\frac{h(t^*)}{t^*h'(t^*)}. \tag{A-18}$$

Given that $h'(t^*) > 0$, it is the case that $\zeta_{t^*,\phi} < 0$. ■

Proof of Proposition 1. Substituting the results of Lemma 1 into equation (27), we obtain

$$\zeta_{L_D(\alpha),\phi} = \begin{cases} \frac{(\sigma-1)F_o}{\Gamma(t^*)^\eta F + F_o}\left[\frac{t^*\gamma(t^*)}{\gamma(t^*)-1}\right] > 0 & \text{if } \alpha < \alpha_o^* \\ \underbrace{-(\sigma-1)t^*}_{<0} \underbrace{+\frac{h(t^*)}{(1-t^*)h'(t^*)}}_{>0} \underbrace{+\frac{(\sigma-1)F_o}{\Gamma(t^*)^\eta F + F_o}\left[\frac{t^*\gamma(t^*)}{\gamma(t^*)-1}\right]}_{>0} & \text{if } \alpha \geq \alpha_o^*. \end{cases} \tag{A-19}$$

Hence, after a decline in ϕ, not-offshoring firms (with productivities below α_o^*) decrease their employment of domestic labor. For offshoring firms ($\alpha \geq \alpha_o^*$), however, the offshoring productivity effect moves in opposite direction to the input cutoff and market share effects. In particular, after a decline in the offshoring cost, the offshoring productivity effect generates an expansion of domestic labor, while the other two effects imply a contraction. From the first and third terms, note that

$$-(\sigma-1)t^* + \frac{(\sigma-1)F_o}{\Gamma(t^*)^\eta F + F_o}\left[\frac{t^*\gamma(t^*)}{\gamma(t^*)-1}\right] = -(\sigma-1)t^*\left[\frac{F_o(\Gamma(t^*)^{\eta-\sigma+1}-1)}{(\Gamma(t^*)^\eta F + F_o)(\gamma(t^*)-1)}\right] < 0,$$

so that the productivity effect dominates the market share effect. Nevertheless, the sign of $\zeta_{L_D(\alpha),\phi}$ when $\alpha \geq \alpha_o^*$ remains ambiguous. ■

Proof of Proposition 2. We need to prove that $\zeta_{N,\phi} > 0$. Taking the natural logarithm of equation (22), and using the results in equation (A-15) and $\frac{d \ln \Gamma(t^*)}{d \ln \phi} = \frac{t^* \gamma(t^*)}{\gamma(t^*) - 1}$, we get $\zeta_{N,\phi} = \frac{d \ln N}{d \ln \phi} = \frac{\eta t^* \gamma(t^*)}{\Gamma(t^*)^{\eta - \sigma + 1} + \gamma(t^*) - 1} > 0$. ■

Table 1: Job Flows Decomposition in California's Manufacturing Industry

	1992-1995	1993-1996	1994-1997	1995-1998	1996-1999	1997-2000	1998-2001	1999-2002	2000-2003	2001-2004
Employment at initial year	3,154,004	3,042,614	3,045,497	3,005,669	2,943,955	2,987,589	3,009,322	3,096,931	3,138,357	3,066,571
Employment at final year	3,005,669	2,943,955	2,987,589	3,009,322	3,096,931	3,138,357	3,066,571	2,917,241	2,784,782	2,741,185
Change in employment										
Due to expansions	331,996	373,782	404,602	446,388	431,332	417,172	341,024	320,243	284,628	297,535
Due to contractions	-330,212	-315,076	-315,817	-299,356	-240,156	-244,535	-284,767	-363,408	-386,536	-324,939
Due to births	261,941	285,588	300,333	268,853	306,224	353,832	373,596	295,118	210,197	150,339
Due to deaths	-412,060	-442,953	-447,026	-412,232	-344,424	-375,701	-372,604	-431,643	-461,864	-448,321
Net changes										
Expansions-Contractions	1,784	58,706	88,785	147,032	191,176	172,637	56,257	-43,165	-101,908	-27,404
Births-Deaths	-150,119	-157,365	-146,693	-143,379	-38,200	-21,869	992	-136,525	-251,667	-297,982
Net employment creation	-148,335	-98,659	-57,908	3,653	152,976	150,768	57,249	-179,690	-353,575	-325,386

Table 2: Changes in Trade Costs by Two-Digit SIC Industry, 1992-2005 (%)

