INFLUENCE OF PROTECTIONISM AND TRADE LIBERALIZATION ON RETURNS TO FACTORS OF PRODUCTION IN UKRAINE

by

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ABSTRACT

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The Stolper-Samuelson Theorem predicts that more open foreign trade will increase product prices and returns to factors which are intensively used in the production of these goods. Therefore, it implies distributional effects when trade is liberalized. Applying the long-run "zero-profit" conditions to the data for the manufacturing industries, I investigate whether the predictions of the Stolper-Samuelson Theorem hold in Ukraine and try to anticipate possible implications of Ukraine's accession into the WTO. As a result, I find that non-tariff barriers have a positive effect on product prices and lead to an increase of returns to capital and a decrease in wages, suggesting that capital is a scarce factor and labor is an abundant factor. In this case it is possible that the income of workers will rise if trade is liberalized. In addition, the small magnitudes of the estimated factor price changes suggest that the distributional effects of non-tariff protection are small, suggesting that current protectionist policies do not have large impact on income distribution. The results of the analysis of non-tariff protection are confirmed by further results that higher trade openness leads to the decrease in returns to capital and to the increase in wages. Again, while the distributional effects are statistically significant, they are not expected to be large.

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GLOSSARY

Abundant factor – a resource of which a country has relatively large supply; country A is labor abundant if the ratio of labor to capital in country A is higher than in country B

Derzhkomstat – the State Committee of Statistics of Ukraine

Factor intensity – describes the technology of production and is the intensity with which different factors are used in the production of a good and is defined as the ratio of one factor used in the production to the other factor

Internal prices - prices at which goods are traded in the domestic market of a country

Non-tariff barriers – foreign trade policy measures of protection from foreign competition such as import quotas, export restraints, technical and sanitarian requirements

Protection – foreign trade policy aimed to shield domestic industries from foreign competition by restricting or hindering the imports or by subsidizing exports

Scarce factor – a resource of which a country has relatively small supply; capital is a scarce factor in country A if the ratio of capital to labor is lower in country A than country B

Tariff barriers – taxes levied on import, usually with the purpose of income redistribution, for the promotion of industries thought to be crucial to the economy or for the balance of payments considerations

Trade liberalization – foreign trade policy of lowering or eliminating tariff and non-tariff barriers to trade; is opposite to the protectionist policy

Chapter 1

INTRODUCTION

Increased international trade as a result of trade liberalization has raised the question of the extent to which it affected factor markets and especially factor earnings by changing the relative prices of traded goods.

During the last decades world trade has increased substantially and, at the same time, has become more open due to the reduction and elimination of trade barriers both unilaterally and within the framework of international organizations. These processes of globalization have raised concerns about the impact of increased trade on national economies and especially labor markets of countries undergoing trade liberalization. Since many developing countries and virtually all developed countries have experienced increasing inequality of earnings for the same period, some policy makers started wondering whether international trade and increased openness contributed to wage inequality among individuals with different skills and between workers and owners of capital. These concerns have induced researchers to revisit the postulates and predictions of standard trade theory, particularly the Stolper-Samuelson Theorem (SS) developed by Stolper and Samuelson in 1941. The SS theorem predicts that increased trade and lower protection lead to an increase in price of the abundant factor of production because of the increase in the price of a good, which extensively uses this factor. As a result, unskilled labor in developed countries considers competition from unskilled labor of developing countries as the source of the decline in their earnings. Unskilled workers in developing countries, however, often claim against trade liberalization since it has failed to increase their wages and make them converge to the wages of skilled workers. Nevertheless, the problem is not specific only to open economies, but also to those liberalizing their trade regimes and searching for a trade policy that could benefit domestic market without imposing substantial harm on internal labor market. That is why a research on this topic could be important for transition economies, which liberalize their foreign trade and are concerned with distributional consequences of trade liberalization.

For Ukraine, one of the reasons of its slow integration into the World Trade Organization (WTO) is that it has not sufficiently liberalized its trade in products, though the tariffs on many services have already been decreased to the levels indicated in the agreements of WTO. Sluggish liberalization of trade of some goods is frequently induced by the lobbying of producers and the owners of factors of production specific to import-competing sector for protection from foreign competition. The resistance to trade liberalization is due to negative short-run effects of increased trade openness. These effects are expressed in increased unemployment in import-competing sectors and the decrease in earnings of labor (or capital) intensively used in the import-competing production. Therefore, an investigation of the relation between foreign trade, wages and the return to capital in Ukraine during the years of independence, and predictions about the possible linkages in future, could give policymakers an insight on how they should shape trade policy and adjust the level of protection on Ukraine's way to the World Trade Organization.

Chapter 2

THEORETICAL FRAMEWORK

The theory that relates factor price changes to product price changes is the ***Stolper-Samuelson Theorem (SS)***, which states that an increase in the price of a good leads to the more than proportional increase in the price of a factor extensively used in the production of this good and to the decline in prices of other factors. Stolper-Samuelson Theorem stems from the ***Heckscher-Ohlin Theory (H-O)*** of labor demand and the ***Theorem of factor-price equalization (H-O-S)***. H-O theory states that a country will tend to specialize and export the goods, whose production is intensive in a factor that is relatively abundant in this country. In the absence of foreign trade the price of the abundant factor is low since its supply is large. After trade liberalization the demand for a good, in which a country specializes will increase, raising the demand for the specific to this production factor. As a result, the price of the abundant factor of production increases. Therefore, H-O theory identifies the conditions for labor demand and H-O-S theorem those for changes in factor prices.

The underlying hypothesis of these theorems is that factor prices are determined by the demand for labor rather than by the supply. By H-O-S Theorem, if prices are fixed, the change in the supply of factors leads only to the change in output. So factor prices may only be affected by changes in product prices. Simultaneously, labor demand may be affected directly by changes in technology or by factor prices or indirectly by changes in the demand for products, which will change relative prices of goods. Therefore, the Stopler-Samuelson Theorem focuses on impact of relative price changes on factor prices.

The Stolper-Samuelson theorem was developed under the *assumptions* of:

1. Perfect competition;
2. Two goods and factors of production (2 x 2) economy;
3. Constant returns to scale;
4. Factors mobile between sectors and immobile internationally, so that there is a fixed factor supply in the economy;
5. Small open economy, which cannot influence world prices.

The relationship between product prices and factor prices is determined by the "zero-profit" condition. According to the underlying assumption of perfectly competitive markets, the "zero-profit" condition assures that in the long-run price is equal to average cost of producing an extra unit of output. For the entire economy with *N* goods and *M* factors of production employed this "zero-profit" condition can be written as:

$$\mathbf{P} = \mathbf{C(W)}$$

where **C (W)** is the cost of a unit of output and **p** is the price of a unit of good sold.

The marginal (or average) cost function is equal:

$$C\,\mathbf{(W)} = \mathbf{A} * \mathbf{W},$$

where **C (W)** is the function of unit costs, which depends on the costs of factors of production and inputs W; **W** is (Mx1) the vector of factor costs; **A** is technology matrix, **A** is (N x M), where each element a_{ij} of **A** is the amount of factor i required for the production of one unit of product j. The resulting "zero-profit" condition is:

$$\mathbf{P = A * W},$$

where **P** is the vector of domestic product prices, **P** is (N x 1); **W** is the vector of **M** domestic factor prices, **W** is (M x 1); A is the technology matrix. In terms of percentage changes the equation can be written as:

$$\hat{P} = \theta \times \hat{W}$$

Where $\hat{P}$ is the vector of product price changes, $\hat{P}$ is (N x 1); $\hat{W}$ is the vector of factor price changes, $\hat{W}$ is (M x 1); θ is the cost share matrix, in which each element θ_{ij} is the share of factor i in the average cost of production of one unit of good j.

In the two-good, two-factor of production (2 x 2) economy the A (or θ) is square and invertible matrix and thus can derive the direct relationship between changes in product prices and changes in factor prices.

However, the real world is multidimensional and it would be difficult to predict the price of which factor changes due to a given change in a product price. Therefore, as Slaughter (1998) argues, only the correlation version of the SS Theorem may be applied to the analysis. The *correlation version* was suggested by Deardorff (1994) and states that the vector of factor price changes will be positively correlated with the vector of product price changes, where these price changes are weighted by each factor-intensity of production, that is

$$\text{Cor}\,(\hat{P}\ , \theta \text{ x } \hat{W}\ ) > 0$$

Therefore, the relationship between product prices and factor prices is determined by the production theory. The impact of external forces such as international trade comes through their influence on product prices. Under the assumption of a small open economy the impact may already be embodied in product prices, since world prices are domestic prices and changes in domestic prices reflect changes in world prices. However, domestic prices do not always equal world prices due to transportation costs, trade restrictions, price rigidities and the power of certain institutions. Therefore, the impact of trade on product prices should first be considered separately, and then these effects should be decomposed according to their influence on factor prices.

C h a p t e r 3

LITERATURE REVIEW

Before 1990's there was relatively little empirical research on the application of the *Stolper-Samuelson (SS)* theorem of international trade. The surge in empirical studies on existence of Stolper-Samuelson effects was prompted by the rising wage inequality in the USA in 1990-s and increased concern of US policy-makers about the negative impact of trade with developing countries on wages of unskilled labor in the USA.

There are two main streams of empirical research on effects of Stolper-Samuelson Theorem. The first approach is the *"consistency checks"* and the second is the *"mandated wage"* analysis. The studies, which use the first approach mainly consider the impact of international trade on product prices and wages. While the authors of the *"mandated wage"* approach link changes in factor prices to changes in product-prices, as the SS theory predicts, and speculate on the extend that international trade and technological progress each contribute to product price and factor price changes.

