# Protecting the Poor: Skill Bias in the International Distribution of Trade Protection

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November 2008
Preliminary, Not for Citation

**Abstract**

We document and analyze a new puzzle in international political economy. For a broad sample of countries, we show that in the very large majority of cases it is unskilled-intensive industries that receive relatively high levels of trade protection. What is especially puzzling is that this pattern of protection holds even in low-income countries in which less-skilled labor is likely to be the relatively abundant factor of production and therefore would be expected in many standard political-economy frameworks to receive relatively low, not high, levels of protection. We propose that one possible explanation is that individual attitudes about inequality–both envy and altruism–lead to systematic differences in support for trade protection across industries with sectors employing lower-earning workers more intensively being preferred recipients for trade protection. We evaluate the argument by examining sector-level evidence on the distribution of trade protection in China and the United States.

# 1 Introduction

This paper documents a new puzzle in international political economy. For a broad sample of countries, we show that in the very large majority of cases it is unskilled-intensive industries that receive relatively high levels of trade protection. Because this pattern of protection holds even in low-income countries in which less-skilled labor is likely to be the relatively abundant factor of production, it is arguably at odds with the common empirical finding that declining, comparative disadvantage industries are more likely to receive protection. Moreover, it is at odds with most theoretical political economy models which tend to either predict, consistent with most empirical work, that losing sectors from international trade receive more protection or that expanding sectors that gain from greater trade should enjoy more government support. Existing accounts are generally good at explaining support for winners or for losers but not why winning sectors are supported in some countries and losing sectors in others and do not explain why the unskilled sectors seem to be advantaged in the contest for government support in almost all countries. Our paper analyzes this puzzle in two steps.

First, we propose and model one possible explanation: that individual preferences over trade policy are shaped by considerations of others, above and beyond one's own income. A growing literature has explored theoretically and empirically the possibility that individuals may have "other regarding" preferences. One important approach assumes that individual utility functions depend not only on the individual's own material payoff but also on the material payoffs that others receive. These social preferences could include everything from altruism, for which utility increases with the well being of other people, to spitefulness, for which utility decreases in the well being of others.

Our model of trade policy incorporates the particularly influential form of social preferences known as "inequity aversion," in which individuals are altruistic toward others if their material payoffs are below an equitable benchmark but envious of others whose payoffs are above this level. We show how individual attitudes about inequality—both envy and altruism—lead to systematic differences in support for trade protection across industries with sectors employing lower-earning workers more intensively being preferred recipients for trade protection. Our argument is that if individual citizens and policymakers care not only about how trade policy influences their real incomes but also how it affects their incomes relative to others, with a preference for policies that promote income equality, government policies will tend to support industries that employ lower-earning, less-skilled workers more intensively. Importantly, we suggest the possibility that these preferences will be observed across lots of different types of countries and will influence the observed sectoral distribution of trade protection across countries with very different factor endowments and political institutions.

Second, we evaluate the argument by examining sector-level evidence on the distribution of trade protection in Chinese and U.S. manufacturing industries from 1998 to 2004. These two cases were chosen because they are large countries with very different factor endowments. For each country's panel of industry-year observations, we examine the key prediction of our model that lower-skill, lower-wage industries should tend to receive higher levels of trade protection. For a host of regression specifications and estimation techniques that account for a wide range of measurement and endogeneity issues, we indeed find this prediction to hold true. In our Chinese data, a two-standard-deviation increase in an industry's average wage is associated with a 34% decline in that industry's tariff. In our U.S. data, the analogous drop is estimated to be about 45%. Thus, for at least two important countries in today's global economy, the pattern of trade protection is consistent with trade preferences motivated by inequity aversion.

The rest of our paper is organized as follows. In Section 2, we present our puzzle of the skill bias in the pattern of trade protection around the world. In Section 3, we model trade policy in a setting in which individual preferences display inequity aversion. Our empirical analysis of China and the United States is in Section 4, and Section 5 offers some concluding remarks.

# 2 The Puzzle: Skill Bias in the Distribution of Trade Protection

This section documents what we think is a new puzzle in the literature on the international distribution of trade protection. For a broad sample of countries, we show that in the very large majority of cases it is unskilled-intensive industries that receive relatively high levels of trade protection. This pattern of protection holds even in low-income countries in which less-skilled labor is likely to be the relatively abundant factor of production and therefore would be expected in many standard explanations of the determinants of trade policy to receive relatively low, not high, levels of protection.

## 2.1 Industry Trade Protection and Skill Intensity in China and the United States

Figure 1 plots trade-weighted tariffs in United States manufacturing industries in 2000 against normalized average wages in those sectors.[1] This graph shows a familiar pattern to students of trade policymaking in the United States. Tariffs are relatively low in the United States but those industries that use low-skilled, lower paid workers more intensively receive higher levels of trade protection. This graph would look very similar employing alternative measures of trade protection and skill intensity.

The most common explanation for the pattern of trade protection observed in this and other similar graphs is that it reflects the more general phenomenon that comparative disadvantage sectors—losers from expanding trade—get more

[1] The data are for 4-digit, ISIC, revision 3 manufacuturing sectors. The data and sources are discussed in greater detail below.

protection. A large empirical literature has documented the tendency of governments to provide greater trade protection to declining industries. In the United States and Europe for example, heavily protected industries include textiles, footwear, clothing, and agriculture which have been contracting for decades. Gawande and Krishna (2003) and Baldwin and Robert-Nicoud (2007) review a number of alternative measures that have been documented to be correlated with higher levels of trade protection in declining industries. These include industry growth rates in terms of output and employment and changes in import penetration ratios. The general idea is simply that governments tend to pick losers when they intervene to support domestic industries.

The reasons for this pattern of intervention are not obvious. As Baldwin and Robert-Nicoud (2007) note, the dominant approach for explaining which industries get protected is various lobbying models and there are good reasons to think that larger, expanding industries would have more resources for lobbying governments to support their businesses.[2] Some explanations for this phenomenon include the idea that losing sectors lobby harder because rents from lobbying are not competed away through entry of new firms, at least as long as the benefits of protection are not too great (Baldwin and Robert-Nicoud, 2007). Grossman and Helpman (1996) focus on the possibility that the asymmetry in lobbying effort may be due to greater free riding in expanding sectors. Krueger (1990) argues that policymakers privilege declining industries because this supports the income of known workers whereas supporting expanding sectors supports unknown beneficiaries. A number of papers have suggested various ways in which policymakers and/or citizens may be generally averse to income losses and that this directly affects how governments set policy in declining and expanding industries (Freund and Ozden 2008, Corden 1974).[3]

One implication of the idea that governments tend to pick losing sectors is that we should expect significant differences across countries in the distribution of trade protection across different sectors of the economy. While some losing sectors may be common across all countries because the source of their decline is due to changes in technology or consumer tastes in all countries, many changes in the fortunes of industries will reflect differences in comparative advantage across countries. For example, it is not an accident that commonly cited declining industries in the United States include textiles, footwear, and toys. These industries are declining in the U.S. in part because they use less-skilled labor intensively and the U.S. is not relatively well endowed with less-skilled workers. In contrast, these industries have been expanding in other countries which are well endowed with less-skilled workers. More generally, to the extent that winning and losing sectors are in part determined by comparative advantage, we would expect that patterns of trade protection vary across countries according to their relative factor endowments.