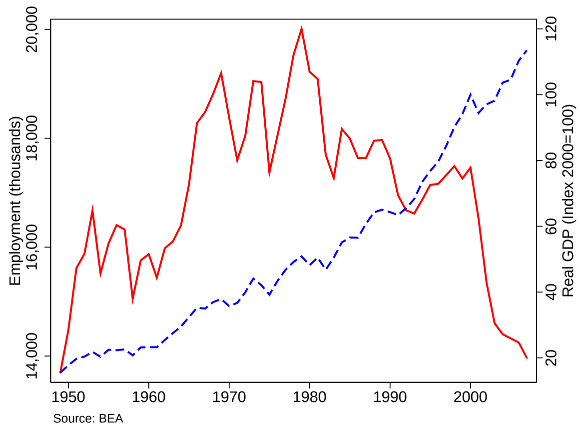
	Tariff rate	Freight rate	Trade cost rate
20 Food	-1.7	-1.9	-3.5
21 Tobacco	-3.6	0.9	-2.7
22 Textile	-5.3	0.5	-4.8
23 Apparel	-5.5	-0.6	-6.1
24 Lumber	-0.7	-2.0	-2.7
25 Furniture	-2.2	5.1	2.8
26 Paper	-0.3	0.9	0.6
27 Printing	-0.8	0.2	-0.5
28 Chemicals	-3.2	-2.1	-5.3
29 Petroleum	-0.5	-1.9	-2.5
30 Rubber	-2.4	1.1	-1.3
31 Leather	-0.8	1.3	0.5
32 Stone	-3.0	4.6	1.7
33 Primary metal	-1.9	-0.6	-2.5
34 Fabricated metal	-2.1	0.3	-1.8
35 Industrial machinery	-1.7	0.1	-1.6
36 Electronic	-2.3	0.1	-2.2
37 Transportation	-0.3	-0.6	-0.9
38 Instruments	-3.5	-0.6	-4.1
39 Miscellaneous	-2.6	0.6	-2.0
Average	-2.2	-0.1	-2.4

Notes: The numbers in the table are percentage points differences between the three-period average measures for 1992 and 2005. For example, the change in the trade cost is equivalent to $\bar{\tau}_{2005} - \bar{\tau}_{1992}$ for each two-digit industry.