Deardorff (1994) discusses theoretical aspects of SS Theory. In his work he presents six versions of SS theory, which differ by such factors as dimensionality of the economy and the presence of effects of international trade. The author reveals that the link between product-prices and factor prices proposed by SS Theorem works through the "zero-profit" condition that should hold in competitive markets to equalize product price with average costs. Given the "zero-profit" condition he introduces a core question of future empirical research and disagreement, mainly of how to distinguish the share of product-price changes that is influenced by international trade. According to the author, the problem is that international trade is endogenous and is influenced by factors that simultaneously affect product-prices. Therefore, there are caveats in using trade flows directly in studies of product-price changes.

There are several main empirical product-price studies that investigated the presence of the effects proposed by SS Theorem. Studies of Bhagwati (1991), Slaughter and Lawrence (1993), Sachs and Shatz (1994) use *"consistency checks"* approach, while Leamer (1996), Krueger (1997), Feenstra and Hanson (1995, 1996, 1999, 2001), Baldwin and Cain (1997), Harrigan and Balaban (1997) follow the *"mandated wage"* approach.

Bhagwati (1991) was the first researcher to consider international trade as the cause of wage inequality in the USA. He argues that because import prices rose more quickly than export prices in the USA in the period 1982-1989, and assuming the US production for export is more skilled-labor intensive, following SS theorem wages of skilled labor should have been lower than those of unskilled, which contradicts the evidence. As a result, he concludes that SS does not hold.

Slaughter and Lawrence (1993), assuming that prices of tradable goods are world prices, consider only the effect of international trade on export, import and domestic prices in 70 US industries in 1980-1989. They find a negative relationship between product price changes and relative employment of non-production to production labor and, thus, come to the conclusion that international trade was not the cause of rising wage inequality in the USA by rising relative prices of skill-intensive goods.

At the same time, by expanding the sample and modifying the analysis of skill composition of labor*, Sachs and Shatz (1994*) confirm the existence of SS effects. They estimate the influence of ratio of production employment to total industry employment on import and domestic prices for 1978-1989 in the USA and find that industries with larger share of production workers had lower relative price increases in 1980-s. Therefore, they conclude that international trade contributed to rising wage inequality through rising relative prices of skilled labor intensive goods, which are deemed to be the exporting goods.

As a result, the conclusions of the "consistency checks" approach are not unanimous. However, they may not be accepted as absolute checks of SS Theorem as they have been criticized by many researchers for the limitations of "consistency checking" approach as a whole. First of all, the studies assume that the USA is a small economy and fail to account for the power of US product prices to influence world prices. In addition, they do not control for internal factors, such as technological progress, that affect prices, and therefore directly link the changes in product prices to skill composition of workers. This assumption leads to the second limitation that the studies do not explicitly show how the product price changes are tightened to factor price changes.

The limitation of the studies of "consistency checks" were tackled by a number of researchers who imposed direct linkage between factor prices and wages through the "mandated wage" approach. In this approach the researchers directly relate product prices to factor-cost shares and factor prices through the zero-profit equation:

$$\boldsymbol{P = \theta * W,}$$

Where $\boldsymbol{P}$- is the vector of product prices, $\boldsymbol{\theta}$ – factor shares in total costs, $\boldsymbol{W}$ – vector of estimated coefficients, called "mandated wages". $\boldsymbol{W}$- coefficients show the changes in wages mandated by the changes in product prices. Then, they compare the estimated "mandated wages" (W *coefficients)* with the actual wages and if they equal, they conclude that SS theorem holds.

Feenstra and Hanson (1995,1996, 1999, 2001) (F&H) drop the assumption that US prices reflect international prices and additionally analyze the contribution of imports of intermediate inputs (outsourcing), which takes most part of international trade, to the increased demand for more skilled labor and to wage inequality in the USA.

According to *Feenstra & Hanson (2001)* trade in intermediates affects not only wages and employment in import competing sectors but also in industries using imported inputs and, therefore, has an effect comparable to skill-biased technological change. Since firms in developed countries will transfer less skill intensive activities to less developed countries outsourcing will lead to the increased demand for skilled labor in developed countries. Thus import and domestic prices should be compared not between industries, but within each industry, and if import prices of inputs increase less rapidly than domestic prices of final goods, these imports is the source of increase wage inequality.

Applying short-run cost function, F&H show that two main forces may lead to increased wage inequality. A decrease in prices of imported intermediates and outflow of capital will both lead to the decrease in wages of unskilled labor. In their empirical investigation for 447 US manufacturing industries in 1972-1979 and 1979-1990 *Feenstra and Hanson (1996)* find that outsourcing explains 31- 51% of increase in the share of non-production workers wage, while share of imports of final goods accounts for 17-29% of the change. When in *Feenstra and Hanson (2001*) other structural variables, such as share of expenditures on computers, are added to the regression, the share of outsourcing has the greatest impact on change in non-production wage share (15-24% vs. 12% for computer expenditures).

Therefore, their empirical analysis confirms their hypothesis that outsourcing from the USA leads to higher demand and wages for skilled labor and thus provides the results for the effects of SS Theorem.

As an implication for developing countries, an important result of *Feenstra and Hanson (1996)* investigation of outsourcing is that it also leads to skill upgrading and rise in inequality of wages in less developed countries to which less skill-intensive activities are transferred by firms from developed countries. Therefore, if before outsourcing developing countries specialized in low-skill activities, they are specializing in the least skill-intensive activities in the presence of outsourcing from the developed countries.

In their work (1999) Feenstra and Hanson use the two-stage approach to the analysis of the presence of Stolper-Samuelson Theorem. They first estimate the influence of the changes in such exogenous variables as outsourcing and high-technology capital on product prices and productivity in US industries. At the second stage they use the decomposed changes in product prices due to the changes in the structural variables form the first step to estimate the corresponding changes in factor prices. Using this techniques F&H find that about 15% of the increase in non-production wage can be attributed to foreign outsourcing and about 13% to computer expenditures.

In line with other researchers who follow the "mandated wage" approach, *Leamer (1996)* uses the zero-profit condition and incorporates the impact of technological change, measured as change in total factor productivity (TFP) and "globalization" on relative prices, thus extending the list of factors that influence product and factor prices. He uses the following set of equations:

$(1-\lambda)\ TFP = \theta^*\beta + e$ for effect of technological change on wages, where λ is the rate of technological pass-through to product prices

$P + \lambda * TFP = \theta * w + \gamma * p + e$ for the effect of "globalization, where P is the vector of changes in product prices, TFP is the total factor productivity and θ is the vector of factor cost shares, w – are the changes in wages; γ is the vector of cost shares of inputs into production.

As a result of estimation, Leamer interprets the "pass-through" rates from TFP and globalization on prices as the "mandated" factor-price changes to keep the zero-profit condition. In "mandated" wage approach these estimated wage shares are then compared to actual shares in the economy and the hypothesis about impact of technological change and trade is tested. Using a different definition of skills and including capital as a factor of production, different "pass-through" rates from TFP and different time periods, Leamer concludes that in 1970-s the Stolper-Samuelson Theorem held, that is product-price changes were rising wage inequality, while in other periods the results do not support the presence of effects of SS Theorem. He also shows that the effect of "globalization" on product and factor prices is stronger than the technological effect.

Baldwin and Cain (1997) use a set of zero-profit equations to estimate the "mandated" wage changes, but instead of incorporating TFP explicitly, they make conclusions about the biases in estimated parameters from the omission of TFP from the general equilibrium model. In their econometric model they follow Leamer and extend pervious analysis by expanding the time period, including all the industries, not just manufacturing and using educational data as skill measure. In addition, they include capital to factors of production and control for intermediate inputs in zero-profit equation. The authors argue that in 1968-1973 there was a decline in wage inequality due to the expansion of skilled workers relative to unskilled and due to the resulting expansion of skill-intensive production. For the period 1979-1991 they find the rise in wages and explain it by skill-biased technological change and resulting shift towards skilled-labor intensive products.

Krueger (1997) was the first to integrate both the "consistency checks" and the "mandated wage" approaches and to analyze the sample of US manufacturing industries in 1990s. He combines the methodology of estimating changes in product prices as a function of factors employed, developed by Lawrence and Laughter (1993) and Sachs and Shatz (1994), and the methodology used by Leamer (1996) and Baldwin and Cain (1997). He, therefore, estimates two equations:

$$(K\text{-}1)\ P = a + \beta\ (PW/(PW + NPW)) + \beta\ D_{comp} + e$$

$$(K\text{-}2)\ P = a + \theta\ \beta + e,$$

where P are product prices, $PW/(PW + NPW)$ is the ratio of wages of production workers (standing for unskilled labor) to the value of total wages, D_{comp} is the dummy for the computer industry, θ – represents factor-cost shares.

In addition to factor-cost shares, he also accounts for shares of intermediates, different labor skills, capital and materials in costs. Using different measurement for labor skills, Krueger finds a positive impact of an increasing share of skilled labor on product prices and on rising "mandated" wage inequality. As the results suggest, Krueger's analysis supports the predictions of Stolper –Samuelson Theorem.

In contrast to all previously discussed studies, which take a micro or regional approach, *Harrigan and Balaban (1997) (H&B)* develop a macroeconomic model of "mandated wage" equations. In their empirical model they analyze how economy-wide wage is influenced by technology, relative factor supplies and relative product prices. The effect of international trade comes through its effect on relative prices. To control for endogenity of prices and technologies Harrigan and Balaban use foreign competition as instrumental variable in their equations. They divide all countries into four quartiles: poor, low-income, middle income and rich and construct the measure of the presence of labor of each group of countries in international market as a share of low-wage labor in the trade to GDP ratio.

