

# Protection and Real Wages

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*Wolfgang Stolper and Paul Samuelson (1941)*

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*No nation was ever ruined by trade*

Benjamin Franklin

*Under a system of perfectly free commerce, each country naturally devotes its capital and labor to such employments as are most beneficial to each... It is this principle which determines that wine shall be made in France and Portugal, that corn shall be grown in America and Poland, and that hardware and other goods shall be manufactured in England*

David Ricardo

*Since NAFTA was put in place, Mexico has lost 1.9 million jobs and most Mexicans' real wages have fallen.*

Stephen F. Lynch

## Introduction and literature review

It is generally thought that tariffs help protect local industry and create employment in the home country. If a country imposes a tariff on a particular product, the price that the local population will be charged for that product will be artificially high but this is beneficial for the local producers of that good as they avoid cheap competition from abroad. So, it is apparent that wages will diverge across countries as countries offer varying support to their industry through tariffs. Frank William Taussig said that free trade did not lead to equalization of money wages across countries as is generally believed. Real wages may be different too as prices, in classical theory differ only by the transportation costs between countries. Gottfried Haberler agreed with Taussig and said that only under perfect mobility of labor can there be such equalization, a condition not likely to be satisfied in the real world. He went on to say that because of this very immobility, the more important labor is in the protected industry, the more harm it will suffer in case of tariff removal.

This classic paper takes the opposite line of thought and talks about the possibility of an equalization of wages. The authors mention that while they were reviewing the literature, they didn't think it was possible to make definitive statements because previous works were full of possibilities and presumptions about the remunerations of the factors of production. The Stolper-Samuelson theorem is presented at the end as the main and definitive conclusion.

### **Assumptions**

- a. The total amounts of the factors of the production are fixed
- b. Total return to labor (capital) = Wage (interest) \* Quantity of labor (capital)
- c. Pure competition, homogeneity of factors of production, and perfect mobility of labor

The Heckscher-Ohlin theorem (regularly cited by the authors) says that a country will export those goods in which it has a comparative advantage. This in turn causes an incomplete tendency toward equalization of factor prices amongst the trading countries (ignoring transportation costs of course). Industries producing the goods that use up the

scarce factor will contract with trade and as this happens in both countries, the price ratios will tend to equalize. The long run effect of a removal of tariff on an industry will be to make it more competitive due to higher competition from abroad but there might be temporary suffering in the short term. The argument is that in the short term, a downturn will result in a reduction in money wages but because this is accompanied by an even bigger fall in prices, real wages actually increase. So in the long run, countries with a comparative advantage in a particular good will end up producing that good and the removal of tariffs doesn't harm the entire economy.

- $MP_L = f(L/K) \gg$  The marginal productivity of labor depends on labor/capital ratio and it stays the same after trade because factors would move between occupations.

#### Value marginal product:

VMP is the same in all occupations but it doesn't only depend on the L/K ratio. In a sense, the VMP can be considered to be a weighted average of the effective demands of the producible commodities and international trade shifts production in both countries as predicted by the Heckscher-Ohlin theorem.

It is interesting to note that not all labor classes are affected in the same way by free trade. Ohlin said that *'it is quite possible under certain circumstance for free trade to reduce the standard of living of the manufacturing labor class.'* So, the effect of removal of tariffs on a sub-group of labor depends on how important that sub-group is in the country and which commodity they are producing. Jacob Viner replied to this assertion by arguing that if labor was an important consumer of the protected product, even with the adverse effect due to low occupational mobility, the decrease in money wages will be recovered if there is a sufficient drop in prices of the protected product. That is, we would see a rise in real wages.

## Assumptions of the Analysis

1. Two commodities: Wheat A and Watches B
2. Two countries with identical production functions in each industry
  - Production functions are homogeneous of degree 1
  - $A = A(L_a, C_a)$  and  $B = B(L_b, C_b)$
  - A and B are known
3. Two factors of production: Labor L and Capital C
  - Total amounts of each factor of production remain the same regardless of trade

$$L_a + L_b = L$$

$$C_a + C_b = C$$

- We know the amount of labor and capital used in each industry as well as the marginal physical productivities of each factor
  - As usual in equilibrium  $MP_{La}/MP_{Ca} = MP_{Lb}/MP_{Cb}$
4. The ratio of commodity prices  $P_a/P_b$  is known
    - This ratio is particularly useful as it captures everything that happens in Country II as a result of trade that may affect our country. In essence, it lets us skip any in-depth analysis of country II.
    - Exploiting the change in  $P_a/P_b$  after trade also allows us to analyze the change in the shares of L and C
  5. Full employment of both factors before and after trade
  6. Perfect physical mobility of both factors
  7. Perfectly competitive markets

To understand what happens to the real wage when  $P_a/P_b$  changes we need a sense of what our agents like to consume. One way to attack this requires detailed knowledge of consumer preferences which is unavailable to us. Consequently, we make the simplifying assumption that we have a single wage good (which is later relaxed). In this case, the real

wage in terms of the wage good is an unambiguous indicator of real income. One approach to analyzing what happens once trade opens up requires analyzing the derivative of our equilibrium equations with respect to  $P_a/P_b$ . This would produce a sum of terms with ambiguous sign that no one at the time could resolve. Stolper and Samuelson, by adding a bit more information, resolve this ambiguity.

## Elimination of Index # Problem

Additional Assumptions:

- Small country- cannot affect terms of trade
- Removal of tariff will not kill off the industry that was protected- just contract it
- Homogenous labor so Value of  $MP_L$  in equilibrium, as well as the wage, must be the same in both industries
- Since we have a single wage good, looking at the  $MP_L$  in the wage good industry gives us the real wage ( $w$ ) in terms of the wage good. Additionally, since labor gets the same wage in both industries, any decrease in  $MP_L$  and real wages in the wage good industry means a decrease in  $MP_L$  and real wages in the other industry.
- Country I has a relative abundance in capital
- $L_A/C_A < L_B/C_B$  meaning wheat uses relatively more capital in its production process.

### Case 1: Wheat is the wage good

(Capital heavy, comparative advantage good- export good)

- Ohlin Analysis: Wheat production expands and is our export good since we have comparative advantage in capital intensive goods. Watch production contracts and is our import good.
- Both capital and labor will be let go from watch factories but they can't be employed the same way in wheat production since factors are used in different proportions in each industry.

- Keeping in mind all workers must be employed before and after trade, the new equilibrium will leave workers in both industries with less capital to work with. That is, in both wheat and watches,  $C/L$  has decreased.
- Focusing in on our wage good, the wage rate in wheat goes down and the redistribution of capital and labor means the real wage goes down as well.
- Incorrect: loss to worker above is solely due to this change in productivity and there is no additional loss to the worker due to the inevitable rise in the price of wheat.

**Case 2: Watches are the wage good**

(Labor heavy, NOT comparative advantage good- import good)

- Ohlin Analysis: Same as before since our comparative advantage has not changed. Wheat is still exported and both labor and capital move from watch to wheat production.
- Now, wheat will not simply absorb all of the redundant labor supply to meet the full employment condition. This explains why the labor left in the watch factories also have less capital to work with and the  $C/L$  ratio changes here as well. Exactly the same as before!
- Focusing in on our wage good we again see wage rates drop, the  $MP_L$  decreases, and the real wage goes down.

Since the real wage decreases in both cases we can now safely drop the assumption of the single wage good.

**Conclusion:** *Real wage of scarce good drops with International Trade*

## Diagrammatical Treatment

This section analyzes the discussion of the previous sections graphically. Figure 1 is a plot of the substitution curve between Watches (B) and Wheat (A) in our given country. Figure 1 is also known as the production possibilities frontier (PPF) of the economy, which may be a more recognizable terminology for some. Note that the smoothness of the PPF implies that producers are able to substitute between labor and capital to some extent. When this is not the case there will be a kink in the PPF.

Before international trade, we have a price ratio  $\left(\frac{PA}{PB}\right)_0$ . This initial price ratio is tangent to the PPF at point M, representing the most efficient point of production in the economy given  $\left(\frac{PA}{PB}\right)_0$ . When trade is introduced, the price ratio increases to  $\left(\frac{PA}{PB}\right)_1$ . The new efficient production point will be the point where the new price ratio is tangent to the PPF, at N.

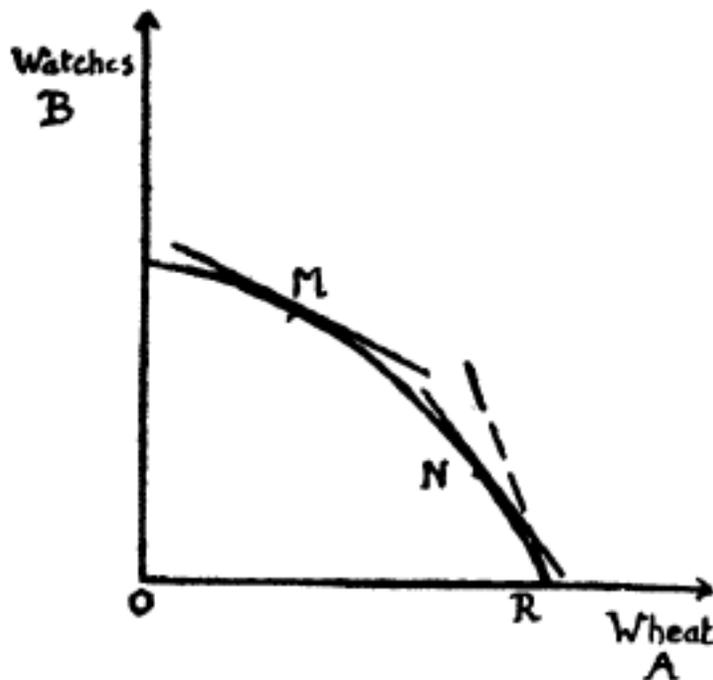
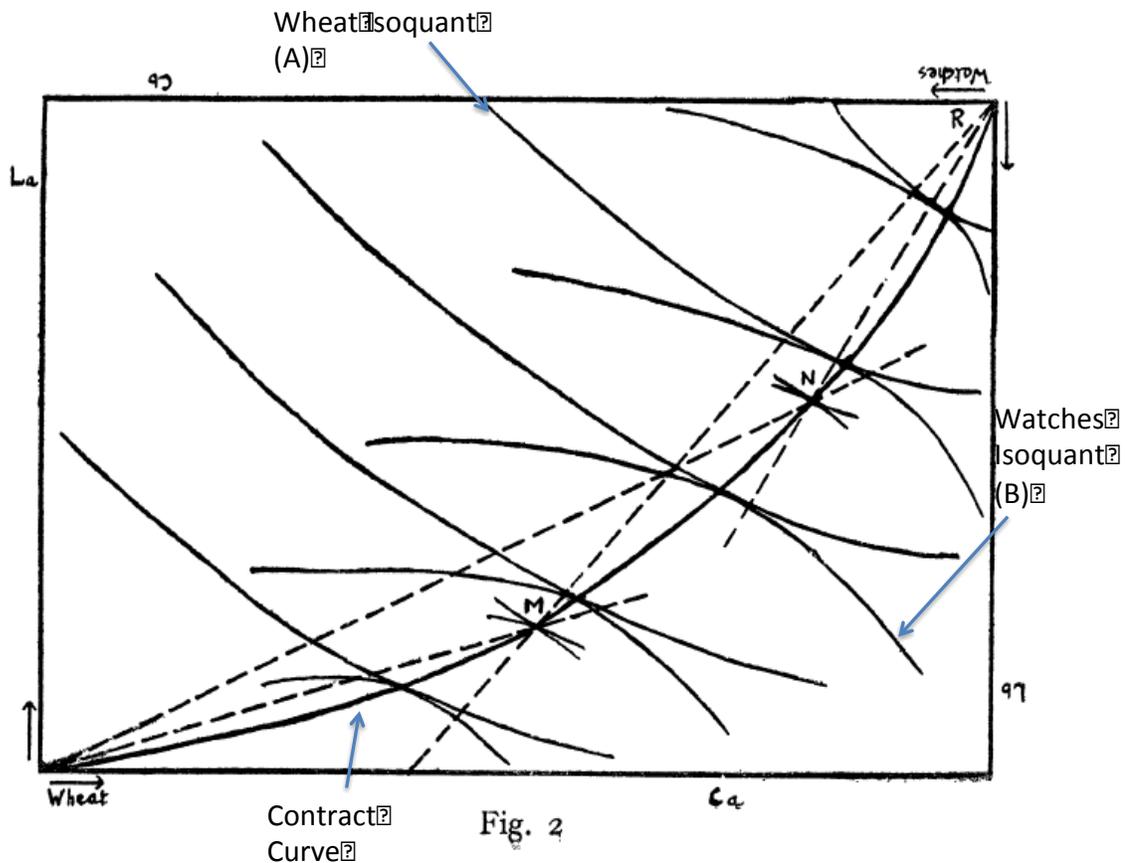


Fig. I

While figure 1 does generally represent how trade may reallocate production from one industry to another, but the authors are also analyzing factor movements between the two industries and the impact on real wage. Therefore, they choose to do a more detailed diagrammatical analysis in Figure 2.

Figure 2 is a Production Edgeworth Box for the domestic economy. The height and length of the box represent the total amount of labor and capital in the economy, respectively.



Some things to note about Figure 2

- Lower horizontal axis indicates the amount of capital used in wheat production (A)
- Left hand vertical axis represents the amount of labor used in wheat production (A)
- Factors not employed in wheat (A) must be employed in watches: Upper horizontal axis reading from right to left gives the amount of capital in watches (B), and the right hand vertical axis reading downwards denotes the amount of labor used in watches (B).

- The dimensions of the box will not change given fixed amount of labor and capital in the economy.
- The dotted rays originating in the bottom left corner represent the capital L/K ratio used in at production points the line intersects.

The labeled contract curve corresponds to the locus of optimal production positions. The assumption of homogenous production functions gives the contract curve this particular shape. On the contract curve, M and N are labeled and correspond to the scenario depicted in figure 1. In moving to point N (free trade) to M (restricted trade), we can see that even though the proportion of total capital to labor is the same, restricting trade raises the proportion of capital to labor in each industry. Although it may seem impossible that the C/L can rise in both industries yet remain the same overall, the authors explain it is possible given that overall C/L is a weighted mean. That is, it is defined by the identity:

$$\frac{L_a C_a}{L L_a} + \frac{L_b C_b}{L L_b} = \frac{C}{L}$$

where the weights are the proportions of total labor supply used in an industry. The restriction of trade will raise the proportion of capital to labor in each industry, but at the same time, the capital intensive industry will receive less weight because of the movement of labor out of that industry. This is the reverse of the argument for what happens when trade is introduced into a previously restricted economy.

Given that the diagram shows restricting trade increases C/L, the authors argue that the real wage in terms of each good must increase regardless of the movement of good prices. Within each industry, the increase in C/L will increase the marginal productivity of labor expressed in terms of physical units of the good produced. Because we argued real wages will be equal across industries, the real wage in terms of any good has increased. This means that, unambiguously, real income has increased.

To summarize the section: Under the assumptions of (a) two commodities (b) two factors of production (c) trade doesn't completely eliminate the harmed industry, the scarce factor of production is unambiguously harmed by trade.

### Three or More Commodities

In order for the result of the previous sections to be meaningful, it should be equally valid with the introduction of any number commodities into the model. The authors choose to examine the validity without indexing the goods, citing it is not necessary. Instead one should realize that introducing trade increases the production of goods using relative large amounts of the abundant factor and lowers the production of goods using relative small amounts of the abundant factor. This will be accompanied by a Heckscher-Ohlin movement towards equalization of factor prices in the two countries, meaning the price of the scarce factor falling relative to that of the abundant factor.

This effect alone does not give the absolute moments in factor prices, but it is nevertheless true that the introduction of trade will harm the scarce factor of production absolutely. To show this is true, recall that a fall in  $w/r$  will lead to relative substitution of labor for capital in each industry. By the same logic as in the two good case, the marginal physical product of labor will be lower in each industry, which means that, by wage equalization, the real wage of workers in terms of any commodity will be lower. So, without indexing or reference to the terms of trade, we determine that the scarce factor of production, labor, is harmed absolutely in this case.

## The Case of Complete Specialization

Thus far we have exploited the relationship between real wages in terms of a given good and the  $MP_L$  of workers producing the good. We can do this for any commodity because we assumed trade does not eliminate any of our industries. We now drop this assumption and apply our argument again. This will show that the classical argument was not so much incorrect as it was limited in scope.

### **Case 1: Costs are not constant**

- We start by assuming we do not have a single wage good i.e. something of both goods is consumed. When trade opens up we see expansion in one industry and contraction in another as before. Likewise, we see the real wage decrease and the position of labor worsen until we reach the critical point R in figure 1. At this point,  $P_a/P_b$  is such that it is no longer worth producing the scarce factor intensive good and its production ceases.
- In terms of the commodity still in production, we determine the real wage as usual by observing the  $MP_L$ . Before we get to R we see the  $MP_L$  decline (remember labor is our scarce factor). However, once we get to R the  $MP_L$  remains unchanged since all our labor is employed and we assumed C in our economy is unchanged.
- In terms of the non produced commodity, we cannot determine the real wage after R by observing the  $MP_L$  because there are no workers in this industry. Thus we have to revert to looking at prices and make use of  $P_a/P_b$ . Beyond R the real wage in terms of the non produced good begins to rise and we compare this to the loss in the real wage prior to specialization. The result of this comparison is ambiguous with the information we have and will depend on the technological and economic features of the trading countries.
- Suppose we somehow knew that the real wage in terms of the non produced good had increased. We would still need to compare this net increase in real wages in the imported good to the loss in real wages in the exported good (since we consume both goods). We may need to reintroduce the index number comparison to resolve the remaining ambiguity.

**Conclusion:** *We have no definitive conclusions on the net change in real wages in the case of complete specialization with non constant costs.*

### **Case 2:** Costs are constant

- Going back to the classical case, with a single factor of production or the same factor ratio assumed in all production, there is no ambiguity after R. Constant costs mean complete specialization if  $P_a/P_b$  changes even in the slightest. Factors don't shift around as in case 1 so our C/L ratio is preserved, leaving real wages unharmed in terms of either good. In terms of the imported good we see that not only are real wages unharmed but they are improved. Consequently, real income increases as well since in the classical case the proportion of income going to the respective factors is fixed and cannot be changed by trade.

**Conclusion:** *With constant costs real wages rise definitively*

### More than 2 factors of production

Heckscher-Ohlin theorem loses its definiteness (and in some cases doesn't hold) if

- 1) Several factors of production are introduced. In this case it becomes hard to compare factor ratios and the scarce and abundant factors cannot be easily identified.
- 2) Cost of production is constant. This means that specialization can't reduce the cost of production and there is no advantage to any country to specialize.
- 3) Production functions in the two countries are different. Here, specialization depends on the efficiency of technology and not factor abundance
- 4) Production factors are different and non-comparable

However, Stolper-Samuelson theorem won't lose its definiteness and will still hold provided the country has only two factors of production. That is, even in cases where the

two countries have incomparable factors of production and different production functions, international trade will move a factors real wage in the same direction as its relative remuneration. For example, even if production functions are different in countries, the prices of import and export goods are affected in a certain ratio that results in expansion of industry, which uses the relatively abundant factor of production and a contraction of the industry using the scare factor. Adding three or more factors in a single country would complicate the analysis and leave us with unresolved ambiguity. There are a number of different complementarities and competitive scenarios that arise making it difficult to make definitive conclusions in changes in the marginal productivities.

## Conclusion

When a country moves from restricted trade to free trade, the factor that is relatively scarce is going to experience loss in earnings while the abundant factor will benefit. So if country is scarce in labor real wages fall with trade. One might think that the Stolper-Samuelson theorem provides a solid base for protectionism but this argument can be countered with appropriate redistribution to ensure that trade benefits all the factors of production in the economy.