[2] See, for example, Olson (1965), Stilger (1971), Peltzman (1976), Hillman (1982), Milner (1987), Grossman and Helpman (1994), Gilligan (1997), Hiscox (1999), and Goldberg and Maggi (1999).

[3] See Baldwin and Robert-Nicoud (2007) for a more complete review.

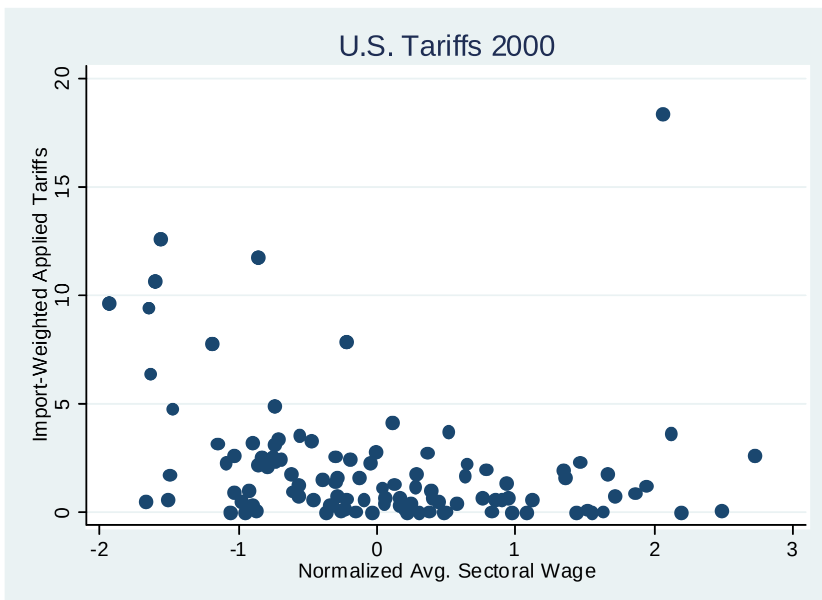


Figure 1: Import-Weighted Applied Tariffs and Average Wages in U.S. Manufacturing in 2000. This figure plots import-weighted applied tariffs in 4-digit, ISIC, Revision 3 manufacturing industries in the United States in 2000 against normalized average wages in these industries. See text for sources.

To investigate this question further, Figure 2 plots trade-weighted tariffs in Chinese manufacturing industries in 2000 against normalized average wages in those sectors.[4] While the level of tariffs in China is higher than the United States, what is striking about this graph is how similar the distribution of protection by factor intensity is compared to the United States. Those sectors which employ less-skilled, lower paying workers more intensively have higher levels of trade protection. This is evident both in the handful of very high tariff sectors but also when considering only those sectors with applied tariff rates below 40%. Under the common empirical claim that China is relatively well-endowed with less-skilled workers, the pattern of protection described in this graph is not easily explained by describing these sectors as losing sectors as in the U.S. case.

It is, of course, possible to describe some individual sectors that use less-skilled workers more intensively as in decline in China for a number of possible reasons. For example, sectors for which state owned enterprises are large employers may be experiencing employment declines as the sector becomes more competitive. More generally, as China develops, wages are increasing, which may erode its comparative advantage in some sectors. That said, this graph at least suggests the possibility that less-skill intensive and lower-paying sectors are more likely to get greater trade protection in a setting in which we would expect these sectors to generally be comparative advantage industries.

## 2.2 Industry Trade Protection and Skill Intensity around the World

To investigate this possibility more systematically, we examine the correlation of trade protection and skill intensity in a large cross-section of countries. Our data for this analysis are from the *Trade, Production and Protection (1976-2004)* World Bank dataset arranged by Alessandro Nicita and Marcelo Olarreaga.[5] This dataset contains variables on trade, production, and protection in 28 manufacturing sectors (3-digit, ISIC rev.2). For each country, we picked a year close to 2001 for which data was available to calculate trade-weighted tariffs and average industry wages. We then calculated Spearman's rank correlation coefficient for the tariff and wage data. Spearman's rank correlation is essentially a Pearson's correlation coefficient on the ranks and average ranks of each variable. A negative Spearman's rank correlation coefficient in this case indicates that the industry ranks for tariffs and average wages are negatively correlated with lower wage industries receiving relatively greater tariff protection. Although we report these results for trade-weighted tariffs, the results look quite similar for simple average tariffs.[6]

[4] The data are for 4-digit, ISIC, revision 3 manufacuturing sectors. The data and sources are discussed in greater detail below.

[5] See http://go.worldbank.org/EQW3W5UTP0.

[6] The graphs reported also exclude tobacco products for all countries because this sector is almost always a significant outlier in each country. The results are qualitatively similar if tobacco products is included though it does somewhat attenuate the negative correlations.

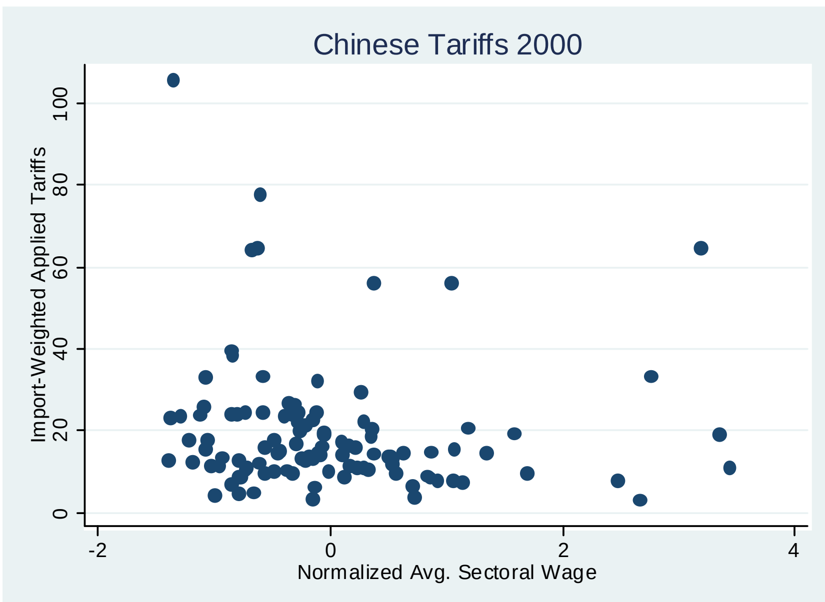


Figure 2: Import-Weighted Applied Tariffs and Average Wages in Chinese Manufacturing in 2000. This figure plots import-weighted applied tariffs in 4-digit, ISIC, Revision 3 manufacturing industries in China in 2000 against normalized average wages in these industries. See text for sources.