As a result of their analysis *Harrigan and Balaban* conclude that unskilled and skilled workers benefit from the increased supply of the other group of workers and that capital accumulation is the main cause of increasing wage inequality. The conclusions about the presence of the Stolper-Samuelson effects is mixed. As the authors find, increases in prices of tradable goods, which intensively use unskilled labor lead to the increase in wages of skilled workers contradicting SS Theorem. Simultaneously, technological progress and increased supply of labor from low and middle-income countries lead to increases in real wages of more skilled workers and thus to the increases in wage inequality.

The main limitation of the "mandated wages" studies is that they do not specify the share of changes in domestic prices that is due to changes in some exogenous factors of international trade, since international trade itself is endogenous to other factors, such as differences in preferences among the countries and the level of trade protection.

To avoid the limitation of "mandated wage" approach *Slaughter and Haskel (2000)* investigate the change in prices due to changes in US tariffs and transportation costs and how these changes in prices in turn affect factor prices. In their empirical analysis they use the data for all US manufacturing categories for 1974-1988. The empirical evidence suggests that in 1970-s and 1980-s cuts in tariffs and transportation costs mainly took place in industries extensively using unskilled labor, leading to the decrease in prices of low skill-intensive goods and thus should have contributed to rising wage inequality in the USA. In their estimation Slaughter and Haskel apply two-stage approach, developed by Feenstra and Hanson (1999), by, first, estimating changes in prices due to changes in trade barriers, TFP, exchange rate, share of the industry in the world output of that industry and other measures of US power in external market. At the second stage they use coefficients for trade barriers from the first stage and estimate them as a function of factor cost shares. In this way they get mandated wage changes that are influenced by trade barriers through their affect on product prices. Slaughter and Haskel came to the conclusion that trade barriers have positive, but insignificant effect on product prices. Therefore, the authors conclude that lowering tariff barriers did not lead to significant rise in wage inequality and, therefore, did not confirm the effects of SS Theorem.

In 1990-s the number of investigations of persistence of Stolper-Samuelson effect increased in developing countries. The motivation for investigations of developing countries is the increased openness and foreign trade liberalization in developing countries and the accession of some of them into the World Trade Organization and other integration groups. The research for developing countries follows the same methodology as for developed countries, but mostly concentrates on analyzing the impact of trade barriers on product prices, employment and wages in developing countries.

Revenga (1995) discusses the impact of trade liberalization on employment and wages in Mexican manufacturing in 1985-1987 and the distribution of benefits from trade liberalization among workers of different skills. She analyzed 2354 manufacturing plants in Mexico for the period 1984-1990, divided into three industry categories according to the level of initial protection (high, medium and low initial protection). She found that a decrease in import restrictions, either tariff or non-tariff barriers, decreases employment. Whereas, a decrease in licensing of intermediate inputs, on the contrary, increases employment. The results are reversed for real wages: a reduction in tariffs and licenses on both output and inputs leads to real wage increases. Revenga explains this relation by increases in labor productivity and change in skill composition of employment due to trade liberalization, since less productive workers are laid off and workers with higher productivity benefit form higher wages.

A positive impact of a reduction in tariffs on real wages suggests that skill composition between industries may change as a result of liberalization. When workers are divided between production and non-production as an approximation for unskilled and skilled labor, the results reveal that employment of production workers as well as their real wages are more sensitive to changes in protection than that of non-production workers, with stronger effect in the industries with greater reforms. Another important result is that reduction in license coverage of input imports increases wages of non-production workers, showing that imported inputs may bring new technologies and lead to increased productivity of production workers.

Therefore, the results of studies by Revenga confirm the fact that international trade influenced wages, that is Stolper-Samuelson Theorem worked in Mexican manufacturing during liberalization in 1985-1987.

The existence of SS effects for Mexican industries during trade liberalization were also investigated by Robertson. *Robertson (2001)* applies both the "consistency checks" and the "mandated wage" approaches to Mexico's data in two periods of liberalization: before accession to GATT in 1986 and before accession to NAFTA in 1994. Robertson finds out that before 1986 prices of skilled-labor intensive goods rose relative to prices of unskilled labor-intensive goods. Whereas prior to accession to NAFTA prices of skill-intensive goods fall due to exposition to competition from USA and Canada, which are more abundant in skilled labor. Estimating the responsiveness of wages to changes in prices from the "mandated wage" equation, Robertson comes to the conclusion consistent with SS Theorem, that the estimated change in wages of non-production workers is positive and that of production workers is negative before accession to GATT, suggesting the rise in wage inequality. However, the results reverse for the period in which Mexico entered NAFTA. Therefore, Robertson finds affirmation for the SS Theorem, showing that Mexico is skill-abundant relative to the rest to the world and unskilled labor-abundant relative to the USA. That is why wage inequality increased in Mexico before GATT and declined before accession to NAFTA.

Goldberg and Pavcnic (2001) (G&P) in their research analyze how trade liberalization in Colombia in 1985-1994 influenced relative wages, measured by industry wage premiums. Controlling for workers' characteristics, they analyze variation in wages among different industries. Using household survey data for 1984-1998 they first decompose the variation in wages on those explained by such characteristics as gender, education, age, dummy for formality of employment and a dummy for industry and then use the estimated coefficient of industry dummy as industry wage premium. In the second stage, G&P analyze the effect of tariffs and a set of industry characteristics on industry wage premium. They find that in industries, which are more protected by tariffs, workers receive lower wages. Therefore, generally, Goldberg and Pavcnic find evidence in support for Stolper-Samuelson effects in Colombian industries.

Therefore, the results for the developing countries are supportive for the impact of foreign trade and trade liberalization on wages. Nevertheless, regarding the results from the existing literature, it would be sensible to take into account factors specific to particular industries and countries in analyzing the presence of SS effects, since the results may change dramatically. For instance, as the results of Goldberg and Pavnic research show, controlling for such industry indicators as capital intensity, concentration indices, as well as such macroeconomic factors as business cycles and the power of unions reverses the effect of trade liberalization on wages.

Chapter 4

METHODOLOGY AND DATA

Model specification

In my research I intend to estimate the presence of Stolper-Samuelson effects in Ukrainian manufacturing industries by using two approaches.

First, the "mandated wage" approach, used by Leamer (1996), Baldwin and Cain (1997) and Harrigan and Balaban (1997) will be applied to predict changes in wages due to changes in product prices. That is the regression of changes in product prices on factor cost shares will be estimated. The estimated equation is:

$$\Delta p_{it} = \theta_{l,t} * \Delta w_{l,t} + \theta_{k,t} * \Delta w_{k,t} + e_{it} ,$$

where Δp_{it} is the change in Producer Price Index in industry *i* in time *t*, expressed as the percentage difference between the price level in time *t* and *t-1* ; θ_l, θ_k are cost shares of labor and capital in total production costs in industry *i* at time *t*; Δw_l is "mandated" change in the average wage in the whole manufacturing, Δw_k - is the "mandated" change in the average cost of capital in the whole manufacturing; e_{it} is the random error term. Δw_l , Δw_k are the changes in factor costs that are mandated to restore the zero-profit condition in an industry when prices change. These mandated changes are then to be compared with actual changes of factor costs. If the estimated changes predict well the actual changes in wages and cost of capital, the methodology performs well and the Stolper-Samuelson effect are present in manufacturing industries in Ukraine.

Most studies distinguish between skilled and unskilled labor in their analysis. However, the data that distinguishes between skilled and unskilled labor are available only for several industries in Ukraine, what limits the possibility of making an analysis of wages of these two groups of workers.

To capture the impact of foreign trade and other structural variables product prices are to be endogenized. At this stage the two-stage approach used by *Feenstra and Hanson (1999)* and *Slaughter and Haskel (2000)* will be applied.

By this approach prices are considered as endogenous and the impact of structural variables on industry price indexes is analyzed. These structural variables will include: Index of Non-Tariff Barriers (INTB), import penetration ratio, change in the average annual hryvnia/dollar exchange rate, variables that control for non-competitive structure of some industries and the existence of state regulation of prices of the products of an industry. The estimation equation for the first stage, which I denote as the "structural" equation, looks like:

$$\Delta p_{it} = \beta * z + v_{it}, \qquad \text{where}$$

z is the matrix of structural variables, some of which vary by industry and time (import penetration ratio) while others vary just by time (exchange rate) or just by industry; Δp_i is the change in Producer Price Index in industry i in time t relative to the Producer Price Index in t-1.

At the second stage $\beta * z_{it}$, where β is the estimated coefficient from the above equation and z_{it} is the value of a structural variable in industry i in time t, are taken as a set of dependent variables and regressed on cost shares of labor and capital in the total production costs, estimating a separate regression for each structural variable independently: The estimated equations are:

$$\beta * z_{it} = \theta_l \Delta w_l + \theta_k * \Delta w_k, \quad \text{where}$$

θ_l, θ_k are cost shares of labor and capital in total production costs in an industry respectively; Δw_l and Δw_k are the estimated coefficients, which are interpreted as shares of changes in factor prices explained by the change in structural variables included in z through their influence on product prices. Such decomposition allows to check whether Stolper-Samuelson Theorem holds, that is if the change in product prices induced by the structural variable, pertaining to foreign trade, influence wages and cost of capital.

Both models will be estimated by using panel data techniques, discriminating between fixed and random effects models and pooled OLS model, depending on the results of the Hausman and Breusch and Pagan Lagrange multiplier tests.

Data description

The data for the estimation of the models for both approaches consists of the series of Producer Price Indexes (PPI) in each industry; total costs of labor and capital, as well as the total costs in each industry; value of industry–competing imports, the hryvnia/dollar exchange rate. (The description of all the variables and data is presented in Appendix A).