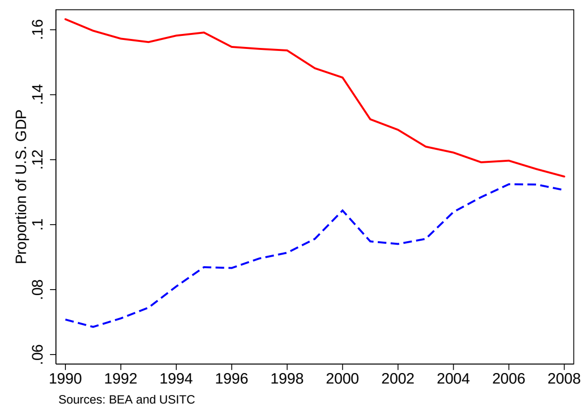
Table 3: Establishment-Level Estimation

Dependent variable (at time t) indicated in columns	Net Employment	Expansion	Job Destruction	Decomposing Job Destruction: Death	Decomposing Job Destruction: Contraction	Probability of: Expansion	Probability of: Contraction
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\triangle$(Trade cost)$_{t-1}$	11.713***	8.569***	-3.144*	-3.164*	0.021	15.573***	1.483*
	(2.722)	(1.773)	(1.632)	(1.633)	(0.778)	(3.896)	(0.849)
$\triangle$(Trade cost)$_{t-1}\times$	-11.358***	-8.668***	2.689*	2.74*	-0.05	-15.739***	-1.583*
(Relative productivity)$_{t-1}$	(2.643)	(1.781)	(1.568)	(1.567)	(0.791)	(3.849)	(0.897)
Establishment characteristic							
(Job creation)$_{t-1}$	0.068***	0.036***	-0.032***	-0.073***	0.040***	0.128***	0.065***
	(0.006)	(0.002)	(0.005)	(0.004)	(0.002)	(0.004)	(0.002)
(Job destruction)$_{t-1}$	0.034***	0.064***	0.031***	0.011	0.019***	0.056***	0.032***
	(0.008)	(0.003)	(0.008)	(0.007)	(0.002)	(0.003)	(0.003)
$\triangle$log(Sales per worker)$_{t-1}$	0.011***	0.000	-0.012***	-0.006***	-0.006***	0.010***	-0.008***
	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
(Age)$_{t-1}$	0.002***	-0.000***	-0.002***	-0.002***	0.000***	0.000***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry characteristic							
$\triangle$log(Value of shipments)$_{t-1}$	-0.011	0.018***	0.029*	0.032**	-0.003	0.040***	-0.005
	(0.017)	(0.004)	(0.015)	(0.015)	(0.003)	(0.008)	(0.007)
$\triangle$log(Price of shipments)$_{t-1}$	0.186**	-0.052***	-0.238***	-0.180***	-0.058***	-0.141***	-0.113***
	(0.075)	(0.020)	(0.070)	(0.065)	(0.015)	(0.039)	(0.028)
$\triangle$log(Price of energy)$_{t-1}$	0.027	0.045***	0.018	0.024	-0.006	0.057**	0.012
	(0.047)	(0.014)	(0.044)	(0.039)	(0.014)	(0.027)	(0.025)
$\triangle$log(Price of materials)$_{t-1}$	0.066	-0.064***	-0.130**	-0.104*	-0.026**	-0.156***	-0.095***
	(0.065)	(0.016)	(0.062)	(0.057)	(0.011)	(0.035)	(0.029)
$\triangle$log(Employment)$_{t-1}$	0.087***	-0.006	-0.093***	-0.085***	-0.009***	-0.014	-0.017**
	(0.021)	(0.005)	(0.020)	(0.020)	(0.003)	(0.009)	(0.008)
log(Wage)$_{t-1}$	0.041***	0.012***	-0.029**	-0.032***	0.002*	0.033***	0.014***
	(0.011)	(0.003)	(0.012)	(0.012)	(0.001)	(0.005)	(0.003)
Observations	757922	757922	757922	757922	757922	757922	757922
R-squared	0.06	0.05	0.10	0.08	0.04	0.09	0.07
F-statistic	235.171	174.528	337.938	271.956	539.954	344.67	557.626

Notes: * denotes significance at 10%; ** denotes significance at 5%; *** denotes significance at 1%. Robust standard errors are clustered at the 4-digit industry level. Dependent variable indicates change in employment between $t-1$ and t. $\triangle$(Trade cost)$_{t-1}$ is the change in the average trade cost between $t-1$ and $t-2$. Relative productivity is the establishment (log of) sales per worker normalized by the median at the industry-level per year. Regressions include time fixed effects.

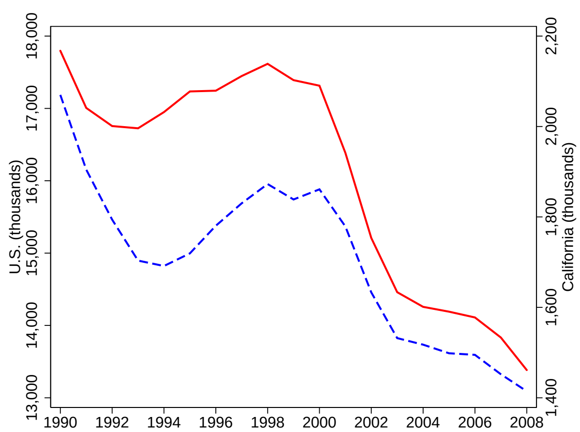


(a) Employment (solid) and real GDP (dashed)

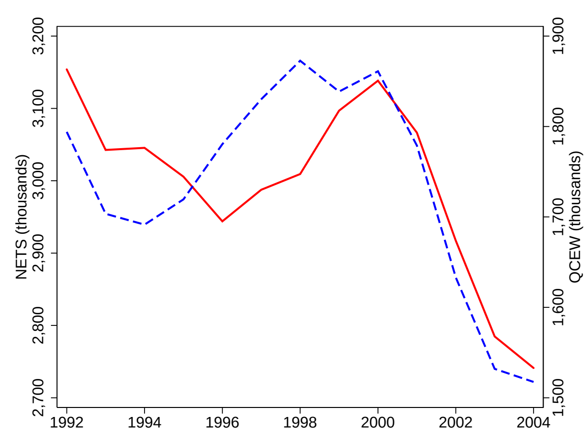


(b) Domestic production (solid) and imports (dashed)

Figure 1: The Manufacturing Industry in the U.S.