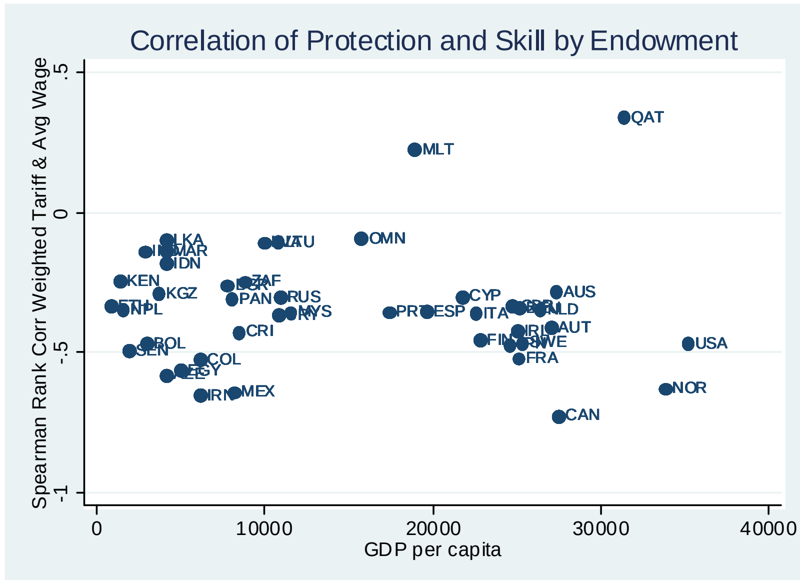


Figure 3: Correlation of Protection and Skill by Endowment. This figure plots the Spearman rank correlation between weighted tariffs and average wages in 3-digit ISIC, revision 2 manufacturing industries in each country against GDP per capita. See text for sources.

Figure 3 plots the Spearman rank correlation between weighted tariffs and average wages in 3-digit ISIC, revision 2 manufacturing industries in each country against GDP per capita.[7] The figure reveals two significant patterns in the data. First, for all but two of the countries, the Spearman's rank correlation coefficient is negative indicating that industries with lower wages receive greater protection in most countries. Second, the magnitude of this correlation does not vary across countries by GDP per capita. If we treat GDP per capita as a rough measure of human/physical capital endowments, this suggests that there is little evidence in this data that comparative advantage is driving the distribution of trade protection across sectors. We do not think that this data is necessarily at odds with the general claim in the literature that losing industries are more likely to be protected but we think it suggests a new puzzle—why do industries that employ less skilled, lower paid workers more intensively get greater trade protection across all types of countries—for the literature on the determinants of trade protection.

Figure 3 is only one way to look at the possibility that low-skilled intensive and lower-paying sectors generally receive greater levels of trade protection. An-

[7]GDP data is from the most recent Penn World Table, http://pwt.econ.upenn.edu/.

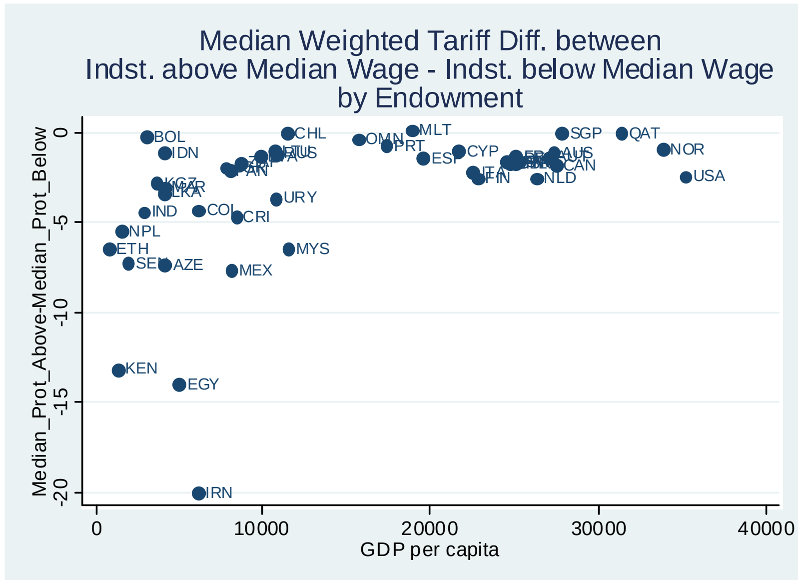


Figure 4: Difference in Median Weighted Tariff between Industries with above Median Wages and Below Median Wages by Endowment. This figure plots the difference in the median weighted tariff in 3-digit ISIC, revision 2 manufacturing sectors with wages above the median and with wages below the median against GDP per capita. See text for sources.

other way to look at this data is to calculate the difference between the median trade-weighted tariff in industries with average wages above the median pay industry and the median trade-weighted tariff in industries below the median pay industry.[8] Figure 4 plots this statistic against per capita GDP. The figure indicates two patterns very similar to Figure 3. First, the difference between the median trade-weighted tariff in industries with average wages above the median pay industry and the median trade-weighted tariff in industries below the median pay industry is never positive and mostly negative indicating that higher paying industries have lower tariffs. Second, the magnitude of these differences are if anything larger in countries with relatively lower GDP per capita (note that because poorer countries have generally higher tariffs, not too much should be made of this greater difference).

For a broad sample of countries, we have presented descriptive evidence suggesting that in the very large majority of cases it is less skilled-intensive industries that receive relatively high levels of trade protection. This pattern

[8] Again, it makes very little difference if simple average applied tariffs are used rather than trade-weighted averages. We again exclude tobacco products in these calculations.

of industrial trade protection is puzzling because it holds even in low-income countries in which less-skilled labor is likely to be the relatively abundant factor of production and therefore would be expected in many standard explanations of the determinants of trade policy to receive relatively low, not high, levels of protection.

## 3 A Social Concerns Model of Trade Protection

The data reviewed in the previous section indicates the possibility that sectors that employ lower-paid, less-skilled workers more intensively may receive greater trade protection across countries with very different factor endowments. There are a number of alternative explanations for this pattern of protection. For example, it may be that tariff levels are constrained by GATT and WTO commitments and these policies are dominated by the domestic political interests of relatively wealthy countries for which losing sectors certainly do include industries that employ less-skilled workers more intensively. Another alternative might be that lower paid sectors lobby harder because their opportunity costs for lobbying are lower. Another possibility which we wish to explore in some detail is simply that individual citizens and policymakers care not only about how trade policy influences their real incomes but also how it affects their incomes relative to others, with a preference for policies that promote income equality. As a result, policies that support the incomes of low earners are favored in the policymaking process.

A growing literature has explored theoretically and empirically the possibility that some individuals may have other regarding preferences. Fehr and Schmidt (2006) provide a review of experimental evidence and various theoretical frameworks for understanding this evidence. One significant approach in this literature is models of social preferences which assume that individual utility functions depend not only on the individual's own material payoff but also on the material payoffs that others receive. The main idea in these treatments is that individuals maximize their utility as they would in more conventional self-interested models but they do not solely care about their own material outcomes. These social preferences could include everything from altruism for which utility increases with the well being of other people to spitefulness for which utility decreases in the well being of others. One particularly influential form of social preference is inequity aversion. Fehr and Schmidt (1999) assume that individuals are altruistic toward others if their material payoffs are below an equitable benchmark but envious of others whose payoffs are above this level. They propose a simple utility function to capture this idea and argue that it is consistent with behavior commonly observed in a wide variety of experimental social interactions such as dictator games, ultimatum games, trust games, public good games, punishment games, and gift exchange games. Empirically the claim is not that all individuals are averse to inequality but that there are at least a significant proportion of individuals who are and that this preference has an important effect on social interactions.

In this section, we propose applying the idea of inequality aversion to the problem of trade policymaking. Our argument is that if individual citizens and policymakers care not only about how trade policy influences their real incomes but also how it affects their incomes relative to others, with a preference for policies that promote income equality, government policies will tend to support industries that employ lower earning, less skilled workers more intensively. Importantly, we suggest the possibility that these preferences will be observed across lots of different types of countries and will influence the observed sectoral distribution of trade protection across countries with very different factor endowments and political institutions. Our argument is related to an older literature that suggested the possibility that governments use trade policy to combat inequality. For example, "social change" arguments discussed in Gawande and Krishna (2003), Baldwin (1985), Ball (1967), Constantopoulos (1974) and Corden (1974) are all related to the idea that reducing inequality might be one explanation for why governments in the United States and Europe seem to favor declining sectors that employ less-skilled workers more intensively. More recently, Davidson, Matusz, and Nelson (2006) argue that inequality aversion is important for understanding trade politics. Davidson, Matusz, and Nelson (2008) also apply Fehr-Schmidt utility functions to a model of trade policymaking though their model focuses on employment risk and does not address our empirical puzzle.

## 3.1 A Three Sector Economy

Our theoretical model is based on standard optimal tariff models of tariff setting and specifically follows Broda et al.'s (forthcoming) treatment with the key difference being that individuals in our model care about their own incomes and their incomes relative to others—they are motivated by both envy and altruism. We will first illustrate our results in a $n = 3$ case before we describe the more general results. In an economy with three individuals $i \in \{1, 2, 3\}$, each individual produces goods $C_0$, $C_1$ and $C_2$ respectively. Individual 1 is endowed with one unit of labor, and individuals 2 and 3 are endowed with one unit of labor and one unit of a specific factor to good $C_1$ and $C_2$ respectively. Each Individual specializes in making one type of good only. The utility function for individual $i$ is:

$$U_i = C_0^i + u_1(C_1^i) + u_2(C_2^i) - \frac{\alpha}{2}\sum_{i \neq j} \max\{I_j - I_i, 0\} - \frac{\beta}{2}\sum_{i \neq j} \max\{I_i - I_j, 0\} \quad (1)$$

This utility function has two main components: the utility from consumption $(C_0^i + u_1(C_1^i) + u_2(C_2^i))$, and the disutility from inequality aversion $(-\frac{\alpha}{2}\sum_{i \neq j} \max\{I_j - I_i, 0\} - \frac{\beta}{2}\sum_{i \neq j} \max\{I_i - I_j, 0\})$. In this simple case, we assume that $u(C)$ is an increasing concave function and it is separable. An individual $i$ with income $I_i$ chooses expenditure on each good to maximize the utility function subject to his/her income constraint $(I_i \geq C_0^i + p_1 C_1^i + p_2 C_2^i)$ respectively. Note that we normalize the price for $C_0$ to one, and $p_1$ and $p_2$ are the domestic price for $C_1$ and $C_2$. Thus, the demand for these goods are simply functions of their own prices, that is, $C_0 = 1$, $C_1 = C_1(p_1)$ and $C_2 = C_2(p_2)$.

To account for inequality aversion, we incorporate a social preference term into each individual's utility function in this model. It is worth noting that the term for inequality aversion is same as the specification in Equation (1) in Fehr and Schmidt (1999:822). In particular, Fehr and Schmidt specify one parameter ($\beta$) for "altruism" when $I_i > I_{-i}$, and the other parameter for "envy" ($\alpha$) when $I_i < I_{-i}$. We keep this feature in order to distinguish between "envy" and "altruism" for an individual who receives an income that is solely due to his/her initial natural endowment. Further, the specification of the utility function implies that an individual would feel altruistic to those who earn less than him/her, and feel envious to those who earn more at the same time. Second, we assume that each individual has full knowledge of all other individuals' incomes. Third, we follow Fehr and Schmidt when assuming the range of values of $\alpha$ and $\beta$. Specifically, we assume $\beta \leq \alpha$, and $\beta \in [0, 1)$, and $\alpha \in [1, +\infty)$. The assumption $\beta \leq \alpha$ is based on the observation that one suffers more from inequality to his/her disadvantage, and Loewenstein et al. (1989) provide evidence for this assumption. Further, we do not set a limit for the degree of envy ($\alpha$) that one feels about inequality.