PPI are producer price indexes by industry for the period 1997-2001, measured in percentage changes of prices in time period *t* relative to the period *(t-1)* and calculated by the State Committee of Statistics using the ***Laspeyres*** formula for price indexes. The description of the construction of the PPI is presented in Appendix B.

For non-tariff barriers the compound ***index of non-tariff barriers (NTBS)*** is applied. INTB are taken from *Movchan (2002)*. The methodology for the calculations of the INTB is presented in Applendix C.

The data for imports are annual data for values of imports of goods in each industry that is these are the imports of goods which production belongs to the corresponding to the Ukrainian classification of industries.

Data for sales, total costs, total wage bill, book value of fixed capital are the industry level data.

From these data the import penetration ratios, trade openness coefficient, the labor cost shares and capital cost shares are calculated.

Import penetration ratio = value of imports/(sales of domestic goods + imports)

Trade openness = (export + import)/total production in an industry

The measures of import penetration ratio and trade openness coefficient are used both as proxies for trade openness of each industry, that is for the competition from foreign products, and as a proxy for foreign trade policy of Ukraine. Using the flow indicator of imports as the measure of the foreign trade policy is arbitral as changes in import flows do not always reflect changes in trade barriers. Nevertheless, the fact that tariffs and non-tariff barriers have direct impact on prices and, therefore, on sales of the imported goods is one of the justifications for the application of the import penetration ratio. That is, when tariffs or non-tariff measures decrease, prices of imported goods in the domestic market decrease and, as a result, demand for imported goods and sales will increase. Simultaneously, the coefficient of trade openness is a broader measure than import penetration ratio as it includes exports and could also capture the effect of liberalization on exports of goods intensive in the abundant factor of production. The analysis will discriminate between the two measures of trade openness to choose the one that captures best the effects of trade policy and trade openness on factor markets. Since the systematized data for import tariffs and non-tariff barriers is not available in Ukraine, no analysis of the effects of tax measures in foreign trade can be conducted so far.

Labor cost shares are calculated as the ratio of total wage bill to the total costs in each industry:

labor_s = total wage bill/total costs

Capital cost shares are calculated as the ratios of the depreciation of the fixed assets to the total costs in each industry:

*cap_s = (δ*book value of fixed assets)/total costs,* where δ is the depreciation rate of fixed assets, which is set to be 5%, the depreciation rate for capital structures and buildings, and the cost of depreciation equals to 5% of the book value of the fixed assets. In fact, there are three different groups of fixed assets in the Ukrainian accounting standards with different depreciation rate assigned to each of them. Nevertheless, the share of capital structures and buildings is the largest in manufacturing, therefore the rate that is applied to this group of fixed assets is used in this analysis. Such a rate of depreciation was also used in *Tsyrennikov (2002)*.

According to the formulae of the rental price of capital, the price of capital equals:

$$v = (r + \delta)*V \text{ ,where}$$

r is the real interest rate which reflects the opportunity cost of holding funds in fixed assets rather than interest bearing assets, and δ is the depreciation rate, V is the current market price of capital.

However, the interest rate for credits was so high for the period of investigation, that even if the real interest rate is applied, there is a tendency for industries to have shares of capital that are greater than unity. In addition, the total costs, reported by the State Committee of Statistics include only the production costs and thus do not take into account the interest paid, and there is no information on whether the firms that are registered in the State Committee actually have credit indebtedness on loans. Taking into account all the underlined reasons, the accounting measure of the cost of capital, rather than the economic measure is used.

Changes in average annual wages by industry will be used for comparison with the estimated mandated wage coefficients.

The data for exchange rates are the average annual exchange rates calculated using the official diary exchange rates of the National Bank of Ukraine.

The data for the number of firms in each industry covers all the manufacturing plants that are mainly open joint-stock companies (OJSC) and that report their statistics to the State Committee. Since all the OJSC must submit their statistical accounts to the State Committee, the data of State Committee is essentially the data for a representative sample of manufacturing plants for each industry and, therefore, should reflect well the market structure of each industry.

The data covers 89 manufacturing industries, among which there are four and five digit and several three-digit industries. The time period covered is 1997-2001. Since in 2002 the classification of industries changed, making the comparison between the period before 2002 and after 2002 impossible for now, the period from 2002 will not be considered in the analysis.

Methodology

Panel data regression is applied to the analysis of the price and wage changes in manufacturing industries to take account of the heterogeneity among the industries, whereby cross industry variation in prices and wages as well as time varying factors can be captured. In the framework of the postulated model, panel data regression will allow to investigate not only time varying factors that influence price changes, such as technological progress, import growth and exchange rate devaluation, but also industry-specific factor intensities. Therefore, Stolper-Samuelson theorem would predict different effects on factor prices, depending on the factor intensities. In addition, different industries may experience different levels of protection from foreign goods and thus will respond differently to trade liberalization and price liberalization.

In panel data estimation further choice should be made between the *Fixed Effects* (FE) and the *Random Effects* (RE) models.

The panel data model has the following form (the Unobserved Characteristics Model):

$$Y_{it} = \boldsymbol{x}_{it}\boldsymbol{\beta} + c_i + u_{it},^{1} \qquad t = 1,2, \ldots, T$$

where $\boldsymbol{x}_{it}$, a $\boldsymbol{1 \times K}$ vector, which contains variables that vary both across t and i (K industries) industries, c_i captures unobserved characteristics of each industry. *Both* RE and FE models assume this specification. However, there is a difference in their treatment of the c_i variable.

The RE model assumes that c_i is the random factor, included in the random error term, imposing the necessary condition that it is not correlated with explanatory variables: $Cov(\boldsymbol{x}_{it}, c_i) = 0$. The FE model relaxes the assumption of zero correlation between $\boldsymbol{x}_{it}$ and c_i.

Thus, FE model is normally used when it is believed that there are specific cross-section factors that are fixed for each individual cross section over time, whereas in the RE model the individual cross sectional effects are assumed to be random. FE is normally used when the data is available for the whole sample, while the RE is applied in the analysis of a randomly drawn sample of cross sectional units over time. By this reason, I should use the RE model as the sample of industries used in my analysis is not a population of all the industries.

Nevertheless, in addition to the common sense, formal tests of RE vs. FE models exist, which provide the rules of choice between the alternative models.

Hausman test (Hausman, 1978) tests whether the RE estimator, which is consistent only under the null hypothesis of no autocorrelation between the error terms and the explanatory variables, differs significantly from the FE effects estimator, which is consistent under both the H_0 and H_1, but inefficient if the H_0 is true. Thus, under the null, there is no difference in estimated coefficients of FE and RE models and if the null hypothesis is accepted the more efficient RE model should be applied.

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[1] Wooldridge J. M. Econometric analysis of cross section and panel data, the MIT Press, 2002.

The Breusch – Pagan Lagrange Multiplier Test and the F-test are designed to test between random effects and the pooled OLS and between the fixed effects and the pooled OLS respectively.

The *Breusch – Pagan LM Test* tests the null hypothesis that the variances of the individual and time specific random effects in the RE model are equal to zero, that is it is the test for the common intercept. Therefore, if the H_0 is rejected, the RE model is the true model.

The *F-test* tests the H_0 of the joint significance of the individual specific dummy variables. Under the H_0 they are all equal to zero and the restricted pooled OLS model is the true model. If the null is rejected the FE model should be applied.

Therefore, the methodology described above will be applied when discriminating between different panel data models.

Empirical evidence in manufacturing industries in Ukraine.

In order to make predictions about the effect of imports on domestic factor markets and thus about the direction of Stolper-Samuelson effects, it is important to determine the factor intensity of the Ukrainian manufacturing production.

Factor intensity of production is determined by the capital/labor ratio, which is calculated as:

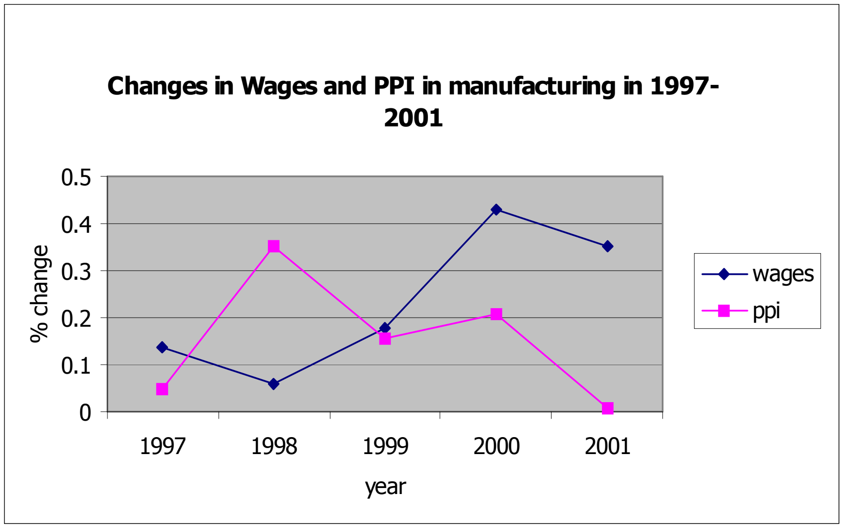
$$K/L = \textit{cost share of capital}/\textit{cost share of labor}$$

The production of an industry is considered to be capital intensive if this ratio exceeds the median ratio for the whole manufacturing and labor intensive if it is lower than the manufacturing median ratio.