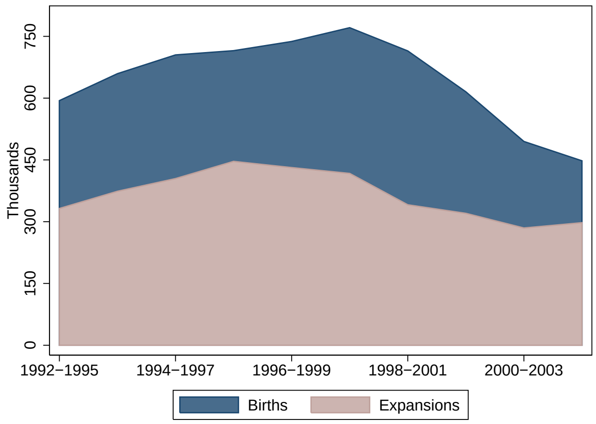


(a) QCEW: U.S. (solid) and California (dashed)

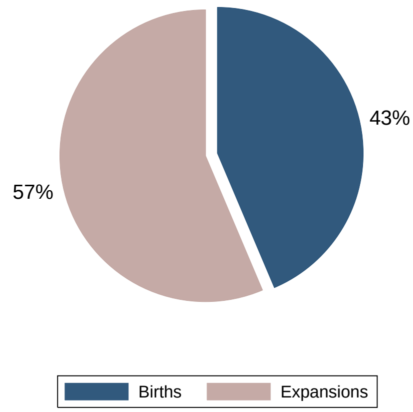


(b) NETS (solid) and QCEW (dashed)

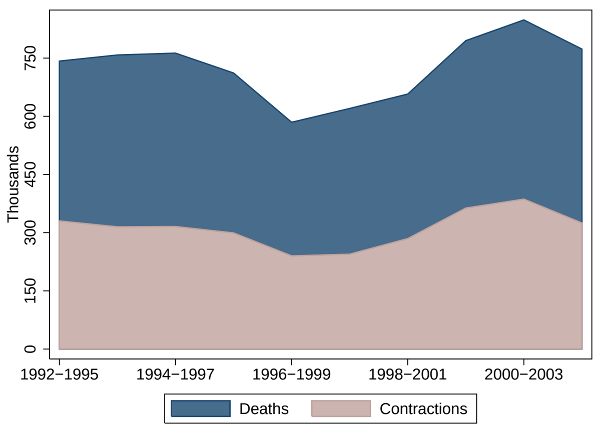
Figure 2: Employment in California's Manufacturing Industry



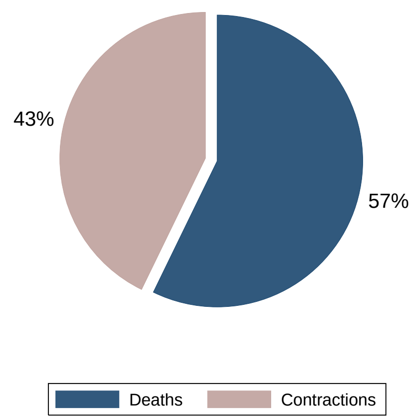
(a) Job creation decomposition



(b) Job creation shares (average)



(c) Job destruction decomposition



(d) Job destruction shares (average)

Figure 3: Employment Creation and Destruction in California's Manufacturing Industry (three-year windows)

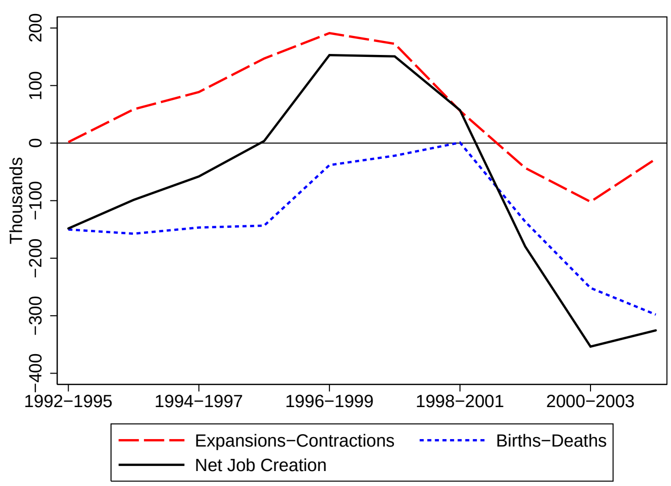


Figure 4: Net Employment Creation in California's Manufacturing Industry

References

Bartelsman, E. J., and W. Gray (1996): "The NBER Manufacturing Productivity Database," NBER Technical Working Papers 0205, National Bureau of Economic Research, Inc.

Bernard, A. B., J. B. Jensen, and P. K. Schott (2006): "Survival of the Best Fit: Exposure to Low-Wage Countries and the (Uneven) Growth of U.S. Manufacturing Plants," *Journal of International Economics*, 68(1), 219–237.

Chaney, T. (2008): "Distorted Gravity: The Intensive and Extensive Margins of International Trade," *American Economic Review*, 98(4), 1707–1721.

Davidson, C., L. Martin, and S. Matusz (1999): "Trade and Search Generated Unemployment," *Journal of International Economics*, 48(2), 271–299.

Davidson, C., and S. J. Matusz (2004): *International Trade and Labor Markets: Theory, Evidence, and Policy Implications*. W. E. Upjohn Institute.

——— (2005): "Trade and Turnover: Theory and Evidence," *Review of International Economics*, 13(5), 861–880.

Davis, S. J., and J. C. Haltiwanger (1992): "Gross Job Creation, Gross Job Destruction, and Employment Reallocation," *The Quarterly Journal of Economics*, 107(3), 819–63.

Davis, S. J., J. C. Haltiwanger, and S. Schuh (1998): *Job Creation and Destruction*, vol. 1 of *MIT Press Books*. The MIT Press.

Dutt, P., D. Mitra, and P. Ranjan (2009): "International Trade and Unemployment: Theory and Cross-National Evidence," *Journal of International Economics*, 78(1), 32–44.

Ebenstein, A., A. Harrison, M. McMillan, and S. Phillips (2009): "Estimating the Impact of Trade and Offshoring on American Workers Using the Current Population Surveys," NBER Working Papers 15107, National Bureau of Economic Research, Inc.

Feenstra, R. C. (2010): *Offshoring in the Global Economy: Microeconomic Structure and Macroeconomic Implications*. The MIT Press, Cambridge, Massachussetts.

Feenstra, R. C., J. Romalis, and P. K. Schott (2002): "U.S. Imports, Exports, and Tariff Data, 1989-2001," NBER Working Papers 9387, National Bureau of Economic Research, Inc.

Ghironi, F., and M. J. Melitz (2005): "International Trade and Macroeconomic Dynamics with Heterogeneous Firms," *Quarterly Journal of Economics*, 120(3), 865–915.

Grossman, G. M., and E. Rossi-Hansberg (2008): "Trading Tasks: A Simple Theory of Offshoring," *American Economic Review*, 98(5), 1978–97.

Helpman, E., and O. Itskhoki (2007): "Labor Market Rigidities, Trade and Unemployment," NBER Working Papers 13365, National Bureau of Economic Research, Inc.

Helpman, E., O. Itskhoki, and S. Redding (2008): "Inequality and Unemployment in a Global Economy," NBER Working Papers 14478, National Bureau of Economic Research, Inc.

Klein, M. W., S. Schuh, and R. K. Triest (2003): "Job Creation, Job Destruction, and the Real Exchange Rate," *Journal of International Economics*, 59(2), 239–265.

Melitz, M. J. (2003): "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity," *Econometrica*, 71(6), 1695–1725.

Melitz, M. J., and G. I. P. Ottaviano (2008): "Market Size, Trade, and Productivity," *Review of Economic Studies*, 75(1), 295–316.

Mitra, D., and P. Ranjan (2009): "Spillovers Across Labor Markets in Search Models: Effects of "Animal Spirits" and Offshoring," Mimeo 9387, UC-Irvine and Syracuse University.

Moore, M. P., and P. Ranjan (2005): "Globalisation vs Skill-Biased Technological Change: Implications for Unemployment and Wage Inequality," *Economic Journal*, 115(503), 391–422.

Moser, C., D. Urban, and B. Weder di Mauro (forthcoming): "International Competitiveness, Job Creation and Job Destruction–An Establishment-Level Study of German Job Flows," *Journal of International Economics*.

Neumark, D., B. Wall, and J. Zhang (forthcoming): "Do Small Businesses Create More Jobs? New Evidence for the United States from the National Establishment Time Series," *Review of Economics and Statistics*.

Neumark, D., J. Zhang, and B. Wall (2007): "Employment Dynamics and Business Relocation: New Evidence from the National Establishment Time Series," *Research in Labor Economics*, 26, 39–83.