Given these assumptions, we can derive an individual's indirect utility as follows:

$$V_i = I_i + \sum_{g=1}^{2} \psi_g(p_g) - \frac{\alpha}{2} \sum_{i \neq j} \max\{I_j - I_i, 0\} - \frac{\beta}{2} \sum_{i \neq j} \max\{I_i - I_j, 0\} \qquad (2)$$

where $\psi_g(p_g) = u_i(C_g^i(p_g)) - p_g C_g^i(p_g)$. The social welfare function is the sum of individual utilities, which include individual incomes $I$ and consumption surplus $\psi_g(p_g)$ as well as disutility from inequality aversion:

$$W = \sum_{i=1}^{3} [I_i + \sum_{g=1}^{2} \psi_g(p_g)] - \sum_{i=1}^{3} [\frac{\alpha}{2} \sum_{i \neq j} \max\{I_j - I_i, 0\} - \frac{\beta}{2} \sum_{i \neq j} \max\{I_i - I_j, 0\}] \quad (3)$$

The trade policy problem in our model is to set a tariff for goods $C_1$ and $C_2$ and we need to make a number of further assumptions about the economy and the political process. First, we assume that the numeraire good ($C_0$) is freely traded and produced under constant returns to scale using one unit of labor, and we normalize the equilibrium wage to one. For the non-numeraire goods ($C_g$ and $g \in \{1, 2\}$), the specific factor earns a return that is increasing to the price of $C_g$, that is, $\pi_g(p_g)$. We index individuals' factor endowments such that $\pi_2(p_2) > \pi_1(p_1)$. Finally, we assume that the tariff revenues for each good, $r_g(p_g)$, are redistributed to all the individuals equally. Hence, we can rewrite the social welfare function (3) as follows after some algebraic manipulation:

$$W = 3 + \sum_{g=1}^{2} [\pi_g(p_g) + r_g(p_g) + \psi_g(p_g)] - (\alpha + \beta)\pi_2(p_2) \quad (4)$$

Following Broda et al., we define the world price of $C_g$ as determined by the market clearing conditions below:

$$m_g((1 + \tau_g)p_g^*) = m_g^*(p_g^*) \quad (5)$$

where $p_g = (1 + \tau_g)p_g^*$; $\tau_g$ is the tariff on good $C_g$; $m_g$ is the domestic import demand; $m_g^*$ is the world export supply; and $p_g^*$ is the world price.

As a starting point for exploring the consequences of inequality aversion for trade policymaking and consistent with the optimal tariff framework we are adopting, we assume policy is set by a benevolent social planner, who tries to maximize the social welfare. We will consider other political economy determinants of trade policymaking in our empirical work below. Incorporating these considerations into a model in which individuals and perhaps policymakers are averse to inequality would be a useful extension of what we present here. Under a social planner, the government chooses a tariff to maximize (4), and we obtain the first order condition:

$$\frac{dW}{d\tau_g} = \sum_{g=1}^{2} [\frac{d\pi_g(p_g)}{d\tau_g} + \frac{dr_g(p_g)}{d\tau_g} + \frac{d\psi_g(p_g)}{d\tau_g}] - (\alpha + \beta)\frac{d\pi_2(p_2)}{d\tau_g} = 0$$

which can be simplified to:

$$\tau_1 p_1^* \frac{dm_1}{d\tau_1} - m_1 \frac{dp_1^*}{d\tau_1} = 0 \quad (6a)$$

$$\tau_2 p_2^* \frac{dm_2}{d\tau_2} - m_2 \frac{dp_2^*}{d\tau_2} - (\alpha + \beta)\frac{d\pi_2(p_2)}{d\tau_g} = 0 \quad (6b)$$

As discussed in Broda et al., if a country does not have market power in trade, then $\frac{dp_1^*}{d\tau_1} = 0$ and $\frac{dp_2^*}{d\tau_2} = 0$. In this case, the optimal tariff $\tau_1$ is zero and $\tau_2$ is $(\alpha + \beta)\frac{d\pi_2(p_2)}{d\tau_g}$. Otherwise, Broda et al. define $\omega_g \equiv [\frac{dm_g^*}{dp_g^*} \cdot \frac{p_g^*}{m_g^*}]^{-1}$ as the inverse export supply elasticity, show that optimal tariffs are equal to $\omega_g$. In this model, we obtain:

$$\tau_1^{opt} = \omega_1 \equiv [\frac{dm_1^*}{dp_1^*}\frac{p_1^*}{m_1^*}]^{-1} \quad (7a)$$

$$\tau_2^{opt} = \omega_2 + (\alpha + \beta)\frac{d\pi_2(p_2)}{d\tau_g} / (p_2^* \frac{dm_2}{d\tau_2}) \quad (7b)$$

Comparing to the optimal tariff in Broda et al., inequality aversion has no effect on the optimal tariff for good 1 and decreases the optimal tariff for good 2. The reason is following. We can further derive that $\frac{d\pi_2(p_2)}{d\tau_2} = \frac{d\pi_2}{dp_2}\frac{dp_2}{d\tau_2}$ and since $p_2 = (1+\tau_2)p_2^*$, $\frac{d\pi_2(p_2)}{d\tau_2} = \frac{d\pi_2}{dp_2}p_2^*$. Hence, we can derive equations (7a & 7b) further to:

$$\tau_1^{opt} = \omega_1 \tag{8a}$$

$$\tau_2^{opt} = \omega_2 + (\alpha+\beta)\frac{d\pi_2}{dp_2}/\frac{dm_2}{d\tau_2} \tag{8b}$$

Finally, since we previously assume that the return of the specific factor is increasing in the good's price, so $\frac{d\pi_2}{dp_2} > 0$. Further, import demand, $m$ decreases as $p_2$ increases, and $\frac{dp_2}{d\tau_2} > 0$, so $\frac{dm_2}{d\tau_2} < 0$. As a result, $(\alpha+\beta)\frac{d\pi_2}{dp_2}/\frac{dm_2}{d\tau_2} < 0$. Therefore, $\tau_1^{opt} = \omega_1$ and $\tau_2^{opt} < \omega_2$. Thus, all else equal, the more important inequality aversion is the lower are tariffs in the relative high paying sector 2 compared to sector 1.

## 3.2 A $n > 3$ economy

We can extend the model for $n$ individuals $(1, 2, ...n)$ and sectors where $n$ is an odd number. Individual 1 is endowed with only one unit of labor, and produces the numeraire good $C_0$. Individuals 2 through $n$ are endowed with one unit of labor and a specific factor to produce $C_1$ through $C_{n-1}$ respectively. The returns of the specific factor are $\pi_{n-1}(p_{n-1})$ for individual $i$ from 2 to $n$. We can rewrite the social welfare function (4) as

$$W = n+\sum_{g=1}^{n-1}[\pi_g(p_g)+r_g(p_g)+\psi_g(p_g)]-(\alpha+\beta)[\pi_{n-1}(p_{n-1})+\frac{1}{n-1}\sum_{g=1}^{n-2}(1+2g-n)\pi_g(p_g)] \tag{9}$$

and the the optimal tariffs are:

$$\tau_g^{opt} = \omega_g + \frac{(1+2g-n)(\alpha+\beta)}{n-1}\frac{d\pi_g}{dp_g}/\frac{dm_g}{d\tau_g},\ g \in [1, n-2] \tag{10a}$$

$$\tau_{n-1}^{opt} = \omega_{n-1} + (\alpha+\beta)\frac{d\pi_{n-1}}{dp_{n-1}}/\frac{dm_{n-1}}{d\tau_{n-1}} \tag{10b}$$

Inequality aversion has different effects on tariffs across sectors that employ individuals with different factor endowments. Optimal tariffs are higher for sectors in which individuals have factor endowments that are lower than the median individual. Specifically, we know that when $n < \frac{n+1}{2}-1$, $(1+2g-n) < 0$ and $\frac{dm_g}{d\tau_g} < 0$, so $\tau_g^{opt} > \omega_g$. In a similar vein, optimal tariffs are lower for sectors in which individuals have factor endowment that are higher than the median individual, as $\tau_g^{opt} < \omega_g$. Further, these effects are larger the further away from the median endowment an individual/sector is.

# 4 Trade Protection and Skill Intensity in China and the United States: 1998-2004

Thus far, we have presented some suggestive evidence that sectors that employ lower paid, less-skilled workers more intensively receive more protection across countries with diverse factor endowments and proposed that one possible explanation for this pattern of protection is that individual citizens are averse to inequality. To evaluate both these claims, two sets of empirical analyses seem likely to be informative. First, we can investigate directly through survey experiments whether the relative wage or skills of workers in a sector influences support for protection in that sector. Second, we can evaluate the robustness of the observed partial correlation between average wages and levels of trade protection. In this version of the paper, we focus exclusively on the latter employing manufacturing data for China and the United States from 1998 to 2004. These two cases were chosen because they are large countries with very different factor enowments. The time period selected was determined by data availability.

## 4.1 Data Description

For both countries, we construct panel datasets at the 4-digit ISIC rev.3 level from various sources for the period from 1998 to 2004. To measure levels of protection, we primarily rely on trade-weighted applied tariffs though our results are qualitatively similar for other tariff-based measures.[9] Specifically, the main dependent variable is *LnWeightedTariff* equal to the natural log of trade-weighted applied tariffs.[10] The source for the tariff measure is the TRAINS database. A potential problem with this measure is that tariffs are governed by WTO rules and therefore, may not be determined by the domestic political economy considerations that are the focus of our theoretical discussion. This consideration may be an important one in deciding on how best to evaluate our theoretical claim. We think examining the correlates of sector tariffs is informative for a number of reasons. First, in this context, we are focusing on tariffs in China and the United States. These are both large, influential countries, which are likely to agree to WTO commitments that do not depart too far from their domestic political interests. Second, tariff-based measures are relatively comparable across industries and countries and have fewer measurement problems than the alternatives. Nonetheless, we will in future iterations of this paper also examine tariff setting in non-WTO countries, such as China prior to 2001, to determine if the estimated correlations are sensitive to WTO membership.

[9] We have looked at simple average applied tariffs and both weighted and unweighted MFN tariffs.

[10] The tariff is logged because we are agnostic about the functional form of the relationship between skill intensity and trade protection and were concerned about the influence of very high tariff industries on our results. While the logged tariff specifications do seem to fit the data somewhat better, this specification decision is not consequential for the main results.

Our theoretical framework hypothesizes that tariffs are likely to be higher in sectors which use lower paid and lower skilled workers more intensively. We employ two different measures of relative wages in each industry. The first measure is *AboveMedianWage* and is equal to one if the average wage in the sector is greater than the average wage in the median sector and zero otherwise. The second measure is *AverageWage* and is equal to the total annual wages and salaries in the sector divided by total employment. For the United States, the source for this data is the most recent UNIDO Industrial Statistics Database (INDSTAT4 2008 ISIC Rev.3).[11] For China, we obtained this data from the China Data Centre at the University of Michigan. Due to data availability, we are only able to obtain yearly data between 1998 and 2004 and so this is the data constraint for the sample years that we analyze. The original dataset consists of over 500 4-digit industries under the Chinese Industrial Classification System (GB/T 4754 - 1994). We then converted the data into 4-digit ISIC rev.3 based on the concordances in *China Industrial Classification for National Economic Activities*.

In addition to relative wages, the model which is an extension of standard optimal tariff models generates the prediction that tariffs should be higher in industries for which market power is higher or more precisely that there should be a positive relationship between the inverse of export supply elasticity and the tariff. Consequently, we include Border et. al.'s (forthcoming) measure of the inverse of export supply elasticity, *InverseExportElasticity,* as a control variable. These data had to be converted using imports as weights from 4-digit HS into 4-digit ISIC rev.3. It is worth noting these import-weighted conversions do not exactly match the data between these two classification systems, but we think they provide reasonable estimates.

The purpose of our model is to provide a theoretical motivation for why inequality aversion may influence which industries get more trade protection. In adopting a welfare maximization framework, we have ignored a number of potentially relevant political economy considerations that previous work suggests may be important in setting tariffs. To account for these omitted factors in our empirical work, we constructed a number of control variables. *ZtoSigma* is equal to the ratio of output divided by imports over import demand elasticity. The sources for the production data is the same as for wages described above. The import data is from COMTRADE and the estimates of import demand elasticity are from Broda et al. (2006).[12] This measure allows us to control for the possibility in Grossman and Helpman (1994) that in organized sectors the tariff is increasing with the inverse of the import penetration ratio because the tariff generates greater benefits the larger the domestic sector and the tariff is decreasing with import demand elasticity because the tariff causes a greater distortion, the greater its effect on import demand. *Employees* is equal to the number of employess in the sector and is an alternative measure of size. *Establishments* is equal to the number of firms in the sector with the idea being that

[11] For more details, please see http://www.unido.org/index.php?id=o3533

[12] http://faculty.chicagogsb.edu/christian.broda/website/research/unrestricted/TradeElasticities/TradeElasticities.html

controlling for size, the more firms a sector has, the more difficult are collective actions problems, which may lead to less lobbying and lower tariffs. The sources for both the *Employees* variable and the *Establishments* variable are the same as for wages described above.

Although these control variables certainly capture some of the most important factors cited in the existing literature, it must be acknowledged that other unmeasured or unobservable differences among sectors may also matter. For example, industry geographic concentration is thought to influence the ability of firms to successfully lobby for protection but we do not have such measures available for our data. To address this potential source of bias, we will exploit the panel structure of our data by including a sector-specific effect for each industry in some specifications. These sector-specific effects capture any time-constant factor across industries that drive variation in levels of protection.

## 4.2 Econometric Models

For each country, we estimate three different types of empirical models. In the first, we estimate ordinary least squares specifications for the pooled cross-sections. The *LnWeightedTariff* variable for each country is modeled as:

$$LnWeightedTariff_{it} = \alpha + \beta AverageWage_{it} + \boldsymbol{\gamma}\mathbf{Z}_{it} + \varepsilon_{it}$$

where $i$ indexes sector and $t$ indexes year; $Z_{it}$ is a vector of control variables; $\alpha, \beta$,and $\gamma$ are parameters to be estimated; and $\varepsilon_{it}$ is the error term. We report robust standard errors clustered on sectors. The key parameter of interest is $\beta$ which we hypothesize to be negative, consistent with the claim that less-skill intensive and lower paying sectors receive greater protection.

The second type of model that we estimate adds to this specification sector-specific effects:

$$LnWeightedTariff_{it} = \alpha_i + \beta AverageWage_{it} + \boldsymbol{\gamma}\mathbf{Z}_{it} + \varepsilon_{it}$$

where the key difference is that the parameter $\alpha$ is now subscripted by $i$ to account for time-constant sector-specific unobserved or unmeasured heterogeneity. We estimate this equation by fixed effects which is consistent even if the sector-specific effects are correlated with the other explanatory variables.

Finally, we consider an alternative approach to accounting for persistence in our panel. Sector-specific effects is one way to account for this correlation but this approach does not allow us to differentiate between the idea that persistence in observations of protection is accounted for by the influence of past realizations of protection on present outcomes and the alternative idea that certain sectors just have unobserved characteristics that lead them to have certain levels of protection. To make this assesment, we add a lag of the dependent variable to our specification.

A lagged dependent variable is obviously correlated with the sector-specific effects; consequently, this specification cannot be estimated via ordinary least squares or random effects. Moreover, the fixed-effects estimator is also biased and inconsistent in the presence of a lagged dependent variable when, as in our data, the number of periods is small. There are a number of alternative estimators for this situation, some of which first-difference the data to deal with sector-specific effects and then use instrumental variables to address the correlation between the error term and lagged dependent variable generated by differencing. We use the Arellano-Bond generalized method-of-moments estimator for the following dynamic panel model:

$$LnWeightedTariff_{it} = \sum_{j=1} \rho_j LnWeightedTariff_{it-j} + \alpha_i + \beta AverageWage_{it} + \boldsymbol{\gamma}\mathbf{Z}_{it} + \varepsilon_{it}$$

where in addition to the fixed effect model already described, $j$ indexes the number of lags and $\rho_j$ is the parameter on the lag(s) of the dependent variable to be estimated.

## 4.3 Results

Table 1 reports the results of the pooled ordinary least squares regressions for China. The specifications for Models 1 and 2 follow our theoretical model closely and include only the variable *InverseExportElasticity* as a control variable. For Model 1 the measure of relative wage is *AboveMedianWage*. The coefficient is negative and statistically significant with a p-value equal to 0.021. Since the dependent variable is the natural log of the applied weighted tariffs, the coefficient on *AboveMedianWage* has the simple interpretation that moving from a sector with below to above median wages is associated all else equal with approximately a 23 percent decline in the applied trade-weighted tariff. This result is consistent with the primary argument of this paper that lower-skilled and lower-paid sectors receive greater trade protection. For Model 2, the measure of relative wage is *AverageWage*. Its coefficient estimate is also negative and statistically significant with a p-value equal to 0.035. The substantive size of this estimate is also significant with a two standard deviation increase in *AverageWage* associated with a 34 percent decline in the trade-weighted tariff. It is worth noting that although the estimated coefficients for the variable *InverseExportElasticity* are positive as expected, they are not statistically significant. Models 3 and 4 add further control variables and yield almost identical estimates for the coefficients on *AboveMedianWage* and *AverageWage*.

One potential objection to the results reported in Table 1 is that there may be unmeasured or unobserved characteristics of some sectors that may lead them to have different levels of protection and these characteristics may be correlated with our independent variables leading to biased coefficient estimates. Table 2 reports estimates for our fixed effect and dynamic panel specifications that account for time constant sector-specific effects. The results in Table 2 use *AverageWage* exclusively to measure relative wages. There are not enough sectors that move between above and below the median wage sector over the short time period of our panel to estimate these models for the *AboveMedianWage* measure

|  | Pooled OLS |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Model 1** | **Model 2** | **Model 3** | **Model 4** |
| *AboveMedianWage* | -0.232 |  | -0.224 |  |
|  | (0.099) |  | (0.099) |  |
| *AverageWage* |  | -0.039 |  | -0.039 |
|  |  | (0.018) |  | (0.018) |
| *InverseExportElasticity* | 0.000 | 0.001 | 0.001 | 0.001 |
|  | (0.002) | (0.002) | (0.002) | (0.002) |
| *ZtoSigma* |  |  | -0.945 | -0.996 |
|  |  |  | (0.298) | (0.296) |
| *Establishments* |  |  | 0.005 | 0.005 |
|  |  |  | (0.055) | (0.054) |
| *Employees* |  |  | 0.002 | -0.001 |
|  |  |  | (0.160) | (0.160) |
| Observations | 697 | 697 | 688 | 688 |
| Sectors | 108 | 108 | 106 | 106 |
| Years | $5 \leq T \leq 7$ | $5 \leq T \leq 7$ | $5 \leq T \leq 7$ | $5 \leq T \leq 7$ |

Table 1: Average Wages and Trade Protection in China, 1998-2004, Pooled OLS Estimates. The Table reports the results of OLS regressions for the variable *LnWeightedTariff* on indicators of relative wages and various control variables for China from 1998 to 2004. The table reports the OLS coefficient estimates for each variable, their sector-clustered robust standard errors in parentheses. A constant term is included in each regression but not reported in the table.

with any precision. None of the models in Table 2 include the control variable *InverseExportElasticity* because it does not vary over time in our data and is therefore accounted for in the fixed effects. Thus, our baseline fixed effect specification, Model 5, includes only the variable *AverageWage*. The estimated fixed effects coefficient for *AverageWage* is -0.041 with a standard error of 0.004. This estimate is almost identical to the pooled OLS estimated reported in Table 1 but with a smaller standard error. Adding further control variables to the fixed effects specification as in Model 6 also has no effect on the estimated coefficient.

Models 7 and 8 in Table 2 are Arellano-Bond estimates that add lags of the dependent variable to our econometric model of sectoral trade protection. In comparing these results to the other models, note that the number of observations declines significantly. First differencing and the use of lagged instruments results in the loss of a number of years of data. The consistency of the Arellano-Bond estimator requires that the errors be serially uncorrelated, in which case the first-differenced residuals should display negative first-order serial correlation but not second-order serial correlation. The addition of four lags of the dependent variable was so that our diagnostic tests were consistent with this assumption.

In these estimations, we also addressed two additional concerns about the previous specificatons. First, the estimates might be biased due to endogeneity if higher tariffs increased sectoral wages. Second, the estimates might be biased due to measurement error in the *AverageWage* variable. We instrument for *AverageWage* using its lagged levels and changes in the same way that the standard Arellano-Bond model instruments for the lagged dependent variable. This approach allows us to account for potential endogeneity, and it also yields consistent estimates on *AverageWage* in the case of random measurement error. The results of this analysis are reported in the balance of Table 2 and indicate that there is still a statistically and substantively significant negative cofficient estimate for *AverageWage* with and without the additional control variables. Our evidence strongly suggests that increases in sectoral wages are associated with lower levels of trade protection in China during this time period.

Tables 3 and 4 report analogous specifications for the United States. Models 1 and 3 again employ the *AboveMedianWage* measure of relative wages with and without additional control variables. As such the coefficient estimates suggest that that moving from a sector with below to above median wages is associated all else equal with an over 40 percent decline in the applied trade-weighted tariff. These estimates are somewhat larger and more precisely estimate than the anagous estimates for China. Models 2 and 4 again use the *AverageWage* variable with and without additional control variables. The coefficient estimates are negative and statstically signficant. The substantive size of this estimate is again somewhat larger than in the China case with a two standard deviation increase in *AverageWage* associated with about a 45 percent decline in the trade-weighted tariff. The fixed effects and dynamic panel results reported in Table 4 yield qualitatively similar results. There is reasonably strong evidence

| | F.E. Panel | | Dynamic Panel | |
|---|---|---|---|---|
| | **Model 5** | **Model 6** | **Model 7** | **Model 8** |
| $AverageWage$ | -0.041 | -0.041 | -0.025 | -0.025 |
| | (0.004) | (0.004) | (0.008) | (0.007) |
| $ZtoSigma$ | | 0.121 | | 0.240 |
| | | (0.196) | | (0.189) |
| $Establishments$ | | -0.118 | | -0.083 |
| | | (0.027) | | (0.033) |
| $Employees$ | | 0.213 | | 0.059 |
| | | (0.084) | | (0.118) |
| $LnWeightedTariff_{t-1}$ | | | 0.684 | 0.679 |
| | | | (0.087) | (0.097) |
| $LnWeightedTariff_{t-2}$ | | | -0.085 | -0.108 |
| | | | (0.111) | (0.115) |
| $LnWeightedTariff_{t-3}$ | | | 0.516 | 0.526 |
| | | | (0.265) | (0.248) |
| $LnWeightedTariff_{t-4}$ | | | 0.190 | 0.181 |
| | | | (0.074) | (0.077) |
| Observations | 697 | 688 | 378 | 370 |
| Sectors | 108 | 106 | 109 | 106 |
| Years | $4 \leq T \leq 7$ | $5 \leq T \leq 7$ | $2 \leq T \leq 4$ | $2 \leq T \leq 4$ |

Table 2: Average Wages and Trade Protection in China, 1998-2004, Fixed Effect and Dynamic Panel Estimates.

| | Pooled OLS | | | |
|---|---|---|---|---|
| | **Model 1** | **Model 2** | **Model 3** | **Model 4** |
| *AboveMedianWage* | -0.411 | | -0.445 | |
| | (0.116) | | (0.121) | |
| *AverageWage* | | -0.024 | | -0.028 |
| | | (0.008) | | (0.009) |
| *InverseExportElasticity* | -0.001 | -0.002 | -0.001 | -0.002 |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| *ZtoSigma* | | | -0.620 | -4.720 |
| | | | (5.830) | (5.620) |
| *Establishments* | | | -0.025 | -0.038 |
| | | | (0.023) | (0.021) |
| *Employees* | | | 0.093 | 0.389 |
| | | | (0.460) | (0.488) |
| Observations | 656 | 656 | 540 | 540 |
| Sectors | 110 | 110 | 108 | 108 |
| Years | $5 \leq T \leq 6$ | $5 \leq T \leq 6$ | $5 \leq T \leq 5$ | $5 \leq T \leq 5$ |

Table 3: Average Wages and Trade Protection in U.S., 1998-2004, Pooled OLS Estimates. The Table reports the results of OLS regressions for the variable *LnWeightedTariff* on indicators of relative wages and various control variables for U.S. from 1998 to 2004. The table reports the OLS coefficient estimates for each variable, their sector-clustered robust standard errors in parentheses. A constant term is included in each regression but not reported in the table.

in this data that increases in relative wages are associated with lower levels of trade protection in the United States during this period.

# 5 Conclusion

In this paper we have documented a new puzzle in international political economy. For a broad sample of countries, we showed that in the very large majority of cases it is unskilled-intensive industries that receive relatively high levels of trade protection. What is especially puzzling is that this pattern of protection holds even in low-income countries in which less-skilled labor is likely to be the relatively abundant factor of production and therefore would be expected in many standard political-economy frameworks to receive relatively low, not high, levels of protection.

We then offered an explanation of this puzzle: individual preferences that display inequity aversion. In such a world, a standard framework of trade policy results in trade barriers that tend to support industries that employ lower-earning, less-skilled workers more intensively. We also examined this model empirically, with econometric analysis of Chinese and U.S. trade protection.

| | F.E. Panel | | Dynamic Panel | |
|---|---|---|---|---|
| | **Model 5** | **Model 6** | **Model 7** | **Model 8** |
| $AverageWage$ | -0.020 | -0.022 | -0.031 | -0.030 |
| | (0.002) | (0.004) | (0.007) | (0.006) |
| $ZtoSigma$ | | -15.500 | | -18.100 |
| | | (5.850) | | (17.500) |
| $Establishments$ | | 0.054 | | 0.068 |
| | | (0.026) | | (0.029) |
| $Employees$ | | -0.491 | | -0.861 |
| | | (0.674) | | (0.548) |
| $LnWeightedTariff_{t-1}$ | | | 0.117 | 0.059 |
| | | | (0.052) | (0.062) |
| $LnWeightedTariff_{t-2}$ | | | 0.086 | |
| | | | (0.033) | |
| $LnWeightedTariff_{t-3}$ | | | -0.031 | |
| | | | (0.007) | |
| Observations | 656 | 540 | 440 | 432 |
| Sectors | 110 | 108 | 110 | 108 |
| Years | $5 \leq T \leq 6$ | $5 \leq T \leq 5$ | $4 \leq T \leq 4$ | $4 \leq T \leq 4$ |

Table 4: Average Wages and Trade Protection in United States, 1998-2004, Fixed Effect and Dynamic Panel Estimates.

Consistent with our model, we found that in both countries tariffs tend to be higher in lower-wage industries.

In future work, we plan to expand our empirical analysis in two directions. First and most importantly, we plan to conduct survey experiments to show that individual trade policy preferences are sensitive to the relative wages of the sector to be protected. Second, we will examine a much larger data set for many other countries and time periods, to see how general our initial results prove to be.

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