For the sample of industries investigated the calculated capital/labor ratios indicate that approximately half of the sample are labor intensive and half are capital intensive industries. Some sectors, such as electricity, oil, gas and coal production as well as chemical production appear to be capital intensive, and the production of food products appears to be labor intensive. Whereas among such sectors as machinery production, metallurgy, textiles and clothing, factor intensities vary among five-digit industries without showing a clear pattern of factor intensity of a sector. Such a factor structure gives support for the use of the four and five-digit level industries in the analysis as it would be incorrect to assign a particular factor intensity pattern to the whole sector when it differs among the more disaggregated sub-industries.

During the period 1997-2001 nominal wages in the manufacturing industries under consideration were increasing by 33% annually on average, while the overall producer price index in manufacturing was increasing 16%. The trends in changes in average wages and producer prices can be seen from the following graph:

Figure.4.1.Changes in wages and PPI in manufacturing in 1997-2001.

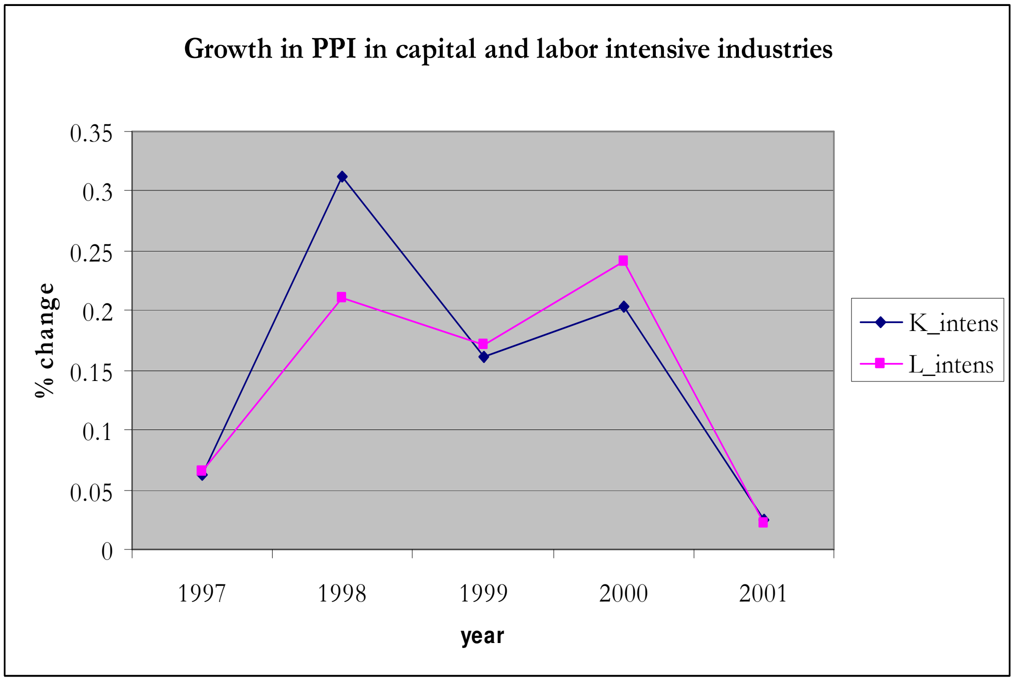


Source of data: Derzhkomstat – the State Committee of Statistics.

As can be revealed from the graph that from 1997 to 1999 the interrelation between prices and wages was negative and from 1999 on nominal wages and producer prices moved in the same direction, although wage changes were greater than changes in producer prices. Therefore, it may be expected that in 1999-2001 Stolper-Samuelson effects were present in the manufacturing industries.

The differences in growth of PPI between capital-intensive and labor-intensive industries are presented in Figure 4.2, where average growth rates of PPI in capital-intensive and labor intensive industries are compared. As can be seen from the graph changes in PPI were greater in capital intensive industries in 1997-1999 and in labor intensive industries in 1999-2001. If Stolper-Samuelson Theorem held in that period, capital should have gained in 1997-1998 due to the greater increases in prices of capital intensive goods and labor should have gained in 1999-2000 to due greater increases in prices of labor intensive goods.

Figure 4.2. Changes in PPI in capital-intensive and labor-intensive industries.



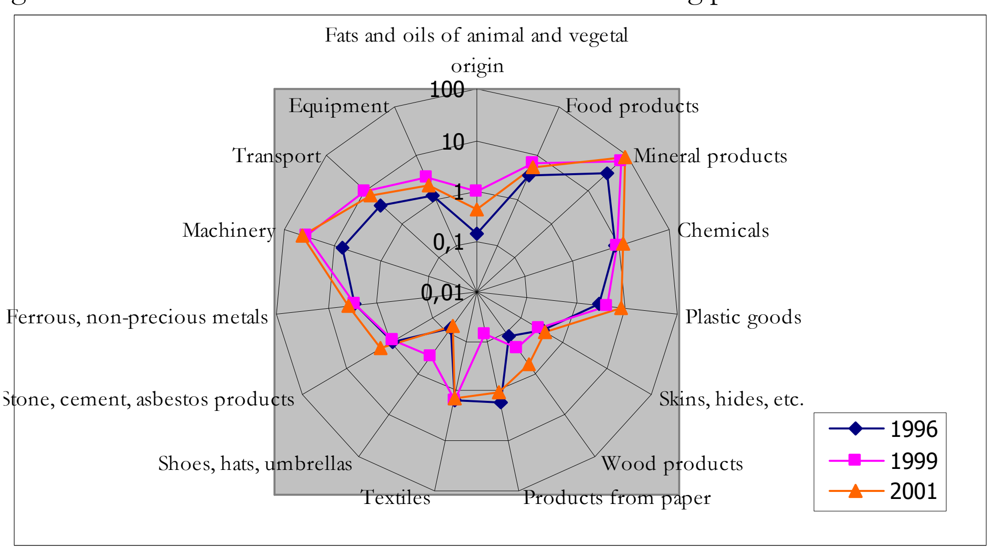
Source of data: Derzhkomstat

The greatest increases in average wages were observed both in some labor-intensive and capital-intensive industries. Among the industries with greater increases in wages are food production, which is mostly labor intensive, and machinery, which is mostly capital intensive. Among the industries that experienced larger increases in the average PPI are non-ferrous metallurgy, chemicals and textiles.

During the same period import penetration ratio increased by 23% in the analyzed manufacturing industries and the share of foreign trade in total production in manufacturing rose by 25% in 1997-2001, indicating increasing trade openness of the considered manufacturing industries. The average coefficient of trade openness was about 60% of the industrial production.

Non-tariff barriers were increasing in most industries from 1996-2001. However, the trend from 1999 onwards was not uniform. For most industries non-tariff protection followed the up-ward trend up to 2001 and only for the transport machinery, food products, production of oils and clothing accessories did the non-tariff barriers decline in 2001. The magnitudes of the Index of Non-Tariff Barriers differ strikingly. As can be seen from the Figure 4.3 non-tariff barriers were greater for mineral products, machinery, chemicals and plastics, which appear to be capital intensive industries, and lower for textiles, food products and wood products, which are mainly labor intensive industries. The levels of the non-tariff barriers for each product group, measured by the Index of Non-Tariff Barriers (INTB), can be observed from the radar-diagram below, measured on a 100 scale, where each point on the radar corresponds to the value of the INTB for a product for 1996, 1999 and 2001.

Figure 4.3. Index of Non-Tariff Barriers for manufacturing products.



Source of data: INTB was taken from *Movchan (2002)*.

The drastic differences in the level of non-tariff protection can be explained by several factors. First, industries with higher non-tariff protection appear to be the capital-intensive industries (they have capital – labor ratios higher than the median manufacturing ratios). The second reason may be contained in the specificity of each industry and its protection, according to which the industries with low non-tariff protection may be protected by tariff barriers.

Therefore, the results of the visual inspection of the data suggest that since capital-intensive industries are protected with non-tariff barriers and we would expect that prices should be higher in capital intensive industries, benefiting the factor intensively used in their production, that is capital, and harming workers by lowering their wages.

Chapter 5

ESTIMATION RESULTS

One-stage "mandated" wage approach

Following the methodological setup, I, first, estimate the price-factor shares equation:

$$\mathbf{PPI}_{it} = \alpha_0 + \alpha_1 * \mathbf{labor\_s}_{it} + \alpha_2 * \mathbf{cap\_s}_{it} + \mathbf{u}_{it}, \text{ where}$$

PPI $_{it}$ - is the percentage change in Producer Price Index in industry *i* in time *t*

labor_s$_{it}$ – share of labor costs in the total costs in industry *i* at time *t*

cap_s$_{it}$ – share of costs of capital in the total costs in industry *i* at time *t*

u$_{it}$ - random error term

The model is estimated both by random effects and by the fixed effects model and the pooled OLS model. The results of the estimation are presented in Table5.1. To discriminate between these models the Hausman specification test and The Breusch and Pagan Lagrangian multiplier test is employed. The null hypothesis that the random effects model is the true model, is accepted as the p-value of the test statistic is 0.62.

The Breusch and Pagan Lagrangian multiplier test for random effects indicates that between the random effects model and the pooled OLS regression the random effects model is the right one, as the null hypothesis of the common intercept is rejected at 1% level of significance. Therefore, the random effects model is analyzed.

As the results of the regression show, the relationship between product prices and factor prices is negative, implying that, if the coefficients reflect the enforced changes in factor prices due to changes in product prices, the increase in the producer price index in an industry by 1% will on average lead to the statistically significant decrease in nominal wages of about 0.32% and an insignificant decrease in the return to capital of about 0.10%. The results of the regression imply that nominal average wages in manufacturing should have been falling more than the cost of capital in 1997-2001.

Table5.1. Estimation of the price-factor shares "mandated wage" equation.

