II. OUTSOURCING AND LABOR MARKETS

B. Outsourcing, Matching, and Networks

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Relative international wages

- We have extensively discussed the impact of offshoring on relative wages within a country. But what about relative wages across countries? Does offshoring contribute to factor-price equalization?

- Let me begin with a quote from Harvard labor economist Richard Freeman, "Are your wages set in Beijing?"

  "If the West can import children's toys produced by low-paid Chinese workers at bargain basement prices, surely low-skilled westerners, who produce those toys at wages 10 times those of the Chinese, will face a difficult time in the job market. It isn't even necessary that the West import the toys. The threat to import them or to move plants to less developed countries to produce the toys may suffice to force low-skilled westerners to take a cut in pay to maintain employment. In this situation, the open economy can cause lower pay for low-skilled workers even without trade: to save my job, I accept Chinese-level pay, and that prevents imports. The invisible hand would have done its job, with proper invisibility."

Informational barriers to trade and networks that overcome them

- Lack of international factor-price equalization has been largely blamed on trade barriers. As tariffs and transportation costs have come down, research has increasingly focused on informal barriers to international trade as an explanation for high trade costs.

- One informal barrier is lack of information about international trade and investment opportunities (Portes and Rey, 1999).

- Empirically identifiable information-sharing networks have been found to increase the volume of international trade. Such evidence has been found for business groups operating across national borders (Belderbos and Sleuwaegen, 1998), immigrants (Gould, 1994), and long-settled ethnic minorities that maintain coethnic business societies, such as the Overseas Chinese (Rauch and Trindade, 2002).

- Gould (1994) and Rauch and Trindade (2002) find that these groups have less effect on trade in more homogeneous products, for which prices can effectively convey the relevant information, than on trade in more differentiated products, for which matching of multifarious characteristics of buyers and sellers is more important.

Matching friction

- Closer study of how coethnic business societies and transnational business groups overcome informational barriers to trade and investment suggests formulating these barriers as a problem of matching entrepreneurs or firms: it is more difficult in the international than in the domestic market for producers to find the right distributors for their consumer goods, for assemblers to find the right suppliers for their components, for investing firms to find the right partners for their joint ventures, and so on.

- Weidenbaum and Hughes (1996, p. 55) write of the Overseas Chinese:

  "the members of the bamboo network operate in the interstices of the trading world. They make components, manufacture for others, and perform subassembly work. They are also heavily involved in wholesaling, financing, sourcing, and transporting….The leading businessmen know each other personally and do deals together, with information spreading through an informal network rather than through more conventional channels."

# Implications of informational barrier view of trade costs

- We can thus view 'ties' that exist across borders as helping agents solve their matching problems and find suitable trade or investment partners in other countries.

- We shall see that modeling informational barriers to offshoring as matching friction yields results that have much different implications for international labor market integration than modeling them as "ice" transportation costs. In particular, matching friction does not simply push more and less developed country wages further apart – it decreases their covariance.

Endowments

- The world is composed of two countries, home and foreign.

- In each country, there is a continuum of types of producers distributed over a circle of unit length. For each type, there is a continuum of producers of unit mass. The producers can therefore be said to lie on a 'unit cylinder'.

- Each country is also endowed with a homogeneous, inelastically supplied mass of internationally immobile labour.

- Since there is an equal mass, one, of producers in both countries, the ratio of labour-producer endowment ratios across countries can be summarised by the ratio L/L*, where L is the home labour endowment and L* is the foreign labour endowment. In all that follows, asterisks will be used to indicate foreign variables.

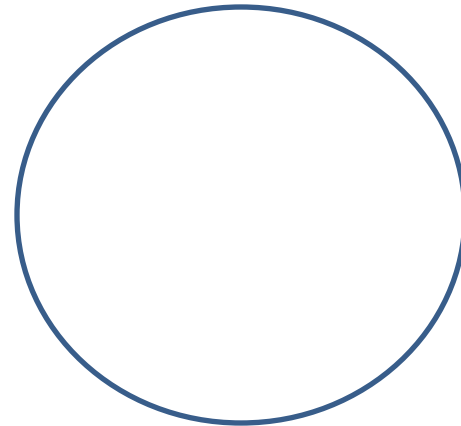- We assume that the foreign country is the labour-abundant country, so that L/L* < 1.

Illustration of endowments
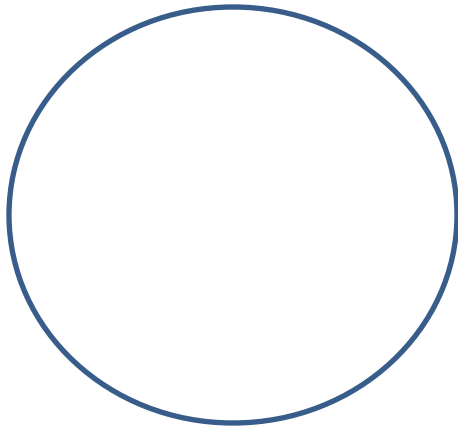
- Producers (capital), mass one   Producers (capital), mass one

- Endowment L Endowment L^*

$$L/L^* < 1$$

Technology

- Output is generated through a joint venture of two producers, and the distance between their types on the circle is an index of their complementarity or the gains from trade that result from their matching.

- To engage in production actively, a partnership needs to hire labour; thus output is a function of the quality of the producers' match and the labour employed:

$$y_{ij} = F(x, z_{ij})$$

  where z_{ij} is the shortest arc distance between the two producers of types i and j, and x is labour. Note that the maximum value of match quality z_{ij} is 1/2. The function F is characterised by constant returns to scale.

- The closeness of our model to the standard one-good, two-factor model of trade is apparent once we recognise that the integral of match qualities z_{ij} over all producer partnerships plays the role of the aggregate capital stock in the standard model.

Labor demand

- Producers want to maximise profits. They take the wage rate *w* as given.
- With a constant returns to scale production function, total profits from the match of types *i* and *j* can be written as:

$$\Pi_{ij} = z_{ij}\pi(w)$$

  where the function $\pi(w)$ is decreasing and convex in *w*. For ease of later derivations, let us also assume that $\pi(w)$ is a constant elasticity function (as would be the case, for example, if the technology were Cobb-Douglas).
- The labour demand generated by a partnership is then given by:

$$L_{ij}^{d} = -z_{ij}\pi'(w),$$

  where the prime sign indicates the first derivative.

Timing

- The timing of the model is the following. First, home country producers travel to the foreign country, where foreign producers await them. Each home producer meets with one and only one potential foreign partner.

- Next, the type of one's partner is revealed, successful matches are confirmed and unsuccessful ones are broken.

- Finally, home and foreign producers who have rejected their international matches establish domestic partnerships with other home and foreign producers, respectively, whose international matches were also unsuccessful.

- The home and foreign labour markets clear when all demands for labour, from domestic and international ventures, are received.

Domestic matching

- Given the model timing, we must find the outcome of domestic matching before we can solve for the results of international matching.

- Domestic matching proceeds as follows. Each producer selects a partner. If his choice does not select him, he gets zero. If his choice does select him, the two producers form a match and bargain over the surplus. If the bargaining breaks down, both producers get zero. Hence the surplus equals the total value of the match. We use the Nash bargaining solution, so any pair of producers that forms a match will divide the total match value equally between them.

- We assume that every producer knows at least the domestic location of his best match type. In this case it seems natural to focus on the efficient equilibrium in which each producer selects the producer opposite him on the circle (and at the same height on the cylinder). This is an equilibrium since no producer has an incentive to change his behaviour after he has chosen and been chosen by his perfect complement.

- In this equilibrium z_{ij} = 1/2 for every partnership. Domestic partnerships are assumed to have access to domestic labour only. Since each producer receives half of the profits, a home producer forming a domestic partnership earns (1/2)(1/2) $\pi(w)$ = $\pi(w)/4$. Similarly, a foreign producer forming a domestic partnership earns $\pi(w^*)/4$.

International matching

- We now turn to international matching. At this point we must distinguish between tied and untied producers.
- We assume that travel of home country producers to the foreign country is costless, and hence only consider equilibria in which all home country producers attempt the foreign market.
- We also assume that a fraction m of every type of producer is tied, in the sense that each home producer in this subset knows the location of the foreign producer that is opposite it on the circle and at the same height on the cylinder. Untied home producers, in contrast, are completely uninformed about the locations of foreign producer types and can therefore meet with any foreign producer type at the same height on the cylinder with equal probability, given the uniform distribution of types over the circle.
- All tied home producers will choose to use their ties since they obtain the maximum match quality by doing so, yet lose nothing in bargaining power because the threat point (the value of a domestic match) of all foreign producers is the same.

Gains from trade and barriers to trade

- International partnerships differ from domestic partnerships in two ways.
- First, an international partnership has the option to locate its operation in either country and can therefore have access to the labour force of either country.
- Second, the producer that manages the international joint venture from abroad loses a fraction t or t^* of its profits. This reflects the transportation costs and trade taxes incurred when repatriating profits in terms of the numeraire good.
- Inclusion of trade taxes means that t or t^* can be varied by unilateral government action, which will allow us to use our model to analyse the impact of a government decision to liberalise (partially) or to further restrict trade.

International bargaining

- If both domestic markets are active, the threat points in international bargaining of every home and every foreign producer are $\pi(w)/4$ and $\pi(w^*)/4$, respectively, where w and w^* are the international trade equilibrium wages. Uniformly distributed, atomless producers and the symmetry of the position of every producer (tied or untied) on the circle ensure that the height of the remaining cylinder of producers in each country is the same for every type and thus domestically every producer can still match with his opposite type.

- From the point of view of the partner from the high wage country, then, the attraction of international matching is access to cheaper labour, whereas from the point of view of the partner from the low wage country, the attraction is greater relative bargaining power than with a domestic partner.

Relation to the standard model

- It is easily shown that in equilibrium $w > w*$ and that all confirmed international matches will employ foreign labour. International matching thus serves to transfer labour demand from the labour-scarce to the labour-abundant country, just as does trade in the standard one-good, two-factor model.

- Also as in this standard model, we can think of producers and workers as using their income to purchase their own production, generating balanced international trade of producer services for numeraire output.

Determining the cutoff match quality

- If a home country producer of type i draws a potential foreign partner of type j, denote their distance on the circle of types by z_{ij}, as represented in the following figure.

- z_{ij} is uniformly distributed on the interval [0, 1/2]. Given the symmetry of the circle we can drop the subscripts from z_{ij}: every home country producer faces a uniform distribution of partner distance z, with support [0, 1/2] on the circle.

- We represent in the subsequent figure the possibilities set that results from a potential international partnership. An international match is acceptable if the threat point is not outside the Pareto frontier (the case shown in the figure).
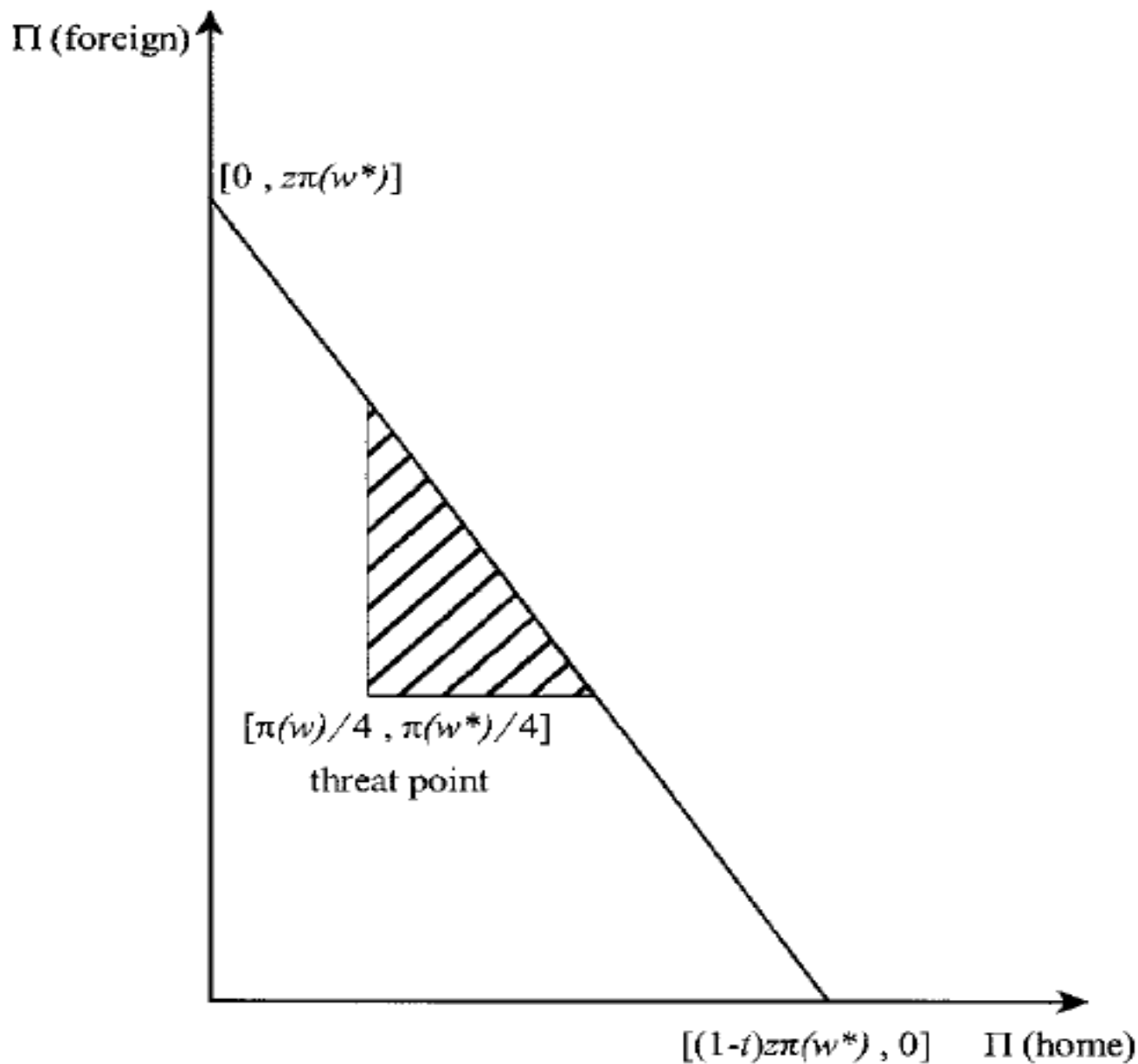
Acceptable vs. unacceptable matches

$1/4 + \psi / 4(1-t)$

$1/2$

$1/4 + \psi / 4(1-t)$

zij
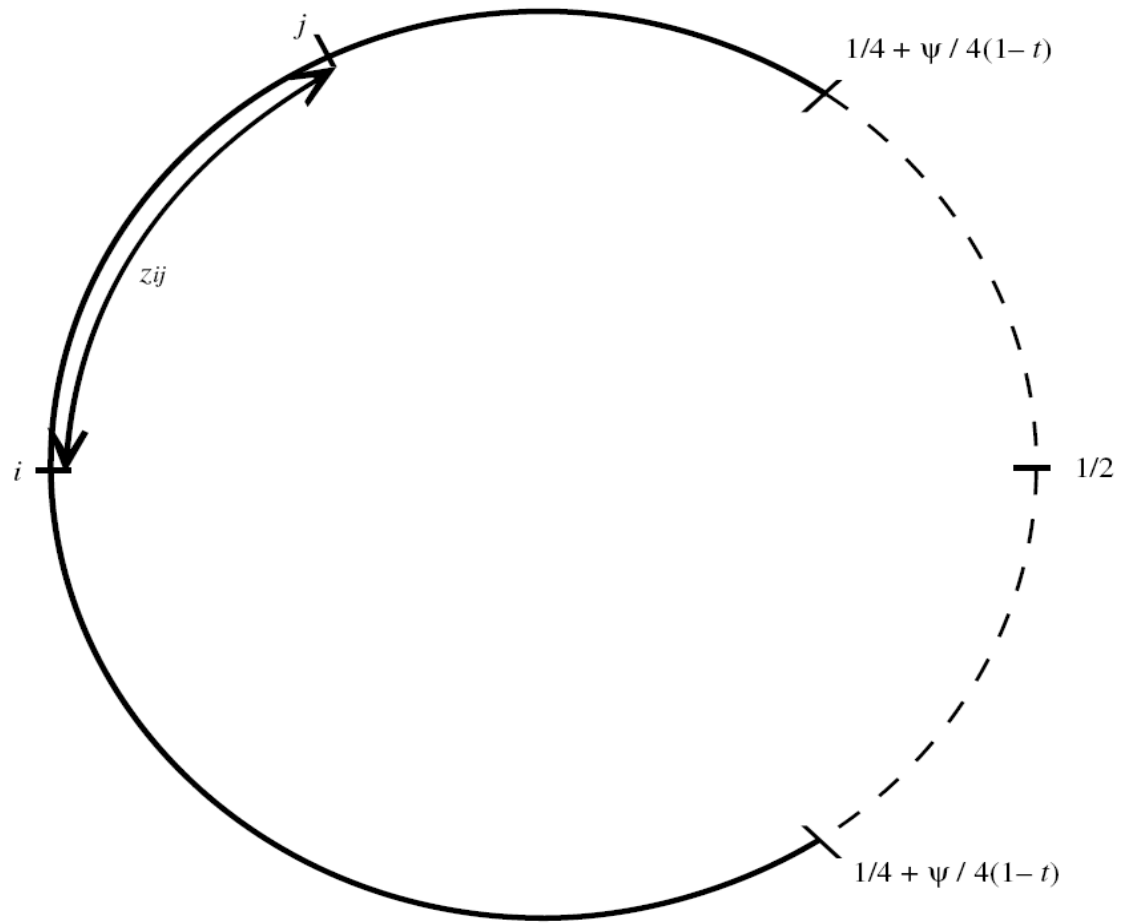
– – – – – – – – – acceptable matches

——————— unacceptable matches

The bargaining problem

Cutoff as a function of gains from trade

- The condition that the threat point is not outside the Pareto frontier can be expressed as:

$$\pi(w*)/4 \leq -\pi(w)/[4(1-t)] + z\pi(w*), \text{ or alternatively as}$$

$$z \geq 1/4 + \psi/[4(1-t)],$$

- where

$$\psi(w*/w) \equiv \pi(w)/\pi(w*)$$

- This cutoff condition is represented in the first figure.
- Note that we can write ψ as $(w*/w)^\varepsilon$ because π is a constant elasticity function. I will loosely speak of the function ψ as the 'wage ratio', which should not cause any confusion because it is just a scaling of the wage ratio.
- Note that the smaller is the wage ratio the more likely is an international match to be of acceptable quality, reflecting the greater gains from international trade.

Consistent with firm heterogeneity

- The key feature of our search and bargaining model is that some home producers draw foreign producers that yield match quality $z < 1/4 + \psi/[4(1 - t)]$ and then return home, with both the home and foreign parties to the failed international matches finding domestic partners instead.

- This is consistent with the considerable heterogeneity that exists at the firm level regarding involvement in foreign transactions. Only a minority of firms even in high wage countries like the US have investments abroad, and in all countries studied many firms that produce tradeable goods have zero exports (Roberts and Tybout, 1997; Bernard and Jensen, 1999).

- The result that some firms that search abroad return home empty-handed would also be obtained in a dynamic search model with an increasing marginal cost of search, but both the closeness to standard static trade models and tractability would be reduced.

Three types of equilibria

- There are three types of equilibria in our model.
- If the labour-producer endowment ratios of the two countries are sufficiently close, the foreign wage will be high enough relative to the home wage that no international matches can be confirmed: if $\psi > 1 - t$ the cutoff match quality is greater than 1/2, the maximum value of z.
- If the wage ratio becomes 1 - t, international matches between tied producers become acceptable because every match between a home producer and the foreign producer to which it is tied yields match quality z = 1/2.
- As L/L^* falls, tied producers prevent the wage ratio from falling below 1 - t because $\psi < 1 - t$ leads all of them to strictly prefer international matches and thus demand foreign labour.
- We call an equilibrium in which ψ = 1 - t and a positive measure of international matches is confirmed a Perfect Arbitrage Equilibrium (PAE) and label as $\underline{L/L^*}$ the smallest ratio of labour-producer endowment ratios for which a PAE obtains.
- Finally, as L/L^* falls below $\underline{L/L^*}$, tied producers cannot transfer enough labour demand to bring about ψ = 1 - t, the wage ratio falls below 1 - t and some matches made by untied producers will be confirmed. We call such an equilibrium an Imperfect Arbitrage Equilibrium (IAE).

Labor endowment ratio for Perfect versus Imperfect Arbitrage Equilibrium

- It can be shown that $\underline{L/L^*}$ = [(1 - m)/(1 + m)]g(1 - t), where

$$g(\psi) \equiv \pi'(w)/\pi'(w^*).$$

- Any Perfect Arbitrage Equilibrium is a Complete Information (Equivalent) Equilibrium (CIE), where a CIE is defined as an equilibrium in which all producers match with their perfect complements (i.e., z = 1/2 for every confirmed match).

- The intuition is that with a sufficiently small difference in labour-producer endowment ratios, tied producers can transfer enough labour demand to realise all the gains from trade that are available given the conventional trade barrier, leaving untied producers to match domestically where they know the locations of their perfect complements.

- Note that as m approaches one we see that $\underline{L/L^*}$ approaches zero and the Imperfect Arbitrage Equilibrium vanishes.

Properties of the
Perfect Arbitrage Equilibrium

- As in the standard model, we have factor price equalization up to the trade barrier wedge

- Relative wages are insensitive to relative endowments – being more labor scarce does not increase home wage relative to foreign

- The impact of trade liberalization is determined only by production technology. Specifically, d[ln $(w*/w)$]/d[ln (T)] = 1/ε, where T is a change of variable from 1 − t.

Properties of the Imperfect Arbitrage Equilibrium

- d($w*/w$)/d($L/L*$) > 0: the less labor abundant is home relative to foreign, the higher is its relative wage

- 0 < d[ln($w*/w$)]/d[ln(T)] < 1/ε: trade liberalisation (an increase in T) causes less convergence in country wages in an IAE than in a PAE.

- The intuition for these results is the same. Consider a decrease in $L/L*$ or an increase in T. Each tends to generate more trade, which requires more international matches to be confirmed. If untied producers confirm more international matches, however, the quality of the marginal confirmed match must fall, requiring a fall in ψ (the wage ratio) relative to T in order for the match to be acceptable.

The Impact of international trade on wages: Freeman once again

- Should the impact of international trade on wages be measured by computing the volume of trade in factor services or by examining cost competition at the margin?

- Now recall the Freeman quote with which we began [slide 2].

- He continues, "…These predictions [of factor-price equalisation] run counter to a wide body of evidence that domestic developments do affect wages: for instance, that the baby boom affected the pay of young workers; that the relative number of college graduates altered the premium paid for education …"

- We might take the liberty of clarifying Freeman's statement to add that the baby boom affected the pay of young workers *more in the US than in China* and the relative number of college graduates in the US altered the premium paid for education *more in the US than in China*.

- This "excess sensitivity" of home wages to home endowments sounds like our Imperfect Arbitrage Equilibrium."

The Impact of international trade on wages: Margins versus volumes

- Having considered the theoretical point that cost competition from labour in low-wage countries could set the wages of comparably skilled labour in high-wage countries, the empirical method for quantifying the impact of international trade on wages that is preferred by Freeman (1995, p. 23) and many others, e.g., Sachs and Shatz (1994) remains factor content analysis:

- "if the United States imported 10 additional children's toys, which could be produced by five American workers, the effective supply of unskilled workers would increase by five…. This five-worker shift in the supply-demand balance would put pressure on unskilled wages to fall, causing those wages to fall in accord with the relevant elasticity."

- Here the impact of low wage competition depends entirely on the volume of net trade and not at all on comparison of costs at the margin.

The Impact of international trade on wages: PAE vs. IAE

- We have seen that in the Perfect Arbitrage Equilibrium of our model the ratio of the home to the foreign wage is determined by the conventional trade barrier and production technology independent of country labour supplies.

- In this equilibrium margins operate perfectly, in the sense that any incipient rise in the home wage relative to the foreign wage above this ratio would be eliminated by a shift in labour demand of tied producers from the home to the foreign country, just as the first Freeman quotation suggests.

- With labour-producer endowment ratios sufficiently far apart, however, tied producers cannot transfer enough labour demand to maintain the perfect arbitrage condition and the Imperfect Arbitrage Equilibrium of our model obtains: elimination of an incipient rise in the home wage requires that untied home producers shift from matching in a complete information environment domestically to an incomplete information environment abroad.

- Margins now operate imperfectly, and relative labour demand is no longer infinitely elastic with respect to relative country wages: the 'relevant elasticity' is finite. In other words, relative wages become a downward-sloping rather than horizontal function of relative labour supplies in the two countries, and we must therefore take into account the volume of (implicit) net trade in labour services when computing the impact of international trade on domestic wages.

- This is presumably the pertinent case for trade between more and less developed countries, given the very large differences in endowments of unskilled labour relative to other factors of production.

Let untied producers rule out some of the worst matches in advance

- From the next figure, we see that the probability of a successful match is now given by

$$P = \frac{\frac{1}{2} - \underline{z}(w^*/w,\ t)}{k/2}.$$

- Smaller k acts like larger m, facilitating transfer of labor demand (offshoring). Moreover, note that the sensitivity of P to both the wage ratio and the tax/transport cost is greater when first-cut quality is greater (k is smaller).

- This indicates the ability of producers to respond more effectively to price-based incentives as a result of improved information. Specifically, the equation for P reflects the fact that the density of producers that are "on the margin" between matching internationally and matching domestically increases as k decreases: more decision makers are in a position to take advantage of substitution opportunities.

- Ties allow margins to function perfectly; better first-cut quality allows margins to function better.
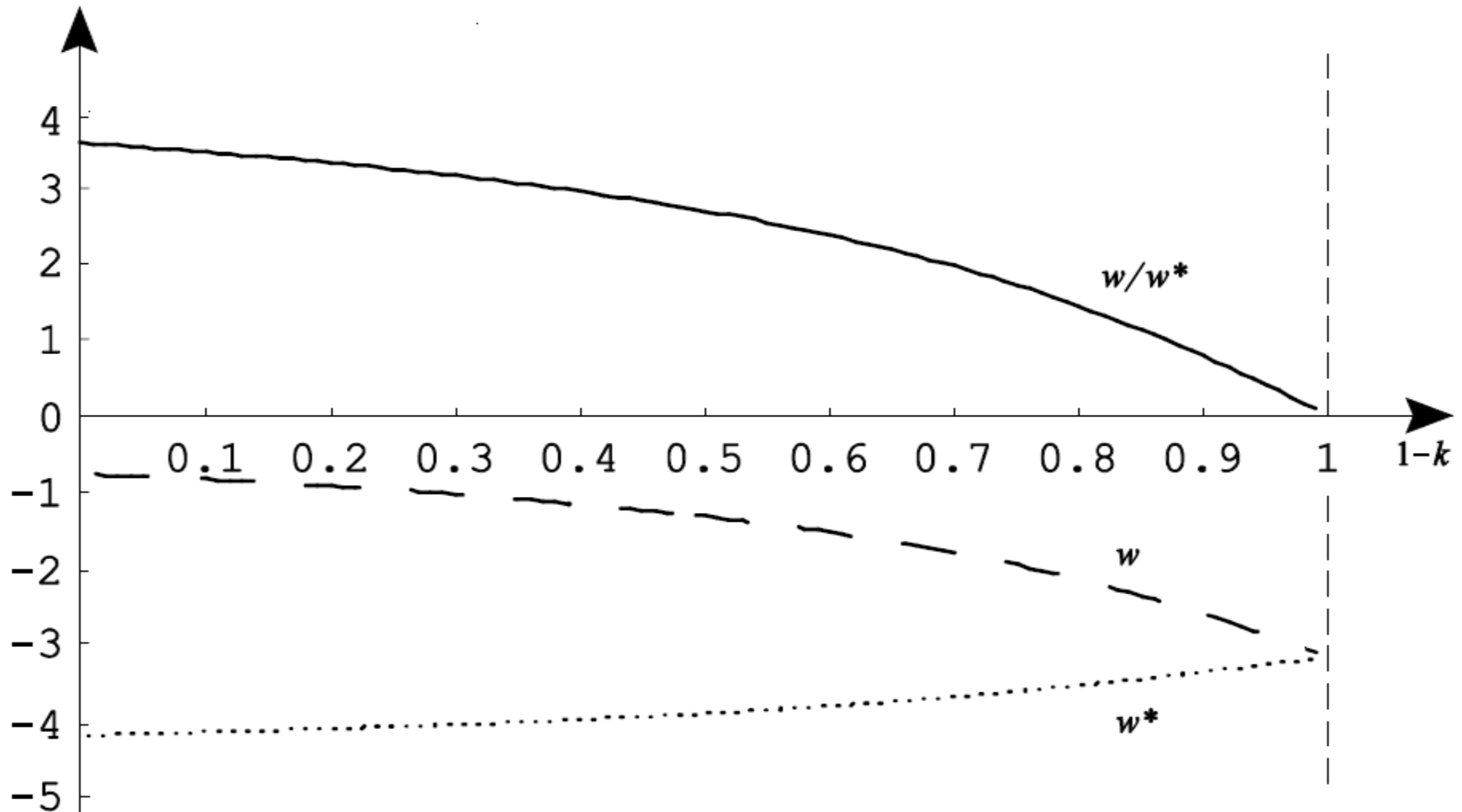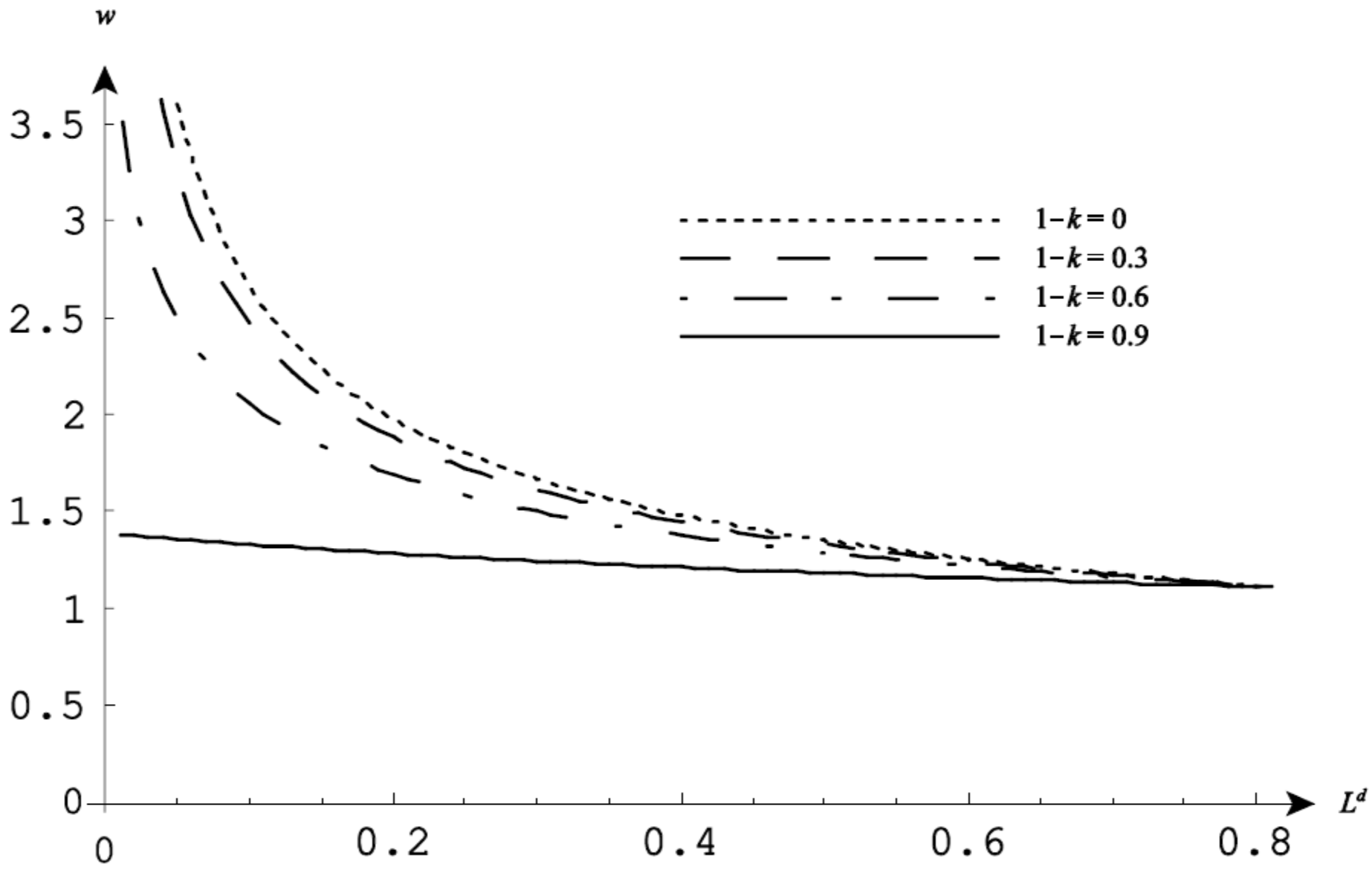
Ruling out 100(1-*k*)% in advance
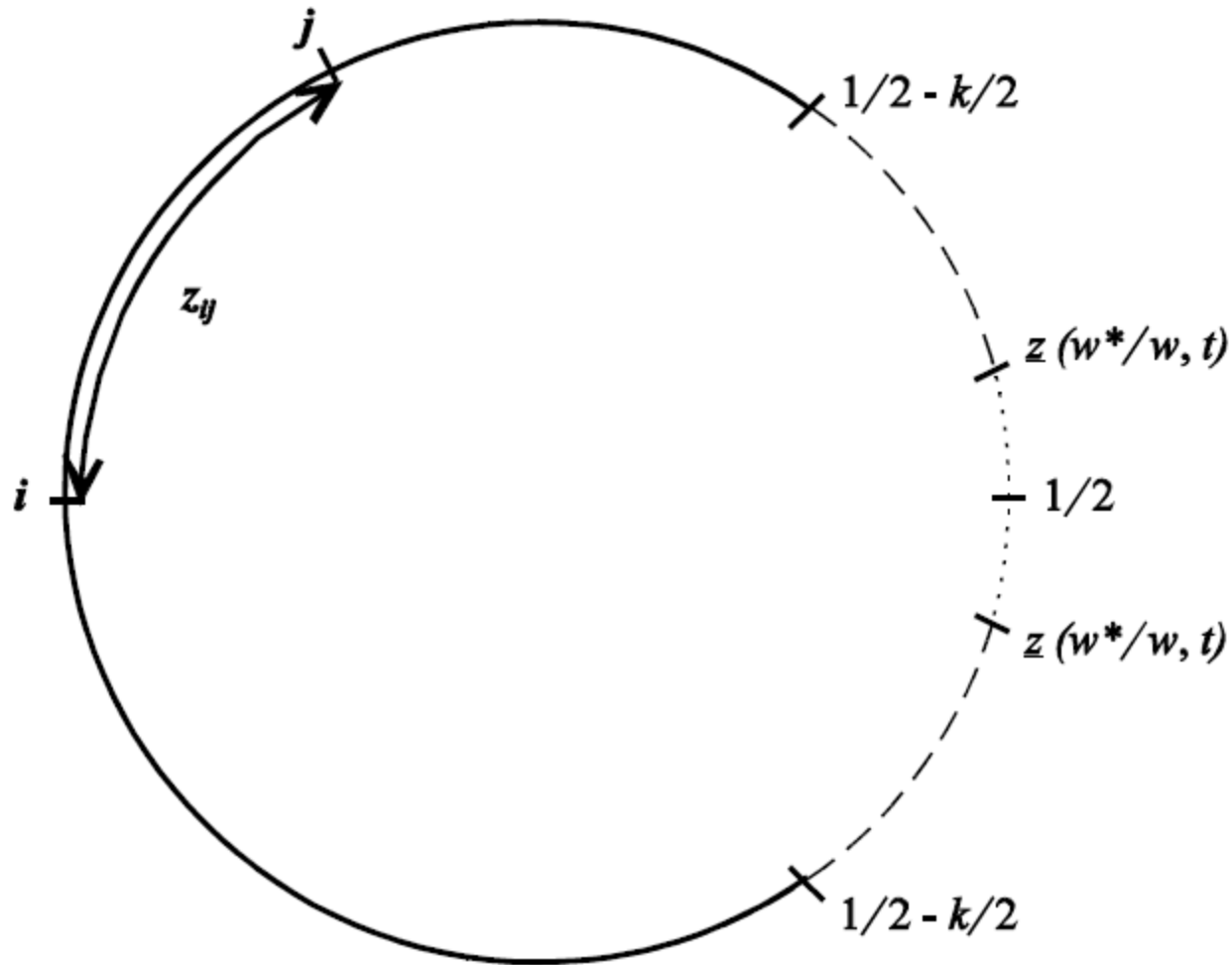
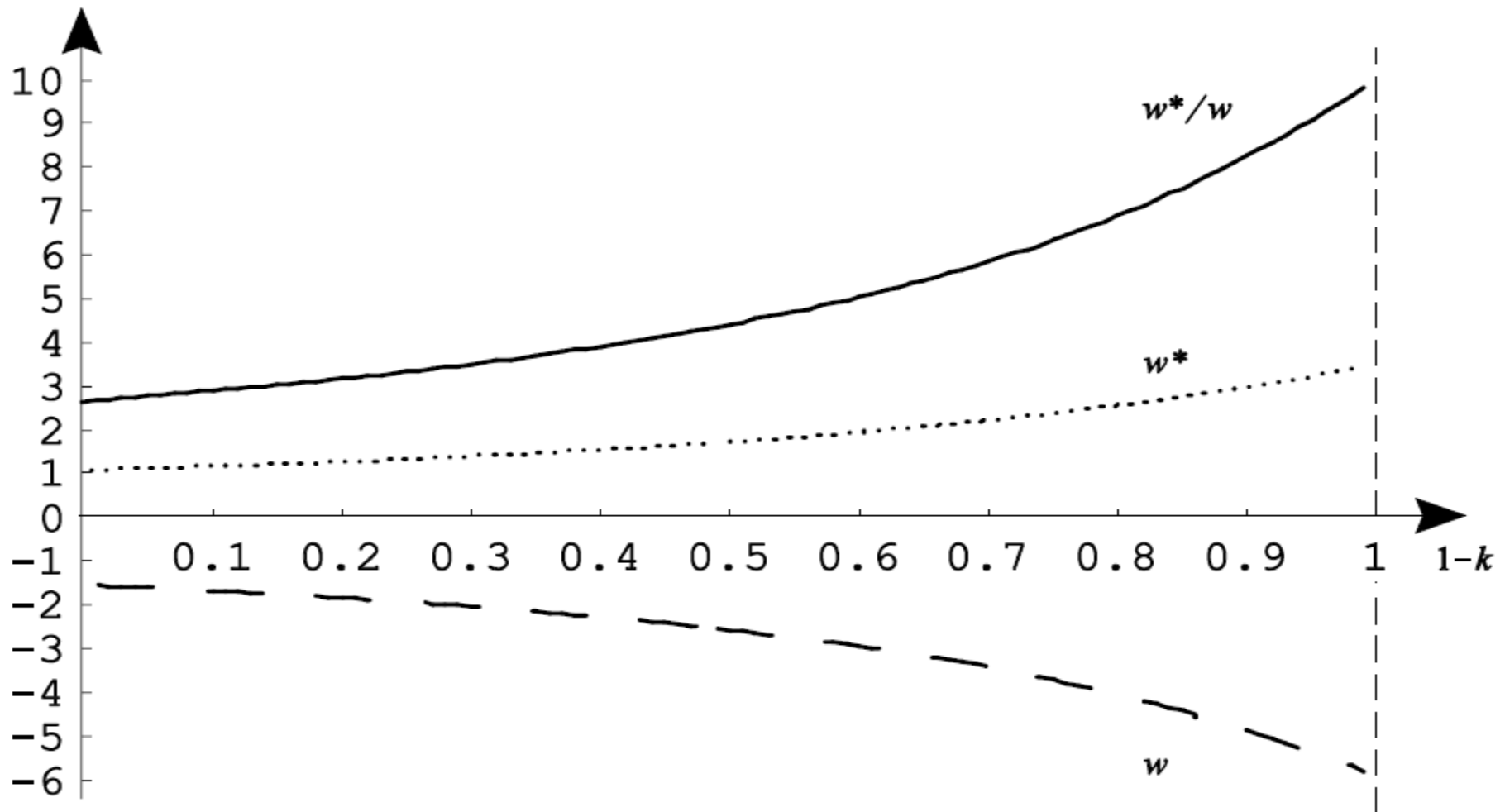# Relative wage response to a 10% increase in foreign labor supply

Percent change

increasing first cut quality →

Changes in home labor demand as first-cut quality increases (w^* fixed)

Relative wage response to a 10% trade liberalization ($\varepsilon = 1$)

Conclusions

- Our model has implications for the effects of trade liberalization on wages, both over time and in cross-section.

- If information is in fact improving with time, past impacts of trade liberalization on wages may underestimate the impacts of future liberalization, at least if the liberalization involves reductions in trade taxes.

- In cross section, our model suggests that trade liberalization with countries with which the initial volume of trade is greater, all else equal, will have greater impact on domestic wages.