Offshoring, Wages, and Employment: Theory and Evidence

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Abstract

Offshoring of US jobs is controversial. Critics fear that offshoring will lead to lost jobs and lower domestic wages at firms that offshore relative to those that do not. This paper offers theory and empirical evidence that challenge this story. The model combines heterogeneous firms with wage bargaining, in which firms endogenously select into offshoring. Given a shock that lowers offshoring costs, the theory predicts that profitability and hence domestic wages rise at offshoring firms relative to domestic wages at non-offshoring firms. Further, the model predicts that domestic employment could in fact rise at offshoring firms as expansion due to the efficiency boost could offset the loss of offshored jobs. However, the model definitely predicts that domestic employment would fall at non-offshoring firms, which lose market share and contract. Using the Mexican FDI Law of 1993 and the peso crisis in 1994 as exogenous shocks to the marginal cost of offshoring to Mexico, I proceed to test the predictions with firm-level data. The empirical findings confirm that domestic wages rise at firms likely to take advantage of the offshoring shock relative to those unlikely. Specifically, average domestic wages rise approximately 6% more during the 1993-97 period for the former set of firms compared to the latter. The results also reveal that there is no evidence of greater job loss at the former set of firms compared to the latter.

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1 Introduction and Motivation

Offshoring[1] has been a source of controversy under the charge that it hurts the American worker. This view contends that firms who offshore reduce wages and shed jobs. Hence, it was no surprise that Gregory Mankiw, while serving as chairman of the CEA, caused an uproar by commenting that offshoring is only "the latest manifestation of the gains from trade that economists have talked about at least since Adam Smith."[2] But as we also know, trade can lead to welfare gains in the aggregate yet still produce "winners" and "losers". If offshoring is the latest manifestation of gains from trade, then who are the winners and losers?

This paper is the first to offer theory and evidence on the firm-level productivity effects of offshoring on wages. By extending previous theoretical work to consider firm-level implications, the model makes novel predictions on the effects of offshoring on wages, employment, and wage inequality. Further, using firm-level data, I test and find empirical support for these new predictions. The main finding is that, contrary to some beliefs, firms who offshore increase wages relative to firms who do not offshore. Furthermore, I find no evidence that there is greater job loss at offshoring firms compared to firms who do not offshore.

The model is characterized by three key features. First, labor markets are imperfect and characterized by search costs and wage bargaining leading to rent-sharing. The wage specification comprises an outside option, which is common to all workers in the sector and a share of firm-specific rents (operating profits per domestic worker). Second, firms are heterogeneous in productivity, which leads to differences in scale. There exist fixed costs of offshoring while the benefits from offshoring increase in the scale of the firm, leading to the implication that only the most productive firms ("MNCs") select into offshoring, while the less productive firms source solely from the domestic

[1] Following Grossman and Helpman (2002), Trefler (2005), I define offshoring to include the movement of production processes abroad but kept within the firm (vertical FDI) as well as arms-length transactions (offshore outsourcing). While my theoretical model can incorporate both modes, my data does not include information on arms-length transactions. Therefore, in the empirical analysis, I restrict offshoring to vertical FDI, which is measured as intrafirm affiliate sales.

[2] See Mankiw and Swagel (2006).

market (”purely domestic firms”). The third feature of the model is that markups are endogenous following Melitz and Ottaviano (2008). Offshoring reduces marginal costs of production for a firm (productivity effect), enabling them to not only expand output but also increase their markups and operating profits per domestic worker, which are then shared in the form of higher wages. This mechanism, which I call the productivity plus rent-sharing (”PRS”) effect, varies by firm and is stronger at more productive firms.

Additionally, the productivity effect from offshoring allows MNC firms to expand production and ”steal business” from purely domestic firms. The business-stealing effect leads to a fall in the relative competitiveness of purely domestic firms and therefore they experience lower markups, lower operating profits per domestic worker and consequently lower wages. This mechanism implies that wage dispersion across firms in the sector increases, with most of the wage dispersion occurring at the upper tail of the wage distribution and little or none occurring at the lower tail, which is consistent with recent empirical findings by Autor, Katz, and Kearney (2008). Finally, the business stealing effect generates a re-allocation of market share and employment from purely domestic firms towards MNCs. Hence, at MNCs, the net effect on employment is ambiguous, with the direct job loss due to offshoring potentially offset by expansion of employment in tasks carried out at home. However, purely domestic firms contract and shed jobs. Summarizing, this theoretical framework borrows from Grossman and Rossi-Hansberg (2008) to place a productivity effect in the context of heterogeneous firms (Melitz 2003) and imperfect labor markets to generate new predictions on the effects of offshoring on firm-level wages and employment. Also, importantly, rather than a move from autarky to full offshoring, the theory models marginal liberalization, which allows for testable predictions.

Using firm-level data on US MNCs and their affiliates, I test the above predictions. The empirical methodology uses a natural experiment as an identification strategy by taking advantage of two episodes in Mexico as a shock to the marginal cost of offshoring to Mexico for US firms.[3] First, the FDI law of 1993 relaxed restrictions and reduced both pecuniary and non-pecuniary costs of foreign ownership of Mexican firms.[4] Second, the peso depreciation at the end of 1994 significantly lowered real wages of Mexican workers in dollar terms making Mexico a more attractive platform for offshoring. Next, firms are separated into treatment and control groups where the treatment group includes US firms offshoring to Mexico in 1993. These firms, having already paid the fixed costs of entry, would be positioned to take advantage of a fall in the marginal cost of offshoring. The control firms include US firms who offshore to other Latin American countries but not Mexico as of 1993.[5] These firms would be less likely to respond to a fall in the marginal cost of offshoring since they would have to still pay the fixed entry cost. Comparing, I find that offshoring, operating profits per domestic worker, and average domestic wages increased more for treatment than control firms during the period 1993-97. Further, these differential changes were statistically significant when compared with the time period 1997-01 for all the same outcome variables. These results offer support for the hypothesis that offshoring, through operating profits per domestic worker, increases within-group (where group is the sector) wage dispersion. Additionally, this empirical analysis finds that there is no evidence of greater job loss at treatment firms relative to control firms.

One potential issue is that a labor composition effect - similar to Feenstra and Hanson (1996) - could also be consistent with these findings. If MNC firms offshore the lowest-paying jobs, then average domestic wages would increase mechanically with offshoring. To address this issue, I perform several robustness checks, including showing that average domestic wages likely increased more for treatment firms in industries with higher rent-sharing, which supports the mechanism proposed in this paper.

Sections 2 delves further into related literature. Sections 3-4 develop the theoretical

[3]There are fixed and marginal costs associated with offshoring. The theory and empirics focus on a shock to the marginal cost of offshoring.

[4]The new law streamlined and expedited the administrative procedures, reduced to a minimum the exercise of discretionary powers by Mexican authorities and increased foreign ownership limits from 49% to 100% in all manufacturing and some service industries.

[5]For robustness, I consider additional comparison groups, which are discussed in section VII.

framework and section 5 examines the comparative statics given an exogenous fall in the marginal cost of offshoring. Section 6 describes the data and presents some descriptive statistics. Section 7 provides background on the episodes in Mexico, describes the empirical methodology and presents the main results. Section 8 handles robustness checks and alternative hypotheses. Finally, Section 9 concludes.

2 Related Literature

Dramatic improvements in transportation and communication technology are changing the rules on what can be produced domestically versus abroad. Increasingly, firms can separate the production process globally to take advantage of factor cost differences without sacrificing gains from specialization. Figure 2.1 shows that intrafirm affiliate sales at all US manufacturing affiliates have increased four-fold in the last two decades. Controlling for the size of US manufacturing firms, figure 2.2 depicts that the strong relationship still holds. Further, Blinder (2006) argues that with continued technological advances, the scope for services offshoring is significant and combined with manufacturing jobs up to 20-25% of American jobs could be vulnerable to offshoring.

The concern that offshoring eliminates jobs and places downward pressure on wages has some economic merit. The most basic argument would be that offshoring substitutes for domestic labor causing the firm's labor demand curve to shift in and lower wages. Also, Rodrik (1997), and Dube and Reddy (2006) argue that globalization can have negative effects on low-skilled domestic workers by shifting bargaining power away from workers towards firms. However, these arguments constitute only part of the story as offshoring also reduces costs and improves the productivity of a firm. In a recent paper, Grossman and Rossi-Hansberg (2008) demonstrate that this productivity effect can actually lead to higher wages for domestic workers whose tasks are more easily offshored.

There are several recent theoretical papers that have looked at the labor market impacts of offshoring. Mitra and Ranjan (2007) also use search frictions in a model with heterogeneous firms under offshoring. However, their focus is on the effects of offshoring on employment; since wages do not vary across firms in their model, they do not offer firm-level impacts of offshoring on wages.[3] In Antras, Garicano, and Rossi-Hansberg (2006) offshoring results in better matching between heterogeneous managers and workers leading to distributional predictions at the team/firm-level. In addition to focusing on an entirely different mechanism, my paper models the effect of a marginal liberalization in offshoring rather than a move from complete autarky to complete offshoring. No model that moves from autarky to fully open offshoring is truly testable; hence, modeling marginal liberalization allows for a better connection between theory and data.

Meanwhile, wage inequality within the US over the last several decades has been rising, concurrent with the aforementioned trends in offshoring. While rising between-group wage inequality - the skill premium - seems to play a major role, evidence exists that within-group wage inequality also appears to contribute to overall wage inequality. Autor, Katz, and Kearney (2008) find that both overall inequality and residual inequality - wage dispersion within demographic and skill groups - has increased at the upper tail (90-50 percentile) of the distribution but has stagnated at the lower tail (50-10 percentile). Several papers have combined heterogeneous firms with imperfect labor markets in a trade context to derive implications on wages and wage inequality.[4] This paper differentiates itself from this literature in two ways. First, these trade models generally assume movement of final goods but not intermediate goods - Yeats (2001) finds trade in intermediate goods has been growing at a much faster rate than trade in final goods and accounts for 30% of world trade in manufacturing. Other authors have similarly demonstrated that the share of intermediate goods trade in total world trade has increased significantly in recent decades.[5] This distinction matters further because the mechanisms are different between trade in final goods and offshoring. In

[3]They do offer firm-level impacts of offshoring on employment, which are similar to the business-stealing effects in this paper.

[4]Egger and Kreickemeier (2007); Felbermayr, Pratt, and Schmerer (2008); Helpman, Itskhoki, and Redding (2008).

[5]See Hummels, Ishii and Yi (2001) and Borga and Zeile (2004).

these papers, under final goods trade, distributional consequences on wages channel through variations in market share, whereas under offshoring in my paper, they channel through variations in the productivity effect. Additionally, a crucial contribution of this paper is that I am able to bring theoretical predictions to the data, bridging the gap betweeen theory and evidence.[6]

In the empirical literature, numerous papers have tries to estimate the effects of globalization on wage volatility and employment. Slaughter et al. (2001, 2004, 2007) offer evidence that globalization has increased the elasticity of labor demand, therefore increasing the wage volatility of workers.[6] Also, there is a fairly extensive literature investigating the impacts of foreign employment on domestic employment, though the findings in this literature are quite mixed.[7]

In another relevant paper, Head and Ries (2002) find evidence in support of the Feenstra and Hanson composition effect - that offshoring changes the average wages at the firm-level through changes in the average skill-composition of the firm-level domestic work force - using firm-level Japanese manufacturing data. Egger and Egger (2003) use the fall of the Iron Curtain as an exogenous shock and find that increased outsourcing to Eastern Europe and the former Soviet Union increased the relative demand of skilled workers in Austria. However, their analysis is performed at the industry-level. While I also find evidence of a composition effect, the focus of

[6] My paper was developed independently of Amiti and Davis (2008), who have a model of rent-sharing with heterogeneous firms with trade in intermediate goods, combined with empirical evidence. My paper distinguishes itself in the following ways. First, I develop a more complete labor market by explicitly modeling bargaining between workers and firms. Second, my paper offers a richer model of offshoring, leading to additional predictions on the extent of offshoring. Third, in addition to wages, my paper predicts and tests the implications of offshoring on firm employment. Finally, my empirical methodology uses an abrupt exogenous shock for identification whereas they use gradual liberalization of tariffs.

[6] Karabay and McLaren (2006) propose a different mechanism where offshoring leads to increased volatility of wages in the offshoring country. Risk-averse workers accept a wage from risk-neutral firms below the spot rate in return for wage smoothing. However, new outsourcing opportunities make it more attractive for firms to deviate from the wage smoothing contract leading to increased wage volatility. See also Munch (2005), Egger, Pfaffermayr, and Weber (2007), and Geishecker (2008) who find that offshoring increases the probability of job dislocation.

[7] See Blomstrom, Fors, and Lipsey (1997), Brainard and Riker (2001); Hanson, Mataloni, and Slaughter (2003); Desai, Foley, and Hines (2005) for the US. See also Braconier and Ekholm (2000), Becker, Ekholm, Jackle, and Muendler (2005), Chen and Ku (2000), Konings and Murply (2006), Navaretti and Castellani (2004), and Debaere, Lee, and Lee (2006) for employment effects in Sweden, Germany, Taiwan, the EU, Italy, and South Korea.

this paper is to provide evidence of a new channel: the productivity plus rent-sharing mechanism detailed in the theorectical section.

In particular, my empirical work contributes to the literature by being the first to combine the following three elements: (1) firm-level analysis; (2) a natural experiment that acts as an exogenous shock to the marginal cost of offshoring to better identify the causal link; (3) more nuanced data that allows me to better separate horizontal (market access) from vertical (offshoring) activity.

Why are these three features important? First, by analyzing the effects of offshoring at the firm-level, I generate and test new predictions on the relative winners and losers from offshoring. Second, a firm-level analysis allows me to take advantage of episodes from Mexico as an exogenous shock to the marginal cost of offshoring for US firms to Mexico. This methodology permits me to establish a more convincing causal link from offshoring to outcome variables of interest. Finally, most papers in the literature examine FDI expansion. However, as we know, there are two main motivations for FDI expansion - horizontal versus vertical. Since the question is mainly about the latter, it is important to be able to better separate between the two types of FDI expansion. Many papers in the literature tackle this by assuming that activity in less-developed countries can proxy for vertical FDI and activity in developed countries can proxy for horizontal FDI. However, my data reveals that while the vertical share of activity in low-income countries is higher than in high-income countries, vertical and horizontal activities occur in both types of countries[8]. Hence, using information on sales of foreign affiliates, I am able to more precisely estimate vertical versus horizontal activity. Closer to this paper, Harrison and McMillan (2008) find that foreign employment complements domestic employment at vertically integrated firms, which is consistent with a productivity effect from offshoring.

[8]Low-income countries are defined by the World Bank as countries with GDP per capita less than \$11,455 as of 2007. High-income countries have GDP per capita greater than \$11,455 as of 2007. As a share of total activity, vertical activity to developed countries (excluding Ireland - for some reason Ireland seems to host a large share of vertical activity) averaged about 15% in the mid to late 90s. In comparison, this share was in the range of 25-30% for most low-income destinations in the same period.

3 Model Preliminaries

3.1 Production and Offshoring Technology

Consider an economy where all goods are produced with one factor, labor, which is homogeneous. L units of total labor are split between two sectors, X and Y. Sector X is a homogeneous goods sector that competes under perfect competition in both product and labor markets. The homogeneous good from sector X is the numeraire and production in sector X employs a simple constant returns to scale technology.[7] Further, I assume that offshoring possibilities are not available for firms in sector X.

Sector Y is a differentiated goods sector that possesses search frictions in the labor market and monopolistic competition in the product market. Production requires only one factor, labor. Following Hopenhayn (1992), firms pay a fixed entry cost (f_e) to learn their productivity parameter from distribution $G(\phi)$. Then, once they realize their productivity, firms act in two stages. First, they search, match, and bargain over wages with workers. Knowing their productivity parameter and wages firms either decide to exit immediately[8] or enter where they compete under monopolistic competition in the product market.

The production of a unit of a differentiated good in sector Y requires a continuum of tasks, indexed by $z \in [0, 1]$. Following the terminology of Leamer and Storper (2001), low z tasks can be thought of as codifiable whereas high z tasks require "tacit information", best communicated through face-to-face relationships. Similarly, Autor, Levy, and Murnane (2003) distinguish between routine (low z) and non-routine tasks (high z), where the former are easier to offshore because they can be described by a simple algorithm. Here, the continuum for z is not related to skill - all workers are homogeneous - rather, within skill-type, some tasks are easier to codify than others.[9]

[7] It is straightforward to endogenize the wage in sector X by allowing for decreasing returns to labor there. Then, as labor flows into sector X, the outside option for workers in sector Y falls, tending to reinforce the effect found here.

[8] Following Melitz and Ottaviano (2007), I do not model fixed domestic production costs for simplicity. Fixed domestic production costs do not add new insights and in fact obscure the key intuition. Because of linear demand, low-productive firms will not be able to survive even without fixed costs.

[9] Blinder (2006) argues that traditional notions of skill do not necessarily correlate with vulnerability of

Next, the production function is linear, $q = \phi N(\phi)$, where $N(\phi)$ is the employment level at a firm with productivity ϕ. Without loss of generality, I assume that each task requires an equal share s of $N(\phi)$ and this is the same across all firms in sector Y ($s(z, \phi) = s, \forall z, \phi$) - hence any task z requires $sN(\phi)$ workers at any firm. Note that assuming a constant s for each task means that z also captures the share of a firm's workforce employed in tasks $[0..z]$.[10] The direct foreign cost of performing any task z is $sN(\phi)w_f$[11], where w_f is assumed to be exogenous.[12] In addition, offshoring is associated with two other costs. First, $t(z)$ captures the technological costs of offshoring task z. Since increasing z reflects that tasks are becoming more non-routine and hence increasingly difficult to offshore, $t'(z) > 0$. In fact, I assume that $\lim_{z \to 1} t(z) \to \infty$, reflecting that the most non-routine tasks are impossible to offshore.[13] Second, there is a policy-related cost, $\beta > 1$, which is the same for all firms and captures the idea that government regulations impose additional costs to offshoring.[14] Hence, the marginal cost of offshoring task z becomes $\beta t(z) sNw_f$. Finally, for simplification, firms in sector Y can import intermediate goods (trade in tasks) but not trade in final goods.

3.2 Labor Market

Labor is perfectly competitive in sector X and is paid its marginal product of labor. Further, this sector absorbs any residual labor from sector Y. Defining the demand for labor/employment in sectors X and Y as L_x and L_y, respectively, the labor market clearing condition becomes: $L = L_x + L_y$.

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a job to offshoring. Rather the new divide could be along the codifiable/routine versus tacit/non-routine distinction, not necessarily by skill.

[10]The assumption of a constant s is not required but serves to simplify the mathematical exposition.

[11]$sN(\phi)w_f$ is the foreign cost of performing a task and is invariant to whether that task is performed abroad within the firm or is outsourced through an arms-length transaction.

[12]What if w_f (foreign wages) were not exogenous but rather rent-sharing with foreign workers did exist? If the rent-sharing parameter (η) were the same between domestic and foreign workers, the main results of the model are unchanged. However, it seems highly unreasonable, given the difference in labor market institutions, that the rent-sharing parameter would be the same for US and foreign labor. Using different rent-sharing parameters for domestic versus foreign workers makes the model intractable. As a possible extension, one could consider other ways of endogenizing w_f.

[13]This assumption ensures that in equilibrium no firm will choose to offshore all tasks.

[14]For example, in the empirical exercise, the Mexican FDI law of 1993 streamlined and expedited the administrative procedures, reduced the ad-hoc, discretionary powers of Mexican authorities and increased foreign ownership limits from 49% to 100% in all manufacturing and some service industries.

Unlike the labor market in sector X, the labor market in sector Y is not perfectly competitive and functions as follows. All workers begin by searching in sector Y for jobs, knowing that even if they do not find one, they can costlessly move to sector X and earn w_x. Workers and firms in sector Y are randomly matched but since the number of searchers, L, exceeds the labor demand in the sector, L_y, not all workers find a match. The unmatched workers in sector Y move to sector X and receive wages w_x. Anticipating the outcome of the bargaining game, firms decide the level of total employment, N, and domestic employment, N_d, in the second stage. For firms, I assume that search costs are prohibitively high such that if an agreement is not reached, firms produce with one less domestic worker. On the other hand, a worker's outside option is to move to sector X and earn w_x. A matched worker and firm in sector Y thus attain a surplus by agreeing on a wage, which I assume is allocated by Nash bargaining. The firm is assumed to bargain simultaneously with all N_d workers; hence, each worker is treated as the N_d^{th} worker, where the other $N_d - 1$ workers have already agreed on a wage.[15]

The Nash bargaining game between a worker and a firm is as follows:

$$\max_{w} \theta \ln(w - w_x) + (1 - \theta)[\Pi_{op}(N_d) - \Pi_{op}(N_d - 1)] \tag{1}$$

$\theta \in [0, 1]$ and $(1 - \theta)$ are the exogenous Nash bargaining parameters of workers and firms, respectively. Also, if the parties reach a wage agreement, the firm earns operating profits $\Pi_{op}(N_d)$, else it earns operating profits $\Pi_{op}(N_d - 1)$. Leaving the details to appendix 1, solving this bargaining game derives the following rent-sharing wage specification:

$$w_d = \eta \pi_{op} + w_x \tag{2}$$

where $\eta = \eta(\theta, \varepsilon_{nw})$ is a function of the Nash bargaining parameter and the wage

[15] The bargaining here only depends on the marginal effect of the additional worker and so differs from Stole and Zwiebel (1996) where wage bargaining depends on both the marginal and inframarginal effects of the additional worker. The simplification in this paper is assumed for tractability.

elasticity of labor demand.[16] Since η is a function of exogenous parameters of the model, it is itself also exogenous. Finally, $\pi_{op} = \frac{\Pi_{op}}{N_d}$ are operating profits per domestic worker.

Empirically, numerous studies have found evidence of rent-sharing at the sectoral and firm-level in many developed countries.[17] Goos and Konings (2001) summarize that the empirical literature on rent-sharing finds an elasticity of wages with respect to rent between 0.1-0.3 for the US, Canada, UK, and some European countries.

Having determined domestic wages, firms now compete in the product market under monopolistic competition, which warrants a discussion of consumer demand.

3.3 Demand

Consumer preferences follow the specification of Melitz and Ottaviano (2008).[18] In an economy with L units of labor:

$$Q = U = q_x + \left[\rho \int_{i \epsilon I} q_i di\right] - \left[\frac{1}{2}\gamma \int_{i \epsilon I} (q_i)^2 di\right] - \left[\lambda(\int_{i \epsilon I} q_i di)^2\right] \tag{3}$$

with the measure of set I representing the mass of goods produced in sector Y and q_x and q_i representing the consumption of the homogeneous good and the differentiated good, respectively, by an individual consumer. The parameter ρ indexes the substitution between differentiated good i and good X while λ indexes the substitution between aggregate good Y and good X. Lastly, γ indexes the degree of product differ-

[16] See Abowd and Lemieux (1993) and Estevao and Tevlin (2003) for more a detailed exposition on the relationship between η and θ.

[17] Some important papers demonstrating evidence of rent-sharing include Abowd and Lemieux (1993), Blanchflower, Oswald, and Sanfey (1996), and Hildreth and Oswald (1997), who examine Canadian bargaining agreements, a panel of US industries, and a panel of UK firms, respectively. Blanchflower, Oswald, and Sanfey further demonstrate that rent-sharing is present even in industries with low unionization rates, demonstrating that rent-sharing can be motivated from non-union models. Budd and Slaughter (2004) go further and using Canadian labor contracts in manufacturing, find the presence of intra-firm, cross-border rent-sharing. Abowd, Kramarz, and Margolis (1999) suggest that firm specific effects explain about 21-26% of higher wages, with the remaining explained by labor specific effects.

[18] CES preferences in this model would generate predictions which are inconsistent with empirical evidence, motivating an endogenous markups setup. For example, under CES preferences, operating profits per domestic worker and domestic wages decrease with firm productivity, with especially the latter being inconsistent with empirical evidence. While I have chosen quasi-linear utility here, any preferences that generate higher markups for more productive firms would lead to the same results.

entiation amongst the differentiated goods in I. The quasi-linear utility form gives no role for income effects to change the consumption of differentiated goods. Each firm is a monopolist in its own good but faces competition from other goods, which are imperfect substitutes ($\gamma > 0$). Solving the consumer's constrained optimization leads to the following inverse demand function:

$$p_i = \rho - \gamma q_i - \lambda Q_y \tag{4}$$

where Q_y represents total consumption of aggregate good Y. Inverting this function gives demand for good i in this sector:

$$Lq_i = \frac{\rho L}{\lambda M + \gamma} - \frac{L}{\gamma} p_i + \frac{\lambda M}{\lambda M + \gamma} \frac{L}{\gamma} \bar{P}_y \tag{5}$$

where M is the measure of consumed varieties from the demand side (or the measure of firms from the production side) and $\bar{P}_y$ is the average price in sector Y defined as $\bar{P}_y = \frac{1}{M} \int_{i \epsilon I} p_i di$.

Also, define p_{max} as the price at which demand for a good vanishes:

$$p_{max} = \frac{\gamma \rho}{\lambda M + \gamma} + \frac{\lambda M}{\lambda M + \gamma} \bar{P}_y \tag{6}$$

Any firm which sets prices $p \geq p_{max}$ earns zero demand and profits.

4 Benchmark: Limited Offshoring

4.1 Production under Limited Offshoring

As mentioned in the introduction, a move from complete autarky to a fully open economy is not truly testable. Hence, in this section, I consider the benchmark case as one with limited offshoring and later examine the impacts of a marginal liberalization on the benchmark equilibrium.

In sector Y, there is a continuum of firms, each producing a different good, i[19] and setting prices to maximize profits. Though prices cannot be solved for explicitly in this model, the following function implicitly defines p:

$$D(p,.) : -\frac{L}{\gamma}p + q + \frac{L}{\gamma}c - q\frac{\eta}{1+\eta} = 0 \tag{7}$$

where q is determined by equation (5) and c by equation (12) below. This implicit function will be crucial in determining how prices and other key firm-level variables respond to a shock to offshoring costs.

Since demand is linear, and p is decreasing in ϕ (shown in appendix 2a), there exists a unique ϕ^* such that $p(\phi^*) = p_{max}$ and $\Pi(\phi^*) = 0$; ϕ^* serves as a cut-off to partition firms between those who exit ($\phi < \phi^*$) and those who stay in the market ($\phi >= \phi^*$) and earn non-negative profits. In addition, firms in this sector would like to take advantage of cheaper wages abroad; to do so, they must pay a fixed cost, f_o, that is related to setting up production facilities abroad. Firms share f_e and f_o but differ in their productivity, ϕ. Since the benefits from offshoring increase with scale, the fixed costs, f_o, partition firms into MNC firms who choose to offshore and purely domestic firms who do not. Appendix 4a shows the existence of and defines the productivity cut-off ϕ_o^*. The following summarizes the separation of firms:

$$\begin{cases} \text{MNC firms:} & \text{if } \phi_o^* < \phi \\ \text{Purely domestic firms:} & \text{if } \phi^* < \phi < \phi_o^* \\ \text{Exiting firms:} & \text{if } \phi < \phi^* \end{cases}$$

Now, the extent of offshoring by a firm - defined as $z^*(\phi)$ - is decided by the the following condition, where a firm offshores tasks until the marginal cost of the offshored task is the same as the marginal costs of performing the task domestically:

$$\beta t(z^*) w_f = w_d \tag{8}$$

[19] Ensuing discussions are from the point of view of an individual firm and so the subscript i is dropped.

where w_d is determined in equation (11). That is, $\beta t(z)w_f < w_d$ for all tasks $z \in [0..z^*)$ and for task z^* task, the above equality holds, implicitly determining the level of offshoring by a firm in equilibrium. Appendix 3 demonstrates that in equilibrium more productive firms offshore more of their tasks. The above equation provides a hint of the intuition - because more productive firms pay higher domestic wages, the cost savings from offshoring any given task are also greater and hence they are able to move further up the $t(z)$ schedule.

Having determined the extent of offshoring for a firm, then average wages paid by the firm can be expressed as:

$$w = \beta T(z^*)w_f + (1 - z^*)w_d \tag{9}$$[20]

where $T(z^*) = \int_0^{z^*} t(z)dz$. Then, total costs are $TC(q(\phi)) = w(\phi)N(\phi) + f_o = \frac{w(\phi)q(\phi)}{\phi} + f_o$; marginal costs are $c(\phi) = \frac{w(\phi)}{\phi}$; where w is expressed in the equation above. I now solve for key variables, π_{op}, w_d, c for a firm:

$$\pi_{op} = \frac{\phi p - \beta T(z^*)w_f - (1 - z^*)w_x}{(1 - z^*)(1 + \eta)} \tag{10}$$

$$w_d = \frac{\eta\phi p - \eta\beta T(z^*)w_f + (1 - z^*)w_x}{(1 - z^*)(1 + \eta)} \tag{11}$$

$$c_d = \frac{\eta\phi p + \beta T(z^*)w_f + (1 - z^*)w_x}{\phi(1 + \eta)} \tag{12}$$

Setting $z^* = 0$ (meaning no offshoring) for equations (10) - (12) gives the equilibrium equations for purely domestic firms. From the above equations, we learn that c is falling with firm productivity, while π_{op} and w_d are increasing in firm productivity (see appendix 2 for proofs). The last feature is consistent with the stylized fact that more

[20] For purely domestic firms, $T(z^* = 0) = 0$ and $w = w_d$.

productive/larger firms pay higher wages (see Abowd, Kramarz, and Margolis (1999); Brown and Medoff (1989)).

4.2 Firm Entry & Exit, Equilibrium under Limited Offshoring

With respect to the entry and exit of firms in sector Y, I follow Melitz (2003). Prior to entry, firms are identical and must pay a sunk entry cost f_e to observe their firm-specific productivity draw from a cumulative distribution $G(\phi)$ with density $g(\phi)$ over the support $[1, \infty)$. As is common in trade models, following Helpman, Melitz, and Yeaple (2004), I assume a pareto distribution to parameterize $G(\phi)$:[21]

$$G(\phi) = 1 - (\tfrac{1}{\phi})^k \quad g(\phi) = \tfrac{k}{\phi}(\tfrac{1}{\phi})^k \tag{13}$$

Having defined ϕ^*, the ex-post distribution of productivities of firms in the market is defined as:

$$\varphi(\phi) = \begin{cases} \frac{g(\phi)}{1-G(\phi^*)} = \frac{k}{\phi}(\frac{\phi^*}{\phi})^k & \text{if } \phi >= \phi^* \\ 0 & \text{otherwise} \end{cases}$$

and subsequently define the average productivity in sector Y, $\bar{\phi}$:[22]

$$\bar{\phi} = \int_{\phi^*} \phi\varphi(\phi)d\phi = \tfrac{k}{k-1}\phi^* \quad \text{assuming } k > 1 \tag{14}$$

Following Melitz (2003), the equilibrium in sector Y is characterized by two conditions. First, the zero-cutoff profit (ZCP) condition asserts that the profits of the marginal entrant should be zero ($\Pi(\phi^*) = 0$). Using this condition, and $\bar{\phi}$ defined

[21] Axtell (2001) shows that pareto accurately captures the distribution of US firms. Using firm level data for eleven European countries, Del Gatto, Mion and Ottaviano (2006) find that "Pareto is a fairly good approximation of the underlying productivity distribution" (p.17) in their data.

[22] I implicitly assume that $\bar{\phi}$ represents a purely domestic firm. Given the pareto distribution of productivities and the empirical fact that the super majority of all firms are purely domestic firms, this assumption is reasonable. However, none of the main results/predictions would change even if $\bar{\phi}$ represented an MNC firm.

above, I solve for average sectoral profits:

$$\bar{\Pi} = \Pi(\bar{\phi}) = \Pi[(\tfrac{k}{k-1})\phi^*] \quad (ZCP) \tag{15}$$

where the full derivation is left to appendix 5. In addition to the ZCP condition, the equilibrium structure in this sector is defined by the free entry condition: expected profits from firm entry in sector Y should equal the sunk entry cost, thereby setting the expected payoffs equal to zero, ex-ante. The FE condition can be written as:

$$\begin{aligned} &[1 - G(\phi^*)]\bar{\Pi}(\phi^*) = f_e \\ &\bar{\Pi}(\phi^*) = f_e(\phi^*)^k \qquad \text{(FE)} \end{aligned} \tag{16}$$

Appendix 5 demonstrates how both the FE and ZCP conditions behave in the $(\bar{\Pi}, \phi^*)$ space and proves the existence and uniqueness of an equilibrium for $k > 1$.[23]

I conclude this section by balancing trade and describing the market clearing condition in sector X. To balance trade, I simply assume that exports of the numeraire good pay for the aggregate offshoring bill. Then, the goods market clearing condition in sector X can be written as:

$$q_x = \phi_x(L_x)^\alpha = [I - \int_{\phi^*}^{\infty} r(\phi)d\phi] + \int_{\phi_o^*}^{\infty} z^* N(\phi) w_f d\phi \tag{17}$$

where the term inside the brackets on the right-hand side is the domestic demand for good x, and the last term represents exports of good x to balance trade.

[23] Axtell (2001) estimates a pareto shape parameter of 1.0-1.1 for US firms using various definitions of firm size. Del Gatto, Mion, and Ottaviano (2006) estimate a pareto shape parameter of 1.6-2.4 for their distribution of productivity across 17 industries, pooling over firms in 11 European countries.

5 Comparative Statics

5.1 Firms' Response to a Fall in the Cost of Offshoring

This section examines how firms in sector Y respond to an exogenous fall in the marginal costs of offshoring, which occurs either through a relaxation in the policy constraint, β[24], or through a fall in foreign wages, w_f.[25] The remainder of the paper discusses the effects of a fall in β; however, a fall in w_f operates in exactly the same way. First, appendix 3 shows that as long as a sufficient condition (see equation (28)), which I call the technological slack condition, is satisfied, a fall in β increases offshoring along the intensive margin as any MNC will respond by increasing z^*. The technological slack condition ensures that firms have not hit their technological wall, above which offshoring becomes technologically too costly to justify, despite a fall in β. In this paper, I assume that the technological slack condition is satisfied and later in the empirics provide evidence in support of this assumption.[26] Additionally, there will also be a rise in offshoring along the extensive margin - the fall in the marginal cost of offshoring elicits the entry of new firms into offshoring (ϕ_o^* falls, see appendix 4b).

Firms can be split up into three categories to simplify the exposition of the comparative statics. The first set are the most productive firms who were offshoring before and and after the shock - MNCs. The next set are the new entrants to offshoring.[27] The last set are the firms who remain purely domestic before and after the shock.

Delving deeper, a fall in β reduces costs for MNC firms for two reasons. Let z_o^* define the level of offshoring for any MNC firm before and after the shock, respectively. Then, a fall in β clearly reduces the cost of marginal tasks $z \in (z^*, z_o^*]$, which is why the firm chooses to offshore these tasks. Additionally, the costs on the inframarginal tasks

[24]Passage of the FDI Law of 1993 is the empirical analog to a fall in β. See footnote 14.

[25]The sudden depreciation of the Mexican peso in late 1994 significantly lowered the wages of Mexican workers in dollar terms.

[26]The technological slack condition is not necessary to derive the main results of this paper since the productivity effect still exists due to inframarginal cost savings. However, I have modeled it this way since the data reveals that MNC firms do respond to a fall in non-technological offshoring costs.

[27]Empirically, new entrants seem to account for a very small fraction of increased offshoring. 94% of increased offshoring by US manufacturing MNCs from 1993-97 occurred along the intensive margin, whereas only 6% occurred along the extensive margin.

$z \in [0, z_o^*]$ are also lowered and the larger this set, the higher the cost savings.[28] While MNC save costs for both reasons, new entrants obviously only benefit on the marginal tasks.

The following propositions summarize the firm-level effects from a fall in policy-related offshoring costs.

Proposition 1: ***For MNC firms, a fall in β reduces marginal costs (c) and prices (p), while raising markups (μ), operating profits per domestic worker (π_{op}), and domestic wages (w_d). Further, π_{op} and therefore w_d increase more for more productive MNC firms. Refer to appendix 6a-e, 6g for a proof of proposition 1.***

As discussed above, a fall in β reduces costs to MNC firms along both marginally and inframarginally offshored tasks (productivity effect), allowing these firms to lower prices and move down their linear demand schedule and increase their output. Additionally, since demand becomes more inelastic at lower prices, firms are able to increase their markups, μ, leading to higher π_{op}, which are shared with the remaining domestic workers, raising their wages. The combined productivity plus rent-sharing mechanism is labeled the PRS effect.

Continuing, cost savings are larger at more productive firms (see appendix 6g for proof) with the following intuition. Even though less productive MNCs could potentially respond with more offshoring, thereby saving more on marginally offshored tasks, more productive firms definitely save more on their inframarginally offshored tasks and the latter savings is enough to guarantee larger overall cost savings for MNC firms. Larger cost savings translate into larger productivity gains meaning that π_{op} and w_d increase more for more productive MNC firms.

Also, a fall in β induces some previously purely domestic firms to be able to offshore and their comparative statics are the same for these new entrants as for MNCs.[29]

[28] The idea that reduced costs to offshoring would save firms on both the marginal and inframarginal tasks comes from Grossman and Rossi-Hansberg (2008).

[29] However, it is ambiguous whether the productivity effect is stronger or weaker at the new entrants compared to MNC firms.

The next proposition captures the effect on the firms who remain purely domestic before and after the shock.

Proposition 2: ***A fall in β has externalities on purely domestic firms, reducing their markups (μ), operating profits per domestic worker (π_{op}), and domestic wages (w_d). Refer to appendix 7a-e for a proof of proposition 2.***

Purely domestic firms are unable to benefit from a fall in β. In fact, new entrants and MNCs lower prices and steal business, shifting in the demand schedules of these purely domestic firms. This causes their markups to fall, which translates into lower π_{op} and consequently lower w_d at these firms.

Proposition 3: ***Offshoring causes wages of workers at MNCs to rise and wages of workers at purely domestic firms to fall, leading to across-firm, within-group wage inequality.***

This is a main prediction of the model and follows directly from propositions 1 and 2. See figure 1.1 for a graphical version of proposition 3, which predicts that wages rise at offshoring firms relative to ones who do not, leading to wages diverging in sector Y across firms. Autor, Katz, and Kearney (2008) document that within-group wage inequality comparing 90-50 percentiles has increased over the last few decades while it has stagnated or even fallen comparing 50-10 percentiles. From proposition 3 and figure 1.1, we see that this model predicts increases in within-group wage inequality at the upper tail of the wage distribution and stagnation at the lower tail, consistent with the empirical findings. Further, this paper offers an explanation that is consistent with observed trends in within-group wage inequality that have paralleled the recent surge in intermediate goods trade.

Proposition 4: ***Offshoring by MNCs leads to a re-allocation of production and labor from purely domestic firms towards new entrants and MNC firms. The net effect***

of offshoring on employment at new entrants and MNCs is ambiguous. However, employment at purely domestic firms fall. Refer to appendix 6f, 7f for a proof of proposition 4.

From proposition 1, we know that a fall in β allows new entrants and MNCs to reduce prices, thereby increasing their competitiveness compared to purely domestic firms. Hence, there is a shift in production and market share towards new entrants and MNC firms. Also, since labor demand at a firm is proportional to production, labor is also re-allocated from purely domestic firms towards new entrants and MNCs and therefore employment falls at purely domestic firms. The effect on employment at new entrants and MNCs is ambiguous though as the employment gain due to expansion is offset by the direct loss of jobs due to offshoring.

Summarizing, a fall in offshoring costs allows new entrants and MNC firms to gain a competitive advantage vis-a-vis purely domestic firms. This leads to opposite effects on markups, operating profits per domestic worker and wages. Furthermore, the business-stealing effect re-allocates production and employment from purely domestic firms to new entrants and MNCs. This theoretical prediction captured by proposition 4 is consistent with evidence found by Becker and Muendler (2008) for Germany. Using employer-employee linked data, they find that expanding MNCs retain more jobs than competitors without foreign expansion.

5.2 Sector Dynamics

An analysis of the effect of marginal liberalization requires an examination of the ZCP and FE conditions. While the FE condition remains unchanged, the ZCP condition is affected by offshoring. Appendix 8 demonstrates that the ZCP curve must shift up in response to increased offshoring leading to a higher ϕ^* and higher $\bar{\Pi}$ in the offshoring equilibrium.[30] Now, let the initial cutoff productivity be denoted as ϕ_a^*. Then, firms with productivity $\phi_a^* < \phi < \phi^*$, must exit the industry, which indicates that for these

[30]This can also be seen from equation (6), which reveals that falling $\bar{P}_y$ lowers p_{max}, which confirms that ϕ^* must be higher in the new equilibrium.

firms, the negative business-stealing effect drives them out of business.

To conclude, let us consider how sector-level variables respond to increased offshoring. Average prices in sector Y, $\bar{P}_y$, decrease with offshoring for two reasons: (1) prices decrease at new entrants and MNC firms; (2) the firms with the highest prices (least productive firms) exit the market. Average productivity increases since the least productive firms exit the industry following offshoring. And as argued above, average industry profitability also increases.

Proposition 5: ***A fall in β leads to a fall in employment in sector Y.***

This claim is consistent with empirical evidence offered by Amiti and Wei (2005), who find that depending on the degree of industry disaggregation, services and materials offshoring have a small negative effect on domestic employment. Continuing, I write L_y in the following way:

$$L_y = \int_{\phi^*}^{\phi_o^*} \frac{q(\phi)}{\phi} d\phi + \int_{\phi_o^*}^{\infty} \frac{(1 - z^*(\phi))q(\phi)}{\phi} d\phi \tag{18}$$

where the first term represents employment at purely domestic firms in sector Y and the second term represents employment at MNCs in sector Y. Now, the effects of offshoring can be broken down into two main channels. The first is the direct effect of the loss of offshored jobs at MNCs - represented by a rise in $z^*(\phi)$, in the second term above. The second channel, as we saw in proposition 4b, operates through a re-allocation of labor from less productive to more productive firms. In equation (18) this re-allocation comprises of four effects: (1) a fall in $q(\phi)$ in the first term (contraction by purely domestic firms), (2) a rise in ϕ^* in the first term (exit of least productive firms), (3) a fall in ϕ_o^* (new entrants becoming MNCs), and (4) a rise in $q(\phi)$ in the second term (expansion by MNCs). See appendix 9 for a proof of why the net effect of offshoring on employment in sector Y is negative.

6 Data

The primary data source for this paper comes from the Bureau of Economic Analysis (BEA) of the US Department of Commerce. The BEA collects confidential data on the activities of US MNCs, defined as the combination of a single consolidated US entity (parent) with at least 10% ownership in a foreign enterprise (foreign affiliate).[9] The BEA data is the most comprehensive data available for US-based MNCs and their foreign affiliates and contains detailed financial and operating numbers for the years 1982-2004.[10]

I begin by constructing a balanced panel over the years 1993-1997 and 1993-2001. First, these panels only include majority-owned affiliates since data on minority-owned affiliates is less complete. Second, though the universe contains both US parent manufacturing and services firms, my main estimations are based on a restricted sample of parent manufacturing firms - defined by SIC codes 200-399 - as data on services offshoring is potentially of lesser quality. Third, a concordance between NAICS and SIC codes allows me to handle the shift from SIC to NAICS codes for industry classification from 1997 onwards. A major strength of the BEA data is that it allows for more precise measurement of cross-border vertical production sharing. Most datasets only capture total FDI by a firm, making it difficult to distinguish between FDI for market access (horizontal) versus FDI for vertical production. The BEA dataset separates affiliate sales between sales within the firm and sales outside the firm. Hence, I proxy cross-border vertical production by constructing intrafirm affiliate sales as the sum of the following three variables: (1) sales from foreign affiliate to US parent; (2) sales from foreign affiliate to other local affiliates in the foreign country; (3) sales from foreign affiliates to other affiliates in other foreign countries. Then, by aggregating over all affiliates, I am able to capture the total amount of intrafirm affiliate sales for a US parent firm. Implicitly, I am assuming that trade amongst affiliates and the parent is part

[9]The consolidated US entity may itself be owned by a foreign firm - approximately 10% of the sample.

[10]See Bureau of Economic Analysis, March 2004, for a thorough description of definitions and survey methodologies used by the BEA.

of the vertical production process while trade to non-affiliated customers is for market access.[11] This measure constructed here is similar to the ones used by Grossman and Rossi-Hansberg (2006) and Harrison and McMillan (2008) to capture vertical activity by multinationals. The number of observations (parent US firms) for 1989-2001 is 34,966 US firms or about 2,300 per year. For manufacturing, there are about 14,882 US firms or approximately 1,000 per year. Key firm-level variables of interest are sales, employment, intrafirm affiliate sales, R&D expenditures, total employment compensation, and operating profits per domestic worker. Variable definitions are described in appendix 10.

7 Estimation

7.1 Background

To test the main predictions from the model, I use events in Mexico as exogenous shock to the costs of offshoring to Mexico. First, the 1993 Foreign Investment Law, which was tied to NAFTA, was passed in December of 1993. Mexico's attitude towards foreign investment had historically been one of caution. Prior to 1973, there was no investment law in Mexico - rather, rules were decreed on a case-by-case basis by the executive branch. In 1973, a Foreign Investment Law was enacted to establish a uniform, comprehensive code, which turned out to be anti-foreign. Among other measures, the 1973 FIL limited foreign companies to a maximum of 49% ownership in Mexican enterprises, reserved certain activities exclusively for the Mexican government and/or domestic investors, and required approval from the Foreign Investment Commission (FIC) on foreign investment into Mexico, adding arbitrariness to the process. During the late 1980s, as the Mexican economy was liberalizing in many areas, the Salinas government realized the importance of foreign investment and passed a 1989 regulation on the 1973 FIL, making it easier for foreign ownership in Mexico. However, the 1989 regulation had little credibility behind it as the Mexican Supreme Court could

[11] Intrafirm affiliate sales over total affiliate sales was approximately 20% in 1982, rising to 35% in 2004.

have deemed it unconstitutional.[12] On the other hand, the 1993 FIL, enacted by the legislature was more legally binding. The new law streamlined and expedited administrative procedures related to foreign investment, reduced to a minimum the exercise of discretionary powers by Mexican authorities and increased foreign ownership limits from 49% to 100% in all manufacturing and some service industries. Further, it was requisite reform for Mexico's participation in NAFTA and hence interestingly, the passage of NAFTA served more as a credibility device than for particular investment reforms itself. Together with NAFTA, the 1993 FIL signaled credibly to the international business community that Mexico was open for foreign investment.

Second, the Mexican peso crisis at the end of 1994 also would have encouraged increased offshoring from the US to Mexico. On December 22, 1994 the peso fell by approximately 25% in relation to the US dollar, and continued falling for several months for a total fall of nearly 60%. This significant depreciation lowered the cost of Mexican labor in dollar terms. The average wage for a male full-time worker with nine years of education fell from approximately $1.50 per hour to $0.90 per hour from 1994 to 1995 (Verhoogen 2008). Though there are a variety of theories regarding what precipitated the depreciation, it was unexpected as the black market and official exchange rates coincided before and after (Verhoogen 2008).

From figures 2.1 and 2.2, we see that these two episodes elicited a strong increase in intrafirm affiliate sales by Mexican affiliates of US manufacturing MNCs. Figure 2.1 depicts that total intrafirm affiliate sales from Mexico jumped noticeably from 1995-97. Figure 2.2 demonstrates a sharp increase in the share of intrafirm affiliate sales from Mexican affiliates of total global sales of US parent firms from 1995-96.[13] I consider the period 1993-97 to examine the effects of the two episodes on US parent firm-level variables.

[12]See Uriarte (1995).

[13]From here on, when referring to the share of intrafirm sales of Mexican affiliates, I mean $\frac{\text{Intrafirm Mexican affiliate sales of the US parent}}{\text{Total global sales of the US parent}}$.

7.2 Empirical Methodology

The theoretical model suggests that wages would diverge across firms who would likely be able to take advantage of a fall in the marginal cost of offshoring to Mexico (MNCs), versus firms who would be unlikely (purely domestic firms). However, the BEA dataset only contains US MNC firms. In this section, I make a slight modification to the theory to allow for the theoretical prediction to connect better to my empirical methodology.

Assume now that there are two Southern countries - a generic Latin American country and Mexico and that offshoring to each requires some fixed costs. Further, due to differences in the ability of workers, I define a $\bar{z}$ such that tasks $z \in [0..\bar{z}]$ are cheaper to produce in the generic Latin American country and tasks $z \in (\bar{z}..1]$ are cheaper to produce in Mexico. Now, I can define another cut-off ϕ_m^* such that a firm with this productivity level offshores exactly $\bar{z}$ tasks in the pre-shock equilibrium. Since it has already been established that more productive MNCs offshore more, MNC firms with $\phi_o^* < \phi < \phi_m^*$ offshore only to the generic Latin American country, whereas the most productive MNC firms $\phi_m^* < \phi$ offshore to both Latin America and Mexico.[14] Now, with a fall in the marginal cost of offshoring to Mexico, the model would predict that the firms who already have a presence in Mexico (that is, have already paid the fixed costs of entry) are likely to take advantage and expand their offshoring to Mexico. Meanwhile, the firms offshoring to Latin America but not Mexico are unlikely to take advantage of this shock. This is borne out by the data. Approximately 94% of the increase in offshoring from 1993-97 occurred along the intensive margin - increase in offshoring by firms already offshoring to Mexico. Only 6% was due to the extensive margin - the entry of new firms offshoring to Mexico. Hence, to test the empirical prediction on wages, I separate firms into treatment and control groups in the following way. The treatment group is defined as firms who have a presence in Mexico at the

[14] What about firms who offshore only to Mexico? This setup does not predict such an outcome. A more complicated model where firms differ on the tasks required for production would address this issue. However, empirically, less than 10% of the treatment firms in my sample offshore only to Mexico. While considering this case could be an interesting extension, I did not think it useful for the scope of this paper.

beginning of the period. Then, the control group is defined as firms who offshore to other countries in Latin America at the beginning of the period, but do not offshore to Mexico. While I use firms who offshore to other countries in Latin America as my initial comparison group, I try another, more general comparison group in the robustness section. From table 1, we see that treatment firms on average are larger along many different measures than control firms, which, as discussed, is predicted from the model. However, this poses some econometric issues that I address in the next section. Beginning with the estimation equation in levels:

$$y_{ijt} = \beta_0 + \beta_1 Treatment_{ij} * Post_t + \beta_2 Post_t + \beta_3 Treatment_{ij} + \gamma_j * Post_t + \epsilon_{ijt} \quad (19)$$

where i, j, and t index firms, industries, and time respectively; y_{ij} is one of the outcome variables; $Treatment_{ijt}$ is a dummy variable, turned on if the firm is in the treatment group and turned off when the firm is in the control group; $Post_t$ is a dummy variable turned on if the year is 1997 and turned off if the year is 1993; $\gamma_j * Post_t$ captures industry trends over time; and ε_{ijt} is a mean-zero disturbance. Differencing the above equation between 1993 and 1997 gives the following equation:

$$\Delta y_{ij} = \beta_2 + \beta_1 Treatment_{ij} + \gamma_j + \varepsilon_{ij} \quad (20)$$

Equation (20) is the main estimating equation. The outcome variables of interest are intrafirm sales share from Mexico, operating profits per US worker, average domestic wages, and employment at the US parent firm.

7.3 Main Results

The results for equation (20) are displayed in table 2, columns 1-4, which show that estimates for β_1 are statistically significant at least at the 10% level for all of the outcome variables except log employment. For example, the share of intrafirm affiliate sales from Mexico rose 0.9% more for treatment firms than for control firms during the 1993-97 time period, confirming that US firms already with a presence in Mexico are better able to take advantage of a fall in the marginal costs of offshoring to Mexico. Further, the fact that treatment firms responded by increasing offshoring indicates that these firms have not hit their technological wall as discussed in the theoretical section.[15] Next, columns 2 - 3 indicate that operating profits per US worker and average domestic wages increased 8.4% and 6.4%, respectively, more for treatment firms than control firms with the magnitudes indicating economic significance. Hence, these initial results confirm the main theoretical prediction that average domestic wages increased at firms who were positioned to take advantage of lower offshoring costs relative to ones who were not. Interestingly, there is no statistically significant difference between the change in employment at treatment firms versus control firms, which is consistent with proposition 4.

For two reasons, the results here could be understating the magnitude of the effect of offshoring on average domestic wages. First, as defined in the introduction, offshoring includes both outsourcing and cross-border intrafirm production sharing. However, in this empirical analysis, only the latter is captured as data on outsourcing is not available; hence, the effects could be even larger if outsourcing is also taken into account.[16] Additionally, this analysis considers only intrafirm affiliates sales from Mexico. Despite Mexico's importance as a source of offshoring, it still constitutes only about 5% of global cross-border intrafirm affiliate sales at US MNCs.

Additionally, Bertrand, Duflo, and Mullainathan (2004) raise an important issue in difference-in-differences estimates - using many years of pre- or post-crisis data without taking into account serial correlation across periods could understate the standard error on the coefficient estimates. Hence, by using just one year of pre-crisis data and one year post-crisis, i.e. 1993 and 1997, I "ignore time-series information" and they

[15] The technogical wall, as mentioned in section 1.5.1, is the point at which the technological costs of offshoring become binding and hence any reduction in non-technological costs will not elicit increased offshoring.

[16] Antras and Helpman (2004) cite BEA data to suggest "that the growth of foreign outsourcing by US firms might have outpaced the growth of their foreign intrafirm sourcing." However, as they write, the evidence is suggestive, not conclusive.

find that this strategy performs well.

8 Robustness Analyses/Alternative Hypotheses

In this section, I strengthen the main findings with robustness checks and tests against alternate hypotheses. First, the main analysis uses parent firms offshoring to Latin America but not to Mexico as the comparison group. In order to mitigate any worries that there is something specific about Latin America biasing the comparison, I consider a broader comparison group: parent firms who offshore to any other developing country but not to Mexico.[17] The results are provided in row 2 of table 3 revealing that the results are robust to this broader comparison groups.

Another concern is related to the fact that I include only US manufacturing firms in my main sample. Again, this was done because the quality of data, especially for offshoring, is better for manufacturing firms than for service firms. However, imagine a firm who is originally classified as manufacturing but then offshores most or all of its manufacturing operations and is left with only headquarter services in the US. This firm would drop from my sample and thus potentially introduce a bias into my estimates. Since its not clear which way this bias could affect my results, I re-run my main estimation with both manufacturing and service parent firms. The results, presented in table A.1 in the appendix are mostly consistent with my main results. The magnitudes of the coefficients are slightly smaller compared to the main results (except for skill ratio) and are statistically significant for all the outcome variables except average domestic wages, where it falls slightly outside of 90% confidence.

Next, the differences between treatment and control firms observed in table 1 - treatment firms are larger than control firms by sales, employees, and R&D, likely indicating that treatment firms are more productive. It is realistic to expect that bigger/more productive firms could have reacted to shocks differently and hence estimated coefficients could be biased. Further, Mexico's unique proximity to the United

[17] Developing countries are defined by the World Bank as countries with GDP per capita less than $11,455 as of 2007.

States could have caused treatment firms to respond differently to shocks than control firms, again biasing the results. To handle these concerns, I compare results from the 1993-97 period to an adjacent period (1997-01) that did not witness exogenous shocks to the cost of offshoring. Comparing the coefficients across the two periods can purge any differential trends between the treatment and control groups. This leads essentially to a triple differences strategy captured by the following equation:

$$\Delta y_{ijt} = \beta_0 + \beta_1 Treatment_{ij} * Period_t + \beta_2 Treatment_{ij} + \beta_3 Period_t + \gamma_j + \varepsilon_{ijt} \quad (21)$$

where $Treatment_{ij}$ includes firms that had a presence in Mexico in the base year - 1993 for the 1993-97 period and 1997 for the 1997-01 period. $Period_t$ is dummy variable taking the value of 0 for the 1993-97 period and 1 for the 97-01 period. Table 3, row 1 presents the estimation results for equation (21). A negative coefficient on the interaction term reveals that β_{93-97} is larger than β_{97-01} implying that treatment firms witnessed a greater increase in outcome variables compared to control firms in the 1993-97 period versus the 1997-01 period. The results in row 1 indicate that the estimates for β_1 are negative and statistically significant for all of the outcome variables. In particular, we can interpret the results in the following way: operating profits per US worker and average domestic wages increased 9.6% and 11.1% more for treatment firms than control firms during the 1993-97 period versus the 1997-01 period. These results indicate that the FDI law and the peso crisis caused differential outcomes in the 1993-97 period between treatment and control firms that was greater than generic differences in background trends.

While the above exercise helps mitigate the concerns regarding differences between treatment and control firms, is there something unique about the 1997-01 period? In order to offer even more general evidence, I run the following equation, which is similar to equation 19, but with year dummies for 1984-2004 rather than a post dummy.

$$y_{ijt} = \beta_0 + \beta_1 Treatment_{ij} * Year_t + \beta_2 Year_t + \beta_3 Treatment_{ij} + \gamma_j * Year_t + \epsilon_{ijt} \quad (22)$$

The coefficient β_1 represents the amount that the outcome variable is higher at treatment firms compared to control firms in a given year. To offer support for my main findings, we would like to see β_1 rising around 1994 and continuing to rise for a few years thereafter before leveling off. The estimated coefficients for β_1 are shown in figures 2.3-2.5 for three outcome variables of interest. The dotted lines in the figures represent the 90% confidence interval. In figure 2.3, we see a sharp increase in offshoring by treatment firms in 1994, continuing until 1997. After 1997, there appears to be a an immediate drop followed by a return to 1997 levels around 2003. In figure 2.4, we see a similar though weaker trend for operating profits per US worker. Finally, figure 2.5 offers a convincing story for average domestic wages. The coefficient increased significantly in 1994 and leveled off soon after. Furthermore, the coefficient is statistically significant only from approximately 1994-98. Together, these offer convincing evidence that the outcome variables trended differently for the treatment and control firms during 1993-97 as compared to other periods.

Again, the issue raised by Bertrand et al. (2004) should be addressed. Since many years of pre- and post-crisis data are used in this specification, I must account for potential serial correlation across periods. One method is to cluster the standard errors at the firm-level, which imposes the restriction that the error term is correlated for a firm across time. However, under this specification, the standard errors for the coefficients actually became smaller. Hence, the results presented here use the robust option, which is the more conservative estimate.

An alternate story could be posed where offshoring increases average domestic wages at offshoring firms due to compositional changes in domestic employment. Feenstra and Hanson (1996) suggest that offshoring of jobs from the North to the South would increase the skill composition of workers in the North as the relatively least-skilled jobs would be sent abroad. Continuing the logic, offshoring could lead to higher average domestic wages at the parent firm simply because the cheapest (least-skilled) jobs have been offshored. Hence, even if wages increase from offshoring, how to separate the PRS effect from a simpler selection story? Since the BEA dataset does not contain information on the skill composition of employees at the parent firm, I instead construct a firm-level variable in the following way. From the CPS March Census, I am able to gather skill compositions at the industry level over time. Then in the BEA data, I identify the top eight product (industry) categories for each parent firm. Combining the data, I derive a weighted average skill composition variable for each US parent firm (see appendix 1). Column (5) of table 1 reveals that skill composition also increased more for treatment firms than for control firms under both comparison groups, demonstrating that the skill composition story is also valid.

Thus far, the evidence indicates that offshoring caused wages to diverge at the firm-level potentially for two reasons. First, offshoring increased operating profits per US worker and under an assumption of rent-sharing, wages increase, offering evidence for the PRS channel proposed in this paper. Second, the increase in the labor skill composition indicates that the least-skilled jobs were offshored, which would mechanically increase average domestic wages at the firm. To convince the reader of the presence of the PRS effect, I offer additional pieces of evidence.

First, I perform the following back-of-the-envelope calculations to check the reasonability of the findings. The empirical literature on rent-sharing has found a wage elasticity with rents of 0.1-0.3. Taking the mid-point of these findings and multiplying by .084 (from row 1, column 2, table 2), gives .017. That is, approximately 25% (1.7 out of 6.4) of the increased spread in average domestic wages between treatment and control firms, during the period 1993-97, can be explained by the mechanism proposed in this paper. The remaining 75% could be explained by the composition effect. In my opinion, these calculations pass an initial reasonability test of the findings.

Next, I determine how big the labor compositional change would have to be in order to entirely explain the 6.4% divergence in wages. From table 1, the average skilled/unskilled labor ratio for a treatment firm is nearly 2.0 in 1993. This ratio would have to rise to about 2.5 in 1997, in order for changes in skill composition to explain the entire 6.4% divergence in wages between treatment and control firms.[18] However, only three[19] manufacturing industries out of eighty-two even had a skill/unskilled labor ratio over 2.5 in 1997, making it highly unlikely that skill compositional changes alone could explain the entire divergence.

While these initial calculations are encouraging, I offer the following argument to further strengthen my story regarding the PRS effect. Recalling equation (2), which indicates that the PRS effect should be stronger in industries with higher rent-sharing, I extend equation (20) to:

$$\Delta w_{ij} = \beta_0 + \beta_1 Treatment_{ij} + \beta_2 Treatment_{ij} * RS_j + \gamma_j + \varepsilon_{ij} \tag{23}$$

where RS_j captures the extent of rent-sharing in industry j. A positive and significant estimate for β_2 would indicate that wages increased more for treatment firms versus control firms in industries with a higher-degree of rent-sharing. To estimate industry-level rent-sharing, I use CPS data from 1993 and regress an individual's wage on a host of observable characteristics and industry dummies. These observable characteristics include state, gender, and marital status dummies, age, age-squared, occupation type, and years of schooling.[20] Taking the coefficients on the industry dummies as a measure of rent-sharing, I then estimate the above equation and display the results in table 4. These results indicate that the estimation for β_2 from the equation above is positive and statistically significant, under both comparison groups, giving further support for the PRS hypothesis put forth in this paper.

As a caveat, the coefficients on the industry dummies from the first-stage can also be interpreted as capturing unobservable worker characteristics rather than rent-sharing.

[18]Conservatively assumes a 2:1 ratio for skilled/unskilled wages during the mid 90s, and the fact that approximately half of the divergence is attributed to a rise in wages at treatment firms (the other half is due to a fall in wages at control firms).

[19]The three industries were drug, computer, and missiles and space vehicles manufacturing.

[20]The observations are weighted based on a sample weighting metric provided by the CPS.

The literature on inter-industry wage differentials is mixed with evidence suggesting both explanations (see Rycx and Tojerow 2007). This alternative interpretation on the coefficients of the industry dummies in the first stage leads to the following conclusion from the second stage: wages increased more at treatment firms in industries with workers of higher unobserved abilities. Why firms in such industries should experience a stronger labor composition effect from offshoring is not clear; hence I would argue that the rent-sharing story seems more likely. Nevertheless, it is reassuring that the results from estimating equation (23) are consistent with the mechanism offered in this paper.

Finally, an alternate explanation based on transfer pricing could be confounding the results. For example, if corporate tax rates were falling in Mexico relative to the United States, then foreign affiliates could charge the US parent firm higher prices for intermediate inputs in order to reduce the firm's overall tax burden. Such a tax/transfer pricing story would show up as increased intrafirm affiliate sales, but without any implications for productivity gains - rather it would merely reflect changes in bookkeeping. However, corporate tax rates in Mexico remain unchanged during the 1993-97 period. Further, state corporate tax rates in the United States remain unchanged or even fell during this period with the only exception being Vermont.[21] Hence, its unlikely that corporate tax rates could be leading to changes in transfer pricing to the US parent firm. Additionally, corporate tax rates in most of the rest of the world either remain unchanged or even fell, negating the notion that transfer pricing could be in effect from Mexican affiliates to other foreign country affiliates of the firm.

9 Conclusion

This paper is the first to combine theory and evidence to understand the productivity effects of offshoring on firm-level domestic wages and employment. The theory predicts that firms who offshore experience productivity gains, raising profitability

[21]State and country corporate tax data reflect the top tax rate and come from the University of Michigan's World Tax Database.

and domestic wages at these firms. Furthermore, while some jobs are lost directly due to offshoring, the productivity gains allows these MNC firms to steal business, expand and demand more labor, thereby netting an ambiguous effect on domestic employment. On the other hand, firms who do not offshore become relatively less competitive leading to a fall in profitability and consequently lower domestic wages. Finally, the business stealing effect forces purely domestic firms to contract or even exit the market entirely, predicting domestic employment loss at these firms.

Access to micro, firm-level data from the BEA, allows testing of the key theoretical predictions. I use two episodes in Mexico - the FDI Law of 1993 and the Mexican peso crisis - as exogenous shocks to the cost of offshoring to Mexico for US firms. Treatment firms are identified as ones who had a presence in Mexico in 1993 and who were more likely to take advantage of new offshoring opportunities having already paid entry costs. Control firms did not have a presence in Mexico but rather in other similar countries. The findings suggest that profitability and average domestic wages increased more for treatment firms than control firms during the 1993-97 period. Also, this differential change was greater during the 1993-97 period than an adjacent period (1997-01) without exogenous shocks to offshoring costs. In addition, the differential change was greater for treatment firms in industries with larger rent-sharing, mitigating concerns that average domestic wages could be increasing entirely due to compositional changes in labor from offshoring. Therefore, the empirical evidence supports the prediction that offshoring leads to within-sector inequality through a productivity and rent-sharing channel. Meanwhile, the empirical analysis finds no evidence of greater employment loss due to offshoring between treatment and control firms, consistent with the theory.

The findings in this paper challenge conceptions that offshoring most negatively affects wages and employment at firms which offshore. Rather, this research suggests that offshoring should be viewed as a technology, enhancing productivity and competitiveness and offers a new way to think about the winners and losers from offshoring. Workers at MNCs performing non-routine tasks could benefit the most from offshoring while workers at purely domestic firms, interestingly, could be hurt the most. What then about the workers at MNCs whose jobs were offshored? It would be interesting to know if these workers were re-hired at expanding MNC firms to perform non-routine tasks at higher wages or if they had to take an outside job earning a much lower wage. This avenue of empirical work would be useful for developing better targeted policies aimed at helping workers hurt by offshoring. Further, in this paper, workers are assumed to be homogeneous. However, clearly, offshoring could affect workers differently by skill-type. Extending the theory and empirics to consider workers of different skill would be an interesting direction for future research.

Appendix

Appendix 1

In order to solve equation (1), I begin by solving the firm's profit maximization problem in the second stage product market competition and work backwards.

(a) Solving a general form of a firm's profit optimization problem under monopolistic competition where p are prices, q is quantity, c are marginal costs, w are wages, and N, N_d are total and domestic employment at the firm:

$$max_p pq(p) - c(q(p), w) \tag{24}$$

where

$$c(q(p), w) = wN_d(q) + (N(q) - N_d(q))\beta t(z(q))w_f$$
$$\frac{\partial c(q(p), w)}{\partial w} = N_d$$

where $\beta t(z)w_f$ is the marginal cost of offshoring. Take the first order condition for (24):

$$pq'(p) + q(p) - \frac{\partial c(q(p), w)}{\partial q}q'(p) = 0 \tag{25}$$

Now, to find $\Pi'(w)$, note that p^* below is the solution to the FOC above:

$$\Pi_{op}(w) = p^*q(p^*) - c(q(p^*), w)$$
$$\Pi'_{op}(w) = \frac{\partial p^*}{\partial w}[p^*q'(p^*) + q(p^*) - \frac{\partial c(q(p^*), w)}{\partial q}q'(p^*)] - \frac{\partial c(q(p^*), w)}{\partial w}$$

The term in brackets above is the same as equation (25) and hence from the envelope theorem:

$$\Pi'_{op}(w) = -\frac{\partial c(q(p^*), w)}{\partial w} = -N_d \tag{26}$$

(b) Next, the firm's surplus from equation (1) becomes:

$$\Pi_{op}(N_d) - \Pi_{op}(N_d - 1) = \frac{\phi(p - c)}{1 - z^*} = \frac{\Pi_{op}(N_d)}{N_d} = \pi_{op}$$

reducing equation (1) to:

$$\max_w \theta \ln(w - w_x) + (1 - \theta)(\pi_{op})$$

Deriving the first order condition of this nash bargaining problem with respect to w, using (26), gives the following solution:

$$w = \eta\pi_{op} + w_x \tag{27}$$

where η approximates to $\frac{\theta}{1-\theta} - \varepsilon_{nw}$ and increasing in θ and falling in the elasticity of labor demand.

Appendix 2

Proofs for how firm-level variables behave by firm productivity. Show that (a) $\frac{dp}{d\phi} < 0$; $(b)\frac{dc}{d\phi} < 0$; (c) $\frac{d\mu}{d\phi} > 0$; (d) $\frac{dq}{d\phi} = 0$; (e) $\frac{d\Pi}{d\phi} > 0$; (f) $\frac{d\pi_{op}}{d\phi} > 0$; (g) $\frac{dw}{d\phi} > 0$.

(a) Show that $\frac{dp}{d\phi} > 0$:

To solve for $\frac{dp}{d\phi}$, remember the function D(p, ϕ) - equation (7) - which implicitly solves for the optimal price for the firm:

$$D(p, \phi) : -\frac{L}{\gamma}p + q + \frac{L}{\gamma}\left[\frac{\eta\phi p + w_x}{\phi(1+\eta)}\right] - q\frac{\eta}{1+\eta} = 0$$

From the implicit function theorem, we know that $\frac{dp}{d\phi} = -\frac{\frac{\partial D}{d\phi}}{\frac{\partial D}{dp}}$:

$$\frac{\partial D}{\partial \phi} = -\frac{L}{\gamma}\left[\frac{w_x}{\phi^2(1+\eta)}\right]$$

$$\frac{\partial D}{\partial p} = -\frac{L}{\gamma}\frac{2}{(1+\eta)}$$

$$\frac{dp}{d\phi} = -\left[\frac{w_x}{2\phi^2}\right] < 0$$

(b) Show that $\frac{dc}{d\phi} > 0$:

Setting $z^* = 0$ in equation (12) and then taking the derivative with respect to ϕ and substituting in for $\frac{dp}{d\phi}$ from part (a) gives:

$$\frac{dc}{d\phi} = -\frac{[w_x](2+\eta)}{2\phi^2(1+\eta)} < 0$$

Hence, so far, I have shown that wages are higher at more productive firms, but marginal costs and prices are lower at more productivity firms.

(c) Show that $\frac{d\mu}{d\phi} > 0$:

It is straightforward to show that $\frac{dp}{d\phi} > \frac{dc}{d\phi}$, which means that $\frac{d\mu}{d\phi} > 0$, indicating that markups are higher at more productive firms.

(d) Show that $\frac{dq}{d\phi} > 0$:

Taking the derivative of equation (5) with respect to ϕ and again plugging in for $\frac{dp}{d\phi}$:

$$\frac{dq}{d\phi} = -\frac{L}{\gamma}\frac{dp}{d\phi}$$

$$\frac{dq}{d\phi} = \frac{L}{\gamma}\frac{w_x}{2\phi^2} > 0$$

(e) Show that $\frac{d\Pi}{d\phi} > 0$:

$\Pi = q * \mu$. Since $\frac{dq}{d\phi} > 0$ and $\frac{d\mu}{d\phi} > 0$ from above, then clearly $\frac{d\Pi}{d\phi} > 0$, meaning that profits are increasing in firm productivity.

(f) Show that $\frac{d\pi_{op}}{d\phi} > 0$:

Setting $z^* = 0$ in equation (10) and then taking the derivative with respect to ϕ and substituting in for $\frac{dp}{d\phi}$ gives:

$$\frac{d\pi_{op}}{d\phi} = \frac{p + \phi\frac{dp}{d\phi}}{1+\eta}$$
$$\frac{d\pi_{op}}{d\phi} = \frac{2\phi p - w_x}{2\phi(1+\eta)} > 0$$

To see why the numerator in the above expression must be positive, set $z^* = 0$ in equation (10), to get the equilibrium solution for π_{op} for purely domestic firms. Since π_{op} must be positive in equilibrium, the expressions $(\phi p - w_x)$ must be positive and so the numerator of the expression above must also be positive.

(g) Show that $\frac{dw}{d\phi} > 0$:

Taking the derivative of equation (2) with respect to ϕ and using the result from part (f) gives:

$$\frac{dw}{d\phi} = \eta\frac{d\pi_{op}}{d\phi} > 0$$

Appendix 3

(a) Show that $\frac{dz^*}{d\beta} < 0$. That is, a fall in policy-related costs induced increase offshoring by MNC firms.

Equation (8) implicitly defines the equilibrium level of offshoring by a MNC firm. Substituting equation (11) for w_d, gives the following implicit function:

$$F(z^*, .) = (1-z^*)(1+\eta)\beta t(z^*)w_f - \eta\phi p + \eta\beta T(z^*)w_f - (1-z^*)w_x$$

From the implicit function theorem, $\frac{dz^*}{d\beta} = -\frac{\frac{\partial F}{\partial \beta}}{\frac{\partial F}{\partial z^*}}$:

$$\frac{\partial F}{\partial \beta} = (1-z^*)(1+\eta)t(z^*)w_f + \eta T(z^*)w_f > 0$$
$$\frac{\partial F}{\partial z^*} = \eta\beta w_f T'(z^*) + w_x + (1-z^*)(1+\eta)\beta w_f t'(z^*) - (1+\eta)\beta w_f t(z^*)$$
$$\frac{dz^*}{d\beta} < 0$$

Note, that if $\frac{\partial F}{\partial z^*} > 0$ is satisfied, which I call the technological slack condition, then $\frac{dz^*}{d\beta} < 0$. The condition is:

$$\eta\beta w_f T'(z^*) + w_x + (1-z^*)(1+\eta)\beta w_f t'(z^*) - (1+\eta)\beta w_f t(z^*) > 0 \qquad (28)$$

This sufficient condition implies that technological constraints are not binding. It holds if technological costs ($t(z^*)$) are small or if the cost savings are large enough through the other parameters: high (w_x), low (β), low (w_f). Hence, as long as the technological slack condition holds, a fall in β induces an increase in offshoring by MNC firms.

(b) Show that $\frac{dz^*}{d\phi} > 0$. That is, more productive MNCs offshore more in equilibrium.

Again, from the implicit function theorem, $\frac{dz^*}{d\phi} = -\frac{\frac{\partial F}{\partial \phi}}{\frac{\partial D}{\partial z^*}}$:

$$\frac{\partial F}{\partial \phi} = -\eta p - \eta\phi\frac{dp}{d\phi} < 0$$

$$\frac{\partial F}{\partial z^*} = \eta\beta w_f T'(z^*) + w_x + (1-z^*)(1+\eta)\beta w_f t'(z^*) - (1+\eta)\beta w_f t(z^*)$$

Then, as long as the technological slack condition is satisfied, $\frac{dz^*}{d\phi} > 0$.

Appendix 4

(a) Show the existence and define ϕ_o^*:

The sunk costs of offshoring, f_o, pin down a productivity cut-off, ϕ_o^*, such that firms with $\phi > \phi_o^*$ are able to offshore and firms with $\phi < \phi_o^*$ are unable to offshore. If such a cut-off were to exist, then the marginal entrant must be indifferent between offshoring and not offshoring. To show existence of a cut-off, I first would like to demonstrate that offshoring allows a firm to pretend that it is a more productive (hence the notion of a productivity effect). More specifically, I will show that offshoring allows any firm to pretend it has a productivity $\tilde{\phi} > \phi$ even though its actual productivity is still ϕ. I find $\tilde{\phi}$ by setting $c(\tilde{\phi}) = c(\phi)$:

$$\eta\tilde{\phi}p(\tilde{\phi}) + \beta T(z^*)w_f + (1-z^*)w_x = \eta\phi p(\phi) + w_x \tag{29}$$

By the revealed preference of the firm's decision to offshore, it must be that:

$$\beta T(z^*)w_f + (1-z^*)w_x < w_x \tag{30}$$

which then leads to:

$$\tilde{\phi}p(\tilde{\phi}) > \phi p(\phi) \tag{31}$$

Now, taking the derivative of $\phi p(\phi)$ with respect to ϕ, and substituting for $\frac{dp}{d\phi}$ from appendix 2a, gives: which then leads to:

$$\frac{d[\phi p(\phi)]}{d\phi} = \frac{2\phi p - w_x}{2\phi} > 0$$

It is increasing in ϕ because the numerator on the right-hand-side is greater than the numerator from equation (12), which itself is positive. Hence, it must be that $\tilde{\phi} > \phi$. Hence, offshoring allows any firm with productivity ϕ to pretend to be of higher productivity $\tilde{\phi}(\phi)$. Since we know that firms with higher productivity achieve higher profits from appendix 2e, define ϕ_o^* as:

$$\Pi_{op}(\tilde{\phi}(\phi_o^*)) - f_o = \Pi(\phi_o^*) \tag{32}$$

(b) Show that a fall in the policy constraint β shifts the cutoff ϕ_o^* down.

A fall in β leads to an increase in z^* (shown in appendix 3), which would cause the inequalities in equations (30) and (31) to be even stronger. This means that increased offshoring allows a firm to pretend to be even more productive than before - that is, for any given ϕ, $\tilde{\phi}(\phi)$ is higher than before. Then, for the equality in equation (32) to hold, ϕ_o^* must fall allowing for new entrants.

Appendix 5

First, looking at the FE condition, I easily derive both first and second derivatives of $\bar{\Pi}$ with respect to ϕ^*:

$$\bar{\Pi}(\phi^*) = f_e(\phi^*)^k$$
$$\bar{\Pi}'(\phi^*) = kf_e(\phi^*)^{(k-1)} > 0$$
$$\bar{\Pi}''(\phi^*) = (k-1)f_e(\phi^*)^{(k-2)} > 0$$

Note that in deriving equation (14), I already had to place the stipulation that $k > 1$ and clearly the last line holds under that condition. Thus, the FE condition is increasing and accelerating in the $(\phi^*, \bar{\Pi})$ space. Next, the ZCP condition from equation (15) expands to:

$$\bar{\Pi}(\phi^*) = \frac{L}{\gamma} \underbrace{(p(\phi^*) - p(\bar{\phi}))}\underbrace{\frac{(\phi^* \frac{k}{k-1} p(\bar{\phi}) - w_x)}{\phi^*(\frac{k}{k-1})(1+\eta)}}$$

with the terms in the left and rights braces being called A, and B, respectively. In order to draw the ZCP condition in the $(\phi^*, \bar{\Pi})$ space, I find $\frac{dA}{d\phi^*}$ and $\frac{dB}{d\phi^*}$:

$$\frac{dA}{d\phi^*} = -\frac{w_x}{2k(\phi^*)^2}$$

$$\frac{dB}{d\phi^*} = \frac{w_x}{2(\frac{k}{k-1})(1+\eta)(\phi^*)^2}$$

Now, taking the derivative of $\bar{\Pi}$ with respect to ϕ^* and simplifying using the above gives:

$$\bar{\Pi}'(\phi^*) = \frac{L}{\gamma} w_x B[\frac{k-2}{2k(\phi^*)^2}]$$

This expression is negative when $k < 2$; constant when $k = 2$; and positive when $k > 2$. When $k < 2$ or when $k = 2$, clearly a unique equilibrium must exist where the ZCP and FE curves intersect. In the case where $k > 2$ since both curves are increasing in the $(\phi^*, \bar{\Pi})$ space, further analysis is required. Taking the second derivative of the ZCP condition with respect to ϕ^* and simplifying gives:

$$\bar{\Pi}''(\phi^*) = \frac{\frac{L}{\gamma} w_x}{2k(\phi^*)^3} \frac{[(1+\eta)w_x(1 + 4(\frac{k}{k-1})(\phi^*)^2) - 4(\frac{k}{k-1})^2(\phi^*)^2 p(\bar{\phi})]}{2(\frac{k}{k-1})(1+\eta)(\phi^*)^2} < 0$$

Upon closer inspection, the term inside the brackets is negative and hence the entire expression is negative. Summarizing, when $k > 2$, the ZCP condition is increasing but decelerating in the $(\phi^*, \bar{\Pi})$ space, while the FE condition is increasing and accelerating. However, to confirm the uniqueness and existence of an equilibrium, the FE condition at ($\phi_{min} = 1$) must be below the ZCP at ($\phi_{min} = 1$), which can be satisfied if f_e, γ are small enough or L is large enough.

Appendix 6

Want to show that (a) $\frac{dp^M}{d\beta} > 0$; (b) $\frac{dc^M}{d\beta} > 0$; (c) $\frac{d\mu^M}{d\beta} < 0$; (d) $\frac{d\pi_{op}^M}{d\beta} < 0$; (e) $\frac{dw^M}{d\beta} < 0$; (f) $\frac{dq^M}{d\beta} < 0$. Before beginning, assume that the technological slack condition is satisfied. Further, the technological slack expression will occur repeatedly in these proofs and henceforth will be referred to as TS.

(a) Show that $\frac{dp^M}{d\beta} > 0$:

First, solve for the function $D(p^M, \beta)$, which implicitly solves the optimal price for the MNC firm:

$$D(p^M, \beta) : -\frac{L}{\gamma}p^M + q + \frac{L}{\gamma}\left[\frac{\eta\phi p^M + \beta T(z^*)w_f + (1-z^*)w_x}{\phi(1+\eta)}\right] - q\frac{\eta}{1+\eta} = 0$$

From the implicit function theorem, $\frac{dp^M}{d\beta} = -\frac{\frac{\partial D}{\partial \beta}}{\frac{\partial D}{\partial p^M}}$:

$$\frac{\partial D}{\partial \beta} = \frac{L}{\gamma}\frac{T(z^*)w_f - \frac{dz^*}{d\beta}TS}{\phi(1+\eta)} + \frac{\partial q}{\partial \beta} > 0$$
$$\frac{\partial D}{\partial p^M} = -\frac{L}{\gamma}\frac{2}{(1+\eta)}$$
$$\frac{dp^M}{d\beta} > 0$$

$\frac{\partial q}{\partial \beta} > 0$ represents the demand curve shifting in for all firms as the price level falls in the sector. For the rest of this proof, I assume that $\frac{\partial q}{\partial \beta}$ is small relative to the first expression in $\frac{\partial D}{\partial \beta}$ and thus drop it. Dropping it does not change the results, but does simplify the exposition.

(b) $\frac{dc^M}{d\beta} > 0$;

Taking the derivative of equation (12) with respect to β and plugging in for $\frac{dp^M}{d\beta}$ from part (a):

$$\frac{dc^M}{d\beta} = \frac{(2+\eta)[T(z^*)w_f - \frac{dz^*}{d\beta}TS]}{2\phi(1+\eta)} < 0$$

(c) $\frac{d\mu^M}{d\beta} < 0$;

Comparing (a) and (b):

$$\frac{dc^M}{d\beta} = \frac{dp^M}{d\beta}\frac{(2+\eta)}{(1+\eta)}$$
$$\frac{dc^M}{d\beta} > \frac{dp^M}{d\beta}$$
$$\frac{d\mu^M}{d\beta} < 0$$

(d) $\frac{d\pi_{op}^{M}}{d\beta} < 0$;

Taking the derivative of equation (10) with respect to β and plugging in for $\frac{dp^{M}}{d\beta}$:

$$\frac{d\pi_{op}^{M}}{d\beta} = \frac{-T(z^{*})w_{f} + \frac{dz}{d\beta}TS}{(1-z^{*})(1+\eta)} + \frac{\pi_{op}\frac{dz}{d\beta}}{1-z^{*}} < 0$$

(e) $\frac{dw^{M}}{d\beta} < 0$; Taking the derivative of equation (11) with respect to β and plugging in from part (f) gives:

$$\frac{dw^{M}}{d\beta} = \eta\frac{\partial\pi_{op}^{M}}{\partial\beta} + w_{x} < 0$$

(f) $\frac{dq^{M}}{d\beta} < 0$;

Taking the derivative of equation (5) with respect to β:

$$\frac{dq^{M}}{d\beta} = \frac{L}{\gamma}\left[\frac{\lambda M}{\lambda M+\gamma}\frac{d\bar{P}_{y}}{d\beta}\right] - \frac{dp^{M}}{d\beta}$$

New entrants and MNCs lower prices more than purely domestic firms: compare appendix 6a with 7a. Hence, $\frac{dp^{M}}{d\beta} > \frac{d\bar{P}_{y}}{d\beta}$ implying that $\frac{dq^{M}}{d\beta} < 0$ and quantity increases with falling offshoring costs (positive "business-stealing effect" for MNCs). Since employment at the firm is a linear function of q, it follows that employment at a MNC firm should increase from this business-stealing effect.

(g) Show that a fall in β leads to cost savings which increase in the productivity of the firm.

In equilibrium, two firms with productivity ϕ_1 and ϕ_2 offshore $[0..z^{*}(\phi_1)]$ and $[0..z^{*}(\phi_2)]$ tasks, respectively, with $\phi_1 < \phi_2$. When β falls, both firms save equally on each inframarginal task $z \in [0..z^{*}(\phi_1)]$. Now, assume that firm 1 increases offshoring and saves on marginal tasks $z \in [0..z_{o}^{*}(\phi_1)]$. Now there are two cases to examine:

Case 1: $z_{o}^{*}(\phi_1) < z^{*}(\phi_2)$ - $z \in [z^{*}(\phi_1)..z_{o}^{*}(\phi_1)]$ represents marginally offshored tasks for firm 1 but inframarginally offshored tasks for firm 2. Firm 2 accrues a larger cost savings on these tasks than firm 1 with a fall in β. Why? Firm 2 was paying $\beta t(z)w_f$ for each of these tasks before whereas firm 1 was paying $w_d(\phi_1)$ for each of these tasks. Clearly $w_d(\phi_1) < \beta t(z)w_f$ because otherwise firm 1 would have offshored these tasks previously. Since both firms have the same cost for these tasks in the new equilibrium, the cost savings are higher for firm 2 in each of these tasks $z \in [z^{*}(\phi_1)..z_{o}^{*}(\phi_1)]$. In addition, firm 2 saves on additional inframarginally and marginally offshored tasks.

Case 2: $z_{o}^{*}(\phi_1) > z^{*}(\phi_2)$ - Same as in case 1, firm 2 saves more on each task $z \in [z^{*}(\phi_1)..z_{o}^{*}(\phi_2)]$. Now, tasks $z \in [z^{*}(\phi_2)..z_{o}^{*}(\phi_1)]$ are marginally offshored by both firms. However, clearly firm 2 saves more on each of these tasks as it was paying $w_d(\phi_2) > w_d(\phi_1)$ for each task. Additionally, firm 2 also saves on additional marginally offshored tasks up to $z_{o}^{*}(\phi_2)$.

Since cost savings are higher at more productive MNCs from a fall in β, then the increase in markups, operating profits per domestic worker, and domestic wages are also greater at more productive MNCs.

Appendix 7

Want to show that (a) $\frac{dp^D}{d\beta} > 0$; (b) $\frac{dc^D}{d\beta} > 0$; (c) $\frac{d\mu^D}{d\beta} > 0$; (d) ambiguously $\frac{d\pi^D_{op}}{d\beta} > 0$; (e) $\frac{dw^D}{d\beta} > 0$; (f) $\frac{dq^D}{d\beta} > 0$.

(a) Show $\frac{dp^D}{d\beta} > 0$:

To solve for $\frac{dp^D}{d\beta}$, remember the function $D(p^D, \beta)$ - equation (7) - which implicitly solves the optimal price for the purely domestic firm:

$$D(p, \beta) : -\frac{L}{\gamma}p + q + \frac{L}{\gamma}\frac{\eta\phi p^D + w_x}{\phi(1+\eta)} - q\frac{\eta}{1+\eta} = 0$$

From the implicit function theorem, $\frac{dp^D}{d\beta} = -\frac{\frac{\partial D}{\partial \beta}}{\frac{\partial D}{\partial p^D}}$:

$$\frac{\partial D}{\partial \beta} = \frac{1}{1+\eta}\frac{\partial q}{\partial \beta}$$
$$\frac{\partial D}{\partial p^D} = -\frac{L}{\gamma}\frac{2}{(1+\eta)}$$
$$\frac{dp^D}{d\beta} = \frac{\frac{\partial q}{\partial \beta}}{2\frac{L}{\gamma}} > 0$$

where the last inequality holds because $\frac{\partial q}{\partial \beta} < 0$ due to increased competition captured by the lower price level in sector Y from offshoring.

(b) Show $\frac{dc^D}{d\beta} > 0$;

Setting $z^* = 0$ in equation (12) and then taking the derivative with respect to β and substituting in for $\frac{dp}{d\beta}$ from part (a) gives:

$$\frac{dc^D}{d\beta} = \frac{\eta}{1+\eta}\frac{dp^D}{d\beta} > 0$$

(c) Show $\frac{d\mu^D}{d\beta} > 0$;

Comparing (a) and (b):

$$\frac{d\mu^D}{d\beta} = \frac{dp^D}{d\beta} - \frac{dc^D}{d\beta}$$
$$\frac{d\mu^D}{d\beta} = \frac{1}{1+\eta}\frac{dp^D}{d\beta} > 0$$

(d) Show $\frac{d\pi^D_{op}}{d\beta} > 0$;

Setting $z^* = 0$ in equation (10) and then taking the derivative with respect to β and substituting in for $\frac{dp}{d\beta}$ gives:

$$\frac{d\pi^D_{op}}{d\beta} = \frac{\phi\frac{dp^D}{d\beta}}{1+\eta} > 0$$

(e) Show $\frac{dw^D}{d\beta} > 0$;

Taking the derivative of equation (2) with respect to β:

$$\frac{dw^D}{d\beta} = \eta \frac{d\pi_{op}^D}{d\beta} + w_x > 0$$

(f) Show $\frac{dq^D}{d\beta} > 0$;

Taking the derivative of equation (5) with respect to β:

$$\frac{dq^D}{d\beta} = \frac{L}{\gamma}\left[\frac{\lambda M}{\lambda M + \gamma}\frac{d\bar{P}_y}{d\beta} - \frac{dp^D}{d\beta}\right]$$

For purely domestic firms, prices fall less than for MNC firms: compare appendix 6a with 7a. Hence, $\frac{dp^D}{d\beta} < \frac{d\bar{P}_y}{d\beta}$ implying that for sufficiently small γ, $\frac{dq^D}{d\beta} > 0$ and quantity decreases for purely domestic firms ("business-stealing effect"). Since employment at the firm is a linear function of q, it follows that employment at a purely domestic firm should fall as a result of this business-stealing effect.

Appendix 8

I want to show that the ZCP condition shifts up with a fall in β when $\bar{\phi}$ represents a purely domestic firm.

From equation (15), the ZCP condition:

$$\bar{\Pi}(\phi^*) = \frac{\frac{L}{\gamma}(p(\phi^*) - p(\bar{\phi}))(\phi^* \frac{k}{k-1} p(\bar{\phi}) - w_x)}{\phi^*(\frac{k}{k-1})(1+\eta)}$$

Taking the derivative with respect to β and plugging in for $\frac{\partial p}{\partial \beta}$ appropriately:

$$\frac{d\bar{\Pi}}{d\beta} = \frac{L}{\gamma}\left[(\frac{\partial p_{max}}{\partial \beta} - \frac{dp(\bar{\phi})}{d\beta})(\mu(\bar{\phi})) + (p_{max} - p(\bar{\phi}))(\bar{\phi}\frac{dp(\bar{\phi})}{d\beta})\right] \tag{33}$$

From 7(a), we derive that the second term within the brackets is negative while the first term is zero. Hence, it must be that $\frac{d\bar{\Pi}}{d\beta} < 0$ meaning that the ZPC curve shifts up with a fall in β.

Appendix 9

Show that a fall in β leads to fall in employment in sector Y. To do this, I perform the following twist to the model: instead of constant returns to scale in sector X, lets assume decreasing returns to scale in sector X. Now, I will show that $w_x'(\beta) > 0$, that is, the outside option of workers in sector Y must fall with offshoring.

Proof by contradiction: assume that $w_x'(\beta) < 0$ - the outside option rises with offshoring. Then, looking at equation (33) in appendix 8, the ZCP curve shifts down with offshoring, meaning that average industry profits have fallen. Thus, in the new equilibrium, it must be that ϕ^* falls. However, for the least productive firms, the following holds:

$$\frac{d\mu^D}{d\beta} = -\frac{(1-\eta)w_x'(\beta)}{2\phi(1+\eta)} > 0$$

Hence, because the outside option of their workers has gone up, wage costs increase, and margins fall for purely domestic firms. Also,

$$\frac{dq^D}{d\beta} = \frac{L}{\gamma}\left[\frac{\zeta M}{\zeta M+\gamma}\frac{d\bar{p}}{d\beta} - \frac{dp^D}{df_x}\right] > 0$$

Here, costs and prices will continue to fall for MNCs (otherwise, they would not offshore in equilibrium). However, costs and prices rise for purely domestic firms since their wage costs have increased and they have no benefit from offshoring. This corresponds to a loss in market share for purely domestic firms. Combined with the fall in margins, their profits unambiguously fall and they should be forced to exit. However, this is inconsistent with ϕ^* falling in the new equilibrium and thus a contradiction arises.

Having shown that $w_x'(\beta) > 0$, combined with the labor market clearing condition, it must be that L_y must fall.

Appendix 10

Variable definitions - BEA data, all values reported in dollars.

Intrafirm affiliate sales	(Sales by affiliate to US parent + sales by affiliate to other local affiliates in the foreign country + sales by affiliate to other foreign affiliates) aggregated over all of the affiliates of a US parent. This value is deflated by the producer price index.
Global parent sales	Total sales as reported for the US parent, deflated by the producer price index.
Share of intrafirm affiliate sales	Intrafirm affiliate sales/Global parent sales.
R&D	R&D expenditures as reported for the US parent, deflated by the producer price index.
Domestic employees	Total number of employees at the US parent.
Operating profits	Sales - COGS - SG&A, where COGS and SG&A are reported for the US parent. This value is then deflated using the producer price index.
Operating profits per domestic worker	Operating Profits/Domestic Employees.
Employee compensation	Total wages and benefits paid for domestic employees as reported for the US parent, deflated by the consumer price index.
Average wage	Employee Compensation/Domestic Employees.
Skilled labor (industry-level)	Number of employees, for a given SIC code, with at least one year of education beyond high school as reported in the March CPS data.
Unskilled labor (industry-level)	Number of employees, for a given SIC code, with high school education or less as reported in the March CPS data.
Labor skill ratio (industry-level)	Skilled Labor/Unskilled Labor, for a given SIC code.
Sales,1 - Sales,8	Total sales for the top 8 business lines as reported for the US parent, by SIC codes, deflated by the producer price index.
Labor skill ratio (firm-level)	Labor Skill Ratio (industry-level) weighted by share of sales for each of the top 8 business lines for the US parent.

Table A.1 - Dependent variable is differenced over the 1993 - 1997 period

	Δ Offshoring Share[a]	Δ Log(Op Profits/ US Employee)	Δ Log(Avg Wages)	Δ Log(Domestic Employment)	Δ Skill Ratio
Treatment (1)	0.084***	0.068*	0.052	-0.069	0.161*
	(0.020)	(0.043)	(0.038)	(0.054)	(0.087)
# Observations	456	452	451	456	455
Treatment (2)	0.074***	0.067*	0.045	-0.050	0.141*
	(0.019)	(0.041)	(0.037)	(0.044)	(.081)
# Observations	523	516	520		526

(a) Intrafirm sales of Mexican affiliates divided by total global sales of US parent

(1) Comparison group is MNCs who offshore to Latin America but not Mexico, in 1993
(2) Comparison group is MNCs who offshore to other developing countries but not Mexico, in 1993

* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level

Robust standard errors in parentheses
Industry fixed effects are included in the regression but not shown here

Note: Sample includes US manufacturing and service firms.

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Tables and Figures

Table 1 - Summary Statistics - 1993

	Full Sample	Treatment	Control	Difference
Num of aff countries	5.8 (0.23)	17.1 (1.13)	10.0 (0.61)	7.1*** (1.2)
Num of affiliates	9.6 (0.59)	35.5 (3.56)	15.9 (1.49)	20.6*** (3.39)
Log (global sales)	12.58 (0.04)	14.11 (0.13)	13.54 (0.10)	0.57*** (0.16)
Log (US employees)	7.32 (0.04)	8.72 (0.13)	8.14 (0.09)	0.58*** (0.15)
Log (R&D)	8.71 (0.06)	10.41 (0.18)	9.44 (0.12)	0.97*** (0.21)
Log (op. profits-per-US worker)	4.92 (0.02)	5.06 (0.05)	5.08 (0.05)	-0.01 (0.07)
Labor skill ratio	1.22 (0.03)	1.93 (0.10)	1.51 (0.07)	0.42*** (0.12)
Log (average wage)	3.89 (0.01)	3.99 (0.03)	3.89 (0.03)	0.10*** (0.04)
Intrafirm aff. sales share†	0.07 (0.00)	0.15 (0.19)		
# Observations	1582	192	304	

† Intrafirm sales of Mexican affiliates divided by total global sales of US parent
** statistically significant at 5% level
*** statistically significant at 1% level

Note: Sample includes US manufacturing firms. Treatment refers to manufacturing firms who offshored to Mexico in 1993 and control refers to manufacturing firms who offshored to other Latin American countries but not Mexico in 1993.

Table 2 - Dependent variable is differenced over the 1993 - 1997 period

	Δ Offshoring Share[a]	Δ Log(Op Profits/ US Employee)	Δ Log(Avg Wages)	Δ Log(Domestic) Employment)
Treatment (1)	0.086*** (0.021)	0.084* (0.044)	0.064* (0.039)	-0.049 (0.054)
# Observations	387	384	383	387

(a) Intrafirm sales of Mexican affiliates divided by total global sales of US parent

(1) Comparison group is MNCs who offshore to Latin America but not Mexico, in 1993

* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level

Robust standard errors in parentheses
Industry fixed effects are included in the regression but not shown here

Note: Sample includes US manufacturing firms only.

Table 3 - Dependent variable is differenced over the 1993 - 1997 period

	Δ Offshoring Share[a]	Δ Log(Op Profits/ US Employee)	Δ Log(Avg Wages)	Δ Log(Domestic) Employment)	Δ Skill Ratio
Treatment (1)	0.086*** (0.021)	0.084* (0.044)	0.064* (0.039)	-0.049 (0.054)	0.147* (0.079)
# Observations	387	384	383	387	386
Treatment (2)	0.076*** (0.019)	0.073* (0.042)	0.058* (0.037)	-0.053 (0.051)	0.127* (.074)
# Observations	432	429	426	432	431

(a) Intrafirm sales of Mexican affiliates divided by total global sales of US parent

(1) Comparison group is MNCs who offshore to Latin America but not Mexico, in 1993
(2) Comparison group is MNCs who offshore to other developing countries but not Mexico, in 1993

* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level

Robust standard errors in parentheses
Industry fixed effects are included in the regression but not shown here

Note: Sample includes US manufacturing firms only.

Table 4 - Dependent variable is differenced over the 1993 - 1997 and 1997 - 2001 periods

	Δ Offshoring Share[a]	Δ Log(Op Profits/ US Employee)	$\Delta Log(Avg$ Wages)
Interact (1)	-0.082***	-0.096*	-0.111**
	(0.023)	(0.059)	(0.057)
Treatment	0.079***	0.040	0.037
	(0.015)	(0.034)	(0.031)
Period	0.026*	-0.110**	0.111***
	(0.016)	(0.046)	(0.037)
# Observations	974	968	974
Interact (2)	-0.012***	-0.088*	-0.107**
	(0.005)	(0.056)	(0.056)
Treatment	0.008***	0.046	0.040
	(0.002)	(0.034)	(0.031)
Period	0.000	-0.118***	0.107***
	(0.001)	(0.042)	(0.034)
# Observations	1029	1022	1029

(a) Intrafirm sales of Mexican affiliates divided by total global sales of US parent

(1) Comparison group is MNCs who offshore to Latin America but not Mexico, in 1993/97
(2) Comparison group is MNCs who offshore to other developing countries but not Mexico, in 1993/97

* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level

Robust standard errors in parentheses
Industry fixed effects are included in the regression but not shown here

Note: Sample includes US manufacturing firms only.

Table 5 - Dependent variable is differenced over the 1993 - 1997 period

	Δ Log(Avg Wages)
Treatment (1)	-0.007
	(0.034)
Treatment*Rent-Sharing	0.461*
	(0.264)
# Observations	377
Treatment (2)	-0.013
	(0.032)
Treatment*Rent-Sharing	0.436*
	(0.248)
# Observations	420

(1) Comparison group is MNCs who offshore to Latin America but not Mexico, in 1997
(2) Comparison group is MNCs who offshore to other developing countries but not Mexico, in 1997

* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level

Robust standard errors in parentheses
Industry fixed effects are included in the regression but not shown here

Note: Sample includes US manufacturing firms only.

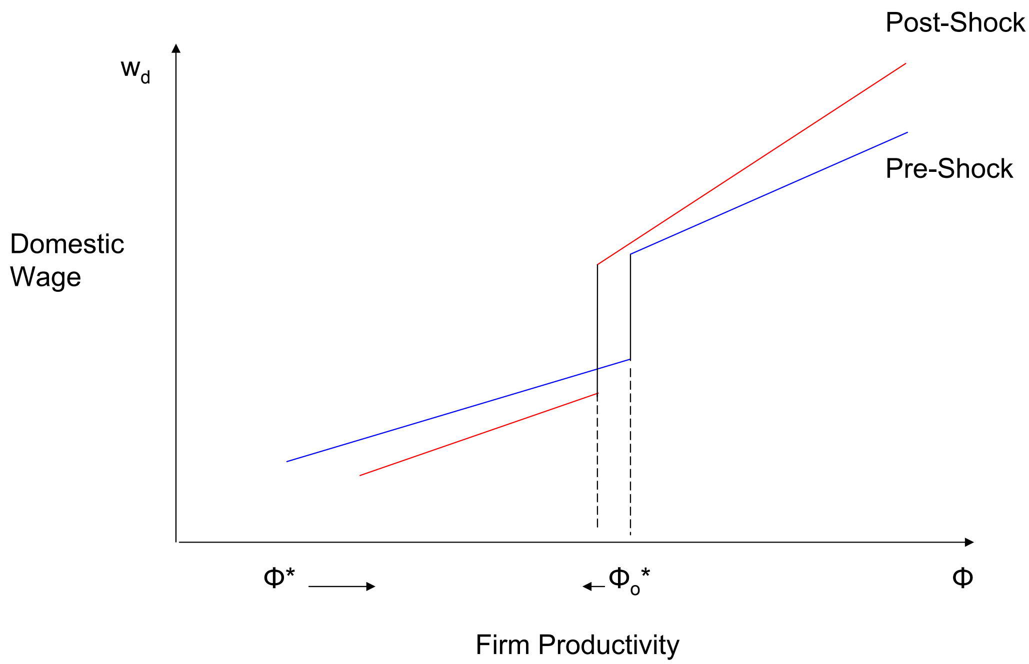

Figure 1: Domestic wage changes following a fall in the marginal cost of offshoring

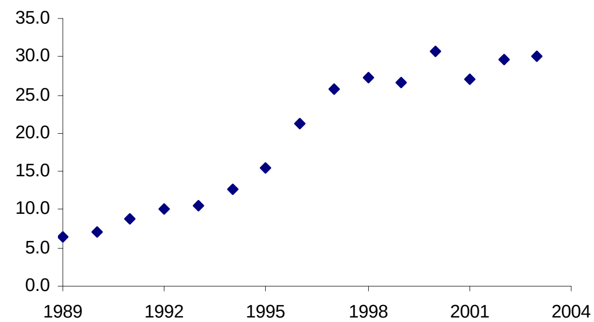

Figure 2: Intrafirm Mexican affiliate sales of US manufacturing MNCs ($Bn)

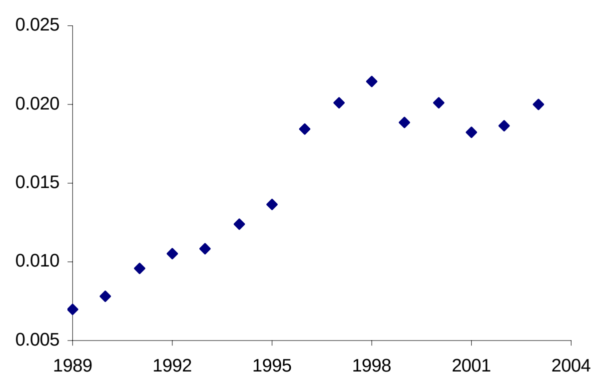

Figure 3: $\frac{\text{Intrafirm Mexican affiliate sales of the US parent}}{\text{Total global sales of the US parent}}$ for US manufacturing MNCs

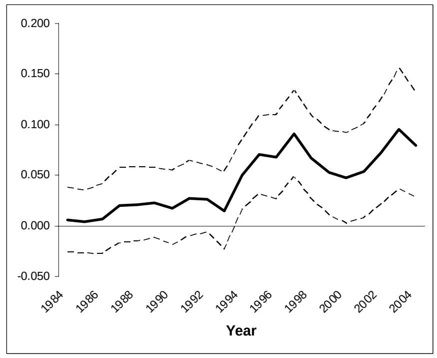

Figure 4: Coefficient for treatment-year interaction from equation 22 where the dependent variable is $\frac{\text{Intrafirm Mexican affiliate sales of the US parent}}{\text{Total global sales of the US parent}}$. Dotted lines represent 90% confidence interval.

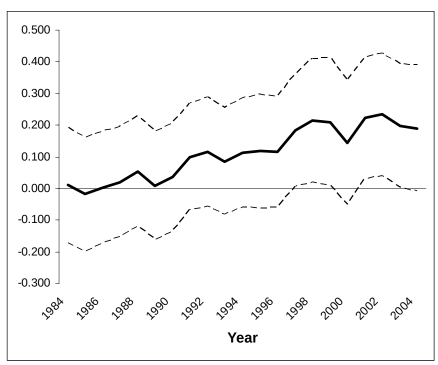

Figure 5: Coefficient for treatment-year interaction from equation 22 where the dependent variable is ln(operating profits per US worker). Dotted lines represent 90% confidence interval.

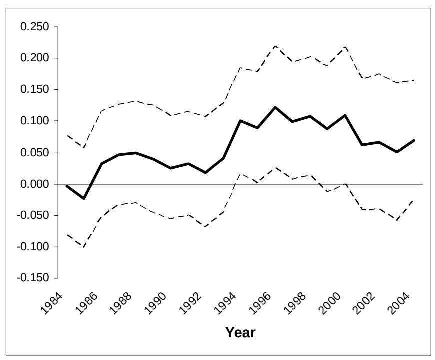

Figure 6: Coefficient for treatment-year interaction from equation 22 where the dependent variable is ln(average domestic wages). Dotted lines represent 90% confidence interval.