Explanatory variables	RE	FE	OLS
LABOR_S	-.317 (0.025)	-.241 (0.493)	-.317 (0.026)
CAP_S	-.102 (0.445)	-.209 (0.234)	-.102 (.446)
CONST	.194 (0.000)	.191 (0.000)	.194 (0.000)
R-squared	0.09	0.056	0.0125
Number of obs.	445	445	445
Number of groups	89	89	
Hausman test statistic	0.95 (0.6217)		
LM test	15.28 (0.0001)		

PPI $_{it}$ – is the dependent variable
P-values in parenthesis
RE – Random effects GLS model, FE – Fixed effects model
R^2: 'between R^2 ' is reported for RE model, the 'within R^2' for FE and the adjusted R^2 for OLS regression

To see in what industries the changes in PPI were greater it is important to check the correlations between the changes in PPI and the factor intensities of the industries (capital/labor ratios).

Table 5.2. Correlation coefficients between changes in PPI and capital/labor ratio.

Correlation	PPI	K_intensity
PPI	1.000	
K_intensity	-0.0113	1.000

Correlations in Table 5.2. indicate that changes in PPI are negatively correlated with the capital intensity of an industry, predicting that returns to capital should fall as prices increase, confirming the results of the regression analysis. If the SS Theorem holds than prices in labor intensive goods and wages should increase. Nevertheless, as the regression analysis revealed, workers also lose from the price increases.

If it is assumed that Ukraine is a small open economy and the internal prices are the world prices, the imposed changes in factor prices would also reflect the impact of competition from other countries, in the form of imports and the impact of foreign trade policy. Then, lower (greater in absolute value) coefficient for the share of labor would indicate that capital would lose by less from increased foreign trade which impacts rental price of capital through the decrease in the relative price of capital intensive goods and labor would lose from increased foreign trade by more through the decrease in relative prices of labor-intensive goods. The negative signs of the coefficients of the mandated changes in the factor prices, which indicate that the relationship between product prices and factor prices was negative, could suggest that the Stolper –Samuelson effects were not present in the Ukrainian manufacturing production in the period under investigation. However, the effect of international trade, as well other factors, cannot be disseminated from the above regression.

In order to make conclusions about the presence of the SS effects and the performance of the zero-profit "mandated wage" equation the estimated changes in nominal wages should be compared to the actual changes in wages. As it was pointed in the description of the economic situation in Ukrainian manufacturing, actual nominal wages were increasing by 33% on annually, which is far greater the increase (actually decrease) in wages predicted by the "mandated" wage equation. Therefore, the "mandated" wage equation either underestimates the actual changes in wages or the product price changes had very little effect on wages, which was substituted by the effects of other variables that influenced wages. The comparison of the signs of the "mandated" wage changes with the correlation coefficient between the PPI and capital intensity and the signs of the actual changes in wages may indicate that there are omitted variables that influence either product prices or the returns to labor and cause them to be negatively correlated with prices. Such possible variables could be the costs of materials which influence prices or a technological progress that affects the productivity of labor, which actually can make wages increase in reality.

In addition, the "mandated" wage regression just establishes correlation between the product price changes and changes in wages. Due to the endogeneity of prices, no strict conclusion can be made about the presence of the Stolper-Samuelson effects and that is why many researchers criticized this methodology and attempted to improve it by endogenizing prices.

Two-stage "mandated wages" approach

In order to control for the endogeneity of prices, the structural equation should be constructed, from which the impact of structural variables on prices can be drawn and then its influence on factor prices can be investigated.

To distinguish the part of price changes that is due to foreign trade or trade liberalization some exogenous factor of foreign trade should be used in the structural price regression. Such exogenous factors could be foreign trade policy measures, like tariff and non-tariff barriers to foreign trade, which are determined exogenously by the governing authorities.

Therefore, three structural equations are estimated where in each equation a different measure of foreign trade policy is used as a key independent variable.

In the first structural equation the dependent variable is the Index of Non-Tariff Barriers (from *Movchan (2002)*).

Foreign trade barriers as an exogenous factor.

Trade barriers are one of the exogenous factors that influence both trade and prices. In order to make the analysis of completely exogenous factors that affect prices the following equation is estimated:

$$\mathbf{PPI_{it} = \beta_0 + \beta_1 * INTB_{it} + \beta_2 * XR\_CHAN_t + \beta_3 * D\_98 + \beta_4 * MONOP + \beta_5 * P\_REG + u_{it}}\text{, where}$$

INTB - is the Index of Non-Tariff Barriers, which is described in the methodological part of the thesis. The construction of the index is described in Appendix. C.

PPI_{it} - is the percentage change in Producer Price Index in industry i in time t;

XR_CHAN_t – is the change in the dollar/hryvnia official exchange rate and thus is equal for all the industries but differs in time**;**

D_98 - is the dummy variable, taking the value of 1 for year 1998 and 0 for all the rest years. This variable is designed to take into account the possible price changes in 1998 due to the Russian crisis, when the increase in the prices of Russian fuel caused the respective rise in the prices of all the fuel-dependent Ukrainian products. Thus, prices should have been higher in 1998 in comparison to the other years.

MONOP – is the dummy variable, which equals 1 if the number of firms in the industry is less than or equal to 4, and is included in the regression to take account of the market structure of an industry and possible mark-ups over the competitive price if the industry is monopolized

P_REG – is the dummy variable, which is equal to 1 if there is state regulation of the domestic price of the product in an industry and 0 otherwise. The value of 1 is assigned upon the existence of regulation and no account is taken over the size of the regulation, whether it is the ceiling or the minimum value of the price that is indicated by the state or any other measure of price controls.

The output of the estimation of the INTB structural equation is presented in Table 5.3.

Table 5.3. Estimation of the 'structural' equation with the INTB as a measure of trade policy.

Explanatory variables	RE	RE	FE	OLS
INTB	.00069 (0.194)	.0011 (0.041)	-.00053 (0.694)	.0011 (0.041)
XR_CHAN	.1997 (0.000)	.2052 (0.000)	.2098 (0.000)	.2052 (0.000)
D_98	.1339 (0.000)	.1332 (0.000)	.1288 (0.000)	.1332 (0.000)
MONOP	.0701 (0.059)	.0699 (0.063)		.0699 (0.064)
P_REG	.0718 (0.001)			
Const	.0444 (0.002)	.0536 (0.000)	.0724 (0.000)	.0536 (0.000)
R-square*	0.253	0.158	0.175	0.162
Number of observations	445	445	445	445
Number of cross sections	89	89	89	
Hausman test statistic	1.69 (0.6401)			
LM Test	12.64 (0.0004)			

PPI $_{it}$- is the dependent variable
p-values are in parenthesis
* - the 'between R^2 ' is reported for RE model, the 'within R^2' for FE and adjusted R^2 for OLS regression, 'overall R^2' is shown for the second RE model

Since price regulation, controlled by P_REG, also concerns some imported goods, it may be collinear with the INTB and may affect the significance of the coefficient of INTB. That is why it is excluded from the RE regression.
Hausman specification test indicates that the random effects model should be applied between the two panel data models (p-value of the test statistic is 0.64, that is the null hypothesis of the true RE model is accepted). Breusch and Pagan Lagrangian multiplier test shows that the RE is preferred to the OLS (p-value of the test statistic is 0.0004 and the null hypothesis of the common intercept is rejected).

The regression results report an increase in the Index of Non-Tariff Barriers, that is of non-tariff protection, leads to a 0,001% increase in producer prices. And though the magnitude of the coefficient is small it is positive and significant at 5% level of significance, indicating that non-tariff barriers do have positive impact on producer prices. The coefficients of all the other variables are positive and significant. The results show that the exchange rate pass-through rate on domestic producer prices is positive, that is a 1% depreciation in hryvnia/dollar exchange rate leads to a 0,2% increase in product price. As the coefficient of D_98 indicates, in 1998 producer prices were on average 0,13% higher than in other years. Higher prices in 1998 can be explained by the persistence of the Russian crisis which caused the prices of all the fuel-dependent products to surge. The coefficient of MONOP shows that industries with less than 4 firms have by 0,07% higher prices than all the other industries, which points out to the existence of mark-up over the competitive price in these industries.

According to the methodology I construct the new dependent variable – INTB_S= INTB*β_1 for the use in the second-stage equation, where β_1 is the coefficient of INTB index in the RE price structural equation. Therefore,

$$INTB\_S = 0.0011 * INTB$$

The calculated INTB share variable is then regressed on the factor shares forming the "mandated wage" equation. The regression equation is:

$$\mathbf{INTB\_S_{it} = \gamma_0 + \gamma_1 \cdot LABOR\_S_{it} + \gamma_2\, CAP\_S_{it} + u_{it},}$$

where the factor share variables are the same as in the previous zero-profit regression and the $\mathbf{INTB\_S_{it}}$ is the index of non-tariff barriers in industry i at time t.

The coefficients of the "mandated" wage equation for the INTB_S variable is given in Table 5.4.

For the above equation Hausman specification test indicates that the RE model is the right model to use (p-values of the test statistic is 0.62 and the null hypothesis is accepted). The results of Breusch and Pagan Lagrangian multiplier test confirm the choice of the RE model, as the hypothesis of no variation in the intercept is rejected at 1% level of significance.

Table 5.4. "Mandated wage" equation with INTB_S as the dependent variable.

Explanatory variables	**RE**	**FE**	**OLS**
LABOR_S	-.0032 (0.801)	-.0077 (0.579)	.0116 (0.359)
CAP_S	.0035 (0.609)	.0016 (0.817)	.0258 (0.033)
CONST	.0104 (0.000)	.0111 (0.000)	.0072 (0.000)
R-squared··	0.004	0.0011	0.012
Number of obs.	445	445	445
Number of groups	89	89	
Hausman test statistic	0.95 (0.6217)		
LM test	15.28 (0.001)		

$\mathbf{INTB\_S_{it}}$ – is the dependent variable

P-values in parenthesis

··- the 'within R^2' are maximum for both FE and FE models and are reported and the adjusted R^2 is shown for the OLS regression

As the results of the estimation show product price increases due to the increase in non-tariff protection lead to the "forced" increases of the returns to capital and decreases of wages in order to restore the zero-profit condition in manufacturing production. Such results suggest that capital owners are protected by non-tariff barriers in Ukraine, whereas workers lose from non-tariff protection. Therefore, if trade liberalization increases and non-tariff barriers are reduced or eliminated, it is expected that returns to capital will fall and wages will rise.

In order to check whether labor-intensive or capital-intensive industries are protected, simple correlations are calculated between the INTB and the capital intensity of an industry. Industry intensities are calculated as explained in the descriptive part of the thesis.

Table 5.5. Correlations between the INTB and the capital/labor ratios.

Correlation	**K_INTENS**	**INTB**
K_INTENS	1.0000	
INTB	0.2008	1.0000

As can be seen the correlation between the capital intensity of an industry and the Index of non-tariff barriers is positive, confirming the results of the regression that capital-intensive industries are protected by non-tariff barriers.

As a result, capital gains from the price increases due to the protection from competition from foreign goods by non-tariff barriers and labor loses as the "mandated" wages falls and rental cost of capital increases. According to the Stolper-Samuelson Theorem these results would suggest that capital is the scarce factor, which gains from trade protection of capital-intensive goods and will lose if barriers are eliminated, and that labor is the abundant factor, which loses from protection as the prices of labor-intensive goods are low and should gain when trade is liberalized. However, the changes in factor prices due to the rise in non-tariff barriers are not statistically significant. These results suggest that the protectionist measures do not have a significant effect on the distribution of income to factors of production and thus protectionist trade policy in the form in

non-tariff barriers is not efficient, that is it does not significantly increase the returns of a scares factor of production. In addition due to the protection of capital by non-tariff measures, workers lose, and therefore there is possibility to increase the income of workers if trade is liberalized.
Therefore, the results of the analysis of the impact of non-tariff barriers as the exogenous measure of trade policy suggest the possibility of gains for workers from trade liberalization.

Therefore, two other structural equations and the corresponding "zero-profit" equation, which include the measure of foreign trade openness, are estimated to analyze the effects of larger trade openness on incomes of workers and owners of capital.

Application of the measures of trade openness.

In the other two structural equations I speculate between two measures of the openness of foreign trade. In the first equation the import penetration ratio is the exogenous variable that pertains to foreign trade and in the second equation it is the ratio of trade to the total production in an industry. Import penetration ratio and the share of trade in production is the measure of the competition from foreign goods and can also be considered as an alternative measure of the extent of trade protection or liberalization. That is an increase in import flows, and total trade in general, could be assumed be the result of lower tariffs. The correspondence between increased trade and trade liberalization is certainly not full, that is value of trade flows may increase due to other than trade policy factors, such as changes in tastes and increases in demand. However, the absence of data for tariff barriers, the indicated trade measures can be a useful approximation for the effects of trade policy measures other than non-tariff barriers.

The following structural equations are estimated separately:

$$PPI_{it} = \beta_0 + \beta_1 \cdot IMP\_R_{it} + \beta_2 \cdot XR\_CHAN_t + \beta_3 \cdot D\_98 + \beta_4 \cdot MONOP + u_{it}$$

$$PPI_{it} = \gamma_0 + \gamma_1 \cdot TR\_OPEN_{it} + \gamma_2 \cdot XR\_CHAN_t + \gamma_3 \cdot D\_98 + \gamma_4 \cdot MONOP + u_{it}$$

IMP_R_{it} – is the import penetration ratio, which is calculated as the share of import in industry ***i*** in time ***t*** in total sales in industry ***i*** at time ***t***. The other structural variables are the same as in the structural equation with INTB.

TR_OPEN_{it} – is the ratio of total trade to the total production in an industry

The results of the estimations are presented in Table 5.6.

Table 5.6. Structural equations with IMP_S and TR_OPEN as measures of trade openness.

Explanatory variables	**RE**	**RE**
IMP_R	.076 (0.017)	
TR_OPEN		-.013 (0.463)
XR_CHAN	.191 (0.000)	.209 (0.000)
D_98	.138 (0.000)	.132 (0.000)
MONOP	.072 (0.054)	.057 (0.139)
const	.049 (0.001)	.062 (0.000)
R-square*	0.172	0.163
Number of observations	445	445
Number of cross sections	89	89

PPI_{it}- is the dependent variable
p-values in parenthesis
*- the 'between R^2' is reported for RE model, the 'within R^2' for FE and adjusted R^2 for OLS regression, 'overall R^2' is shown for the second RE model

The results of the Hausman specification test for both equations show that that the null hypothesis that the random effects model is the right model is accepted, as the p-value of the statistic is 0.30 and 0.98 respectively. The Breusch and Pagan Lagrangian multiplier test for random effects rejects the null hypothesis of the common intercept (p-value is lower than 1% for both regressions), clearly indicating that the random effects model as an alternative model should be applied. Therefore, the RE model is maintained as the best model and further decomposition of the effects of structural variables on the factor costs is based on the results of the RE regressions. (The results of the FE and OLS models and the tests are presented in Appendix D.)

The interest of this decomposition is in the coefficients of **IMP_R** and **TR_OPEN** for their further application in the "mandated wage" equation. **IMP_R** allows to distinguish the share of variation in prices that is due to the increased competition from foreign goods and changes in foreign trade policy and is used in further analysis of the "mandated" changes in factor prices. As the results of the regression suggest, greater trade openness in the form of higher import penetration leads to the increase in producer prices in manufacturing. An increase in import penetration ratio by 1% leads to a 0,07% increase in producer prices.

In order to build the "mandated" equation, the new variable, **IMP_S**, is generated:

$\mathbf{IMP\_S_{it} = IMP\_R_{it} \cdot \beta_1}$ **,** where β_1 is the coefficient of the **IMP_R** from the structural equation. **IMP_S** represents the share of the variation in the industry producer price index that is attributed to the import penetration ratio. The coefficient is the same for each industry (.076)**,** thus $\mathbf{IMP\_S_{it} = IMP\_R_{it} \cdot (.076)}$**.** Since the pass-through of increased import is positive, **IMP_S** actually measures the share of price increases that is attributed to the industry-competing import flows into the country**.**

Contrary to the import-penetration larger overall trade flows lead to the decreases in product prices. From the structural equation the new variable **OPEN_S** is formed. **OPEN_S = TR_OPEN * γ_1 = TR_OPEN · (-.013)**
The calculated import share variable is then regressed on the factor shares forming the "mandated wage" equation. The regression equations are:

$$\mathbf{IMP\_S_{it} = \delta_0 + \delta_1 \cdot LABOR\_S_{it} + \delta_2 \cdot CAP\_S_{it} + u_{it},}$$

$$\mathbf{OPEN\_S_{it} = \psi_0 + \psi_1 \cdot LABOR\_S_{it} + \psi_2 \cdot CAP\_S_{it} + u_{it}} \text{ where}$$

IMP_S$_{it}$- the share of price changes that is attributed to the industry-competing import flows into the country;

OPEN_S$_{it}$ – the share of price changes that is attributed to the increase in the trade openness;

LABOR_S$_{it}$ - is the share of labor costs in the total costs in an industry;

CAP_S$_{it}$ – is the share of costs of capital in the total costs in an industry.

The results of the estimation of both "mandated" wage equations are presented in Table 5.7.

The estimated coefficients are the changes in factor prices (wages and rental rate of capital) that are attributed to price changes, which in turn have been determined by changes in import penetration ratios in each industry and by the changes in trade openness. The estimated coefficient should reflect the changes in factor prices, "mandated" by the changes in product prices.

Table 5.7. Estimation results of the "mandated" factor price changes.

Explanatory variables	Dependent variable	
	IMP_S (FE)	OPEN_S (RE)
LABOR_S	-.074 (0.014)	.01 (0.068)
CAP_S	-.01 (0.524)	-.0037 (0.228)
CONST	.027 (0.000)	.001 (0.261)
R-squared*	0.046	0.0406
Number of obs.	445	445
Number of groups	89	89

p-values in parenthesis
*- the 'between R^2' is reported for RE model, the 'within R^2' for FE and adjusted R^2 for OLS regression, 'overall R^2' is shown for the second RE model

In the regression with the OPEN_S as the dependent variable the Hausman test and the Breusch and Pagan Lagrangian multiplier test show that the RE model is the best model to estimate (the p-value of test statistic for Hausman test is 0.06 and the RE is accepted at 5% level of significance; p-value if less than 1% for LM test). However, the tests indicate that the FE model should be used in the regression with the IMP_S as the dependent variable (p-value of the test statistic is 0.03, that is the null hypothesis of the true RE model is not accepted). F-Test confirms the application of the fixed effects model (p-value of the hypothesis that all the individual intercepts are equal to 0 is rejected at 1% level of significance, therefore the FE is the preferred model). (The results of the other specifications and the tests are presented in Appendix D).

As the results of the FE estimated regression report, the increase in industry producer price index due to the increased import penetration, or foreign competition, has negative effect both on wages and on rental price of capital. That is an increase in prices in an industry by 1%, due to the increase in import share of domestic consumption, should lead to the 0.07% "mandated" decrease in wages and 0.01% insignificant decrease in the rental price of capital in order for the industries to break even. These changes can be considered as the share of changes in factor prices that is due to the increased imports or increased liberalization of foreign trade. However, the coefficient of capital, that is the "mandated" change in rental cost of capital, is insignificant.

Therefore, it may be concluded that workers as well as the owners of capital suffer from increased import flows and increased competition form foreign goods.

Nevertheless, the results of the estimation of price changes with a different measure of trade openness (OPEN_S) suggest that labor gains as a result of increased trade and trade openness. A 1% increase in product prices due to the increased trade openness mandates a 0.1% statistically significant increase in wages and a 0.004% fall in the return to capital in order to restore zero-profits in the manufacturing industries. Though the magnitude of the coefficient of the changes in the return to capital is low, it is insignificant. The results of the latter model confirm the results of the analysis of non-tariff barriers, that workers may experience an increase in their wages as a result of more open trade and increased trade flows. Therefore, labor would gain and the owners of capital would lose from trade liberalization. However, since the magnitudes of the mandated effects are small for both factors, increased trade would not have large distributional effects on factor prices if trade is liberalized confirming the results of the analysis of non-tariff protection.

The differences in the signs of the coefficients of the import penetration ratio the coefficient of trade openness may indicate the existence of the causality in the import penetration regression, which goes rather from higher prices to imports than vise versa, which makes the coefficient of the import penetration ratio to be positive. That is why the results of the trade openness regression are preferred for the purpose of this analysis, as the coefficient of trade openness (TR_OPEN) includes both imports and exports.

In addition, another important caveat should be mentioned concerning the use of trade flows and trade openness indicators in the analysis. The application of the import penetration ratio and trade ratio as the exogenous measures of trade policy suffer one drawback, mainly, that they are also endogenous, or are influenced by other factors that affect foreign trade flows and prices as well, such as increased demand in domestic or foreign market or the changed tastes of consumers. That is why, the results of the trade openness regressions should be used with caution. Another way to avoid the endogeneity of prices and to reveal the results of increased trade liberalization for the factor prices would be to analyze import tariffs, which could be a way to expand further research.

Chapter 6

CONCLUSIONS AND POLICY IMPLICATIONS

The purpose of this paper was to investigate the effects of foreign trade and protection on the factor markets in Ukraine and reveal the possible future effects of trade liberalization and Ukraine's accession into the WTO on factor returns.

Therefore, on the basis of the Stolper-Samuelson Theorem I analyzed whether changes in product prices predict significant changes in the prices of factors and whether non-tariff barriers and competition from foreign trade has an impact on the returns to labor and capital through changes in product prices.

The results of the analysis show that changes in product prices are negatively correlated with changes in factor returns, with the effect for labor being stronger than for capital. Since in reality nominal wages and prices were rising, the results of the estimation suggest that there are variables omitted, such as the technological progress and the cost of materials, that that can have a great impact on both product prices and factor rewards.

When the influence of exogenous factors on prices is considered, the results show that non-tariff barriers lead to the increases in product prices, which in their turn lead to the increase of the return to capital and to the fall in wages. This suggests that capital is a scarce factor and labor is an abundant factor in Ukraine. However, the "mandated" changes in factor returns appear to be insignificant suggesting that the protectionist policy has small impact on the distribution of income between the factors of production. Such results imply that workers could gain if trade is liberalized. This gives a further impetus for trade liberalization and the enhancement of the Ukraine's accession processes into the WTO.

The possibility of gains to labor from increased trade are confirmed by the analysis of the effects of trade openness on product prices and factor returns. The results of the two-stage regressions show that workers will gain given that producer prices will increase.

As a result, an important policy implication is suggested by the analysis. While reduction in non-tariff protection may have small distributional effects on the returns of factors of production, further liberalization of foreign trade could have potential positive effects on wages of workers.

It is also important to indicate some caveats concerning the present analysis, which should be taken into account in further research. First, the omission of some important inputs or factors of production or the neglect of the possible effects of the technological progress on the productivity of labor, may cause the "mandated wage" equation to underestimate or overestimate the factor price changes. Second, in order to decompose the changes in prices on the effects of other factors pure exogenous variables should be employed, which are difficult to find. Finally, the failure to explicitly include tariffs in the analysis (due to the lack of data) implies that the policy implications need to be interpreted with care.

The presence of all these caveats concerning the present analysis gives a wide field for further investigation. Future research could be directed toward including the tariff barriers in the analysis. It would also be more insightful to include agricultural sector and service in the investigation and see whether the results are robust. And finally, it is important to distinguish between skilled workers and unskilled workers and see whether they would experience different distributional effects of trade liberalization.

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APPENDIX A. DESCRIPTION OF VARIABLES

Variable	Notation	Description	Source
Producer Price Index	PPI	Measured as the end of period growth and based on *Laspeyres* formula for price indexes	State Committee of Statistics
Import penetration ratio	IMP_R	Calculated as the ratio of imports to the total sales (sales of domestic production + imports) (authors own calculations)	Data from the State Committee of Statistics
Coefficient of trade openness	TR_OPEN	Calculated as the ratio of total trade (import + export) to the total domestic production (domestic sales + export) (authors own calculations)	State Committee of Statistics
Labor cost share	LABOR_S	Calculated as total wage bill/total costs (authors own calculations)	Data on wage bill and total costs from State Committee Of Statistics
Capital cost share	CAP_S	Calculated as depreciation of fixed capital/total costs (authors own calculations)	Data on book value of capital from State Committee of Statistics
Index of Non-Tariff Barriers	INTB	Index number, calculated from methodology explained in *Appendix C* (borrowed from *Movchan (2002)*)	*Movchan V.* EERC Conference Paper (2002)
Hryvnia/Dollar exchange rate	XR_CHAN	Average annual hryvnia/dollar exchange rate	National Bank of Ukraine
Number of firms in an industry	MONOP	Number of firms, that report their statistics to the State Committee, mainly OJSC (open joint-stock companies)	State Committee of Statistics

All the data is the annual industry level data for the period1997-2001.
The sample includes 89 four and five digit manufacturing industries.

APPENDIX B

Laspeyres formula for the construction of the industrial Producer Price Indeces (the State Committee of Statistics calculations):

$$I^{t,t-1} = \frac{\Sigma\, CW_i^{t-1} * (p_i^t / p_i^{t-1})}{\Sigma\, CW_i^{t-1}} ,$$

where $I^{t,t-1}$ is the change in price in time period t in comparison to the previous time period t-1; $CW_i^{t-1} = w_i^0 * (p_i^t / p_i^0)$ the weigh of the good i in period t-1, w_i^0 is the weight of good i in the base period, (p_i^t / p_i^0) is the price index in the previous time period $(t$-$1)$ in comparison to the base period (0); (p_i^t / p_i^{t-1}) is the price index in the current period (t) in comparison to the previous time period $(t$-$1)$.

APPENDIX C

Methodology for the construction of the **Index of Non-Tariff Barriers** (calculated by Movchan(2002)**:**

$$INTB\,j = \frac{\Sigma\, NTB_{ij} * IM\,j}{\Sigma\, IM_j},$$

where $INTB\,j$ is the index of non-tariff barriers for commodity *j*, NTB_{ij} is an indicator of application of non-tariff barrier *i* to commodity *j*, i = *1,…,I, j =1,…, J* where *I* is the number of non-tariff barriers in the industry and *J* is the total number of commodities (groups of commodities).

NTB_{ij} takes values *(0, 25, 50, 75, or 100)*

NTB = 25 if the product is subject to a technical barrier, such as mandatory certification, ecological control, sanitary control, veterinary control),

50 – if the product is subject to price control (minimal custom value, dumping measures),

100 – if the product is subject to quotas and licenses.

APPENDIX D1. ESTIMATION AND TEST RESULTS

Table D1.1. Estimation results of the 'structural' equation.

Explanatory variables	**RE**	**RE**	**FE**	**OLS**
IMP_R	.0512 (0.113)	.076 (0.017)	.134 (0.002)	.076 (0.017)
XR_CHAN	.191 (0.000)	.191 (0.000)	.178 (0.000)	.191 (0.000)
D_98	.137 (0.000)	.138 (0.000)	.144 (0.000)	.138 (0.000)
MONOP	.072 (0.053)	.072 (0.054)		.072 (0.054)
P_REG	.07 (0.002)			
Const	.041 (0.004)	.049 (0.001)	.042 (0.008)	.0489 (0.001)
R-square**	0.159 (between)	0.172 (overall)	0.2	0.165
Number of observations	445	445	445	445
Number of cross sections	89	89	89	

PPI $_{it}$- is the dependent variable

* - p-values in parenthesis

**- the 'between R^2 ' is reported for RE model, the 'within R^2' for FE and adjusted R^2 for OLS regression, 'overall R^2' is shown for the second RE model

Table D1.2. Results of the Hausman and Breusch and Pagan Lagrangian multiplier tests

Tests	Test statistic	P-value
Hausman Test	3.66	0.3001
Breusch and Pagan Lagrangian multiplier	8.15	0.0043

Table D2.1. "Mandated wage" equation with **IMP_S_{it}** as the dependent variable.

Explanatory variables	RE	FE	OLS
LABOR_S	-.062 (0.001)	-.074 (0.014)	-.058 (0.000)
CAP_S	.005 (0.694)	-.01 (0.524)	.022 (0.123)
CONST	.025 (0.000)	.027 (0.000)	.023 (0.000)
R-squared*	0.063 (between)	0.046 (between)	0.033
Number of obs.	445	445	445
Number of groups	89	89	

IMP_S_{it} – is the dependent variable
P-values in parenthesis
*- the 'within R^2' are maximum for both FE and FE models and are reported and the adjusted R^2 is shown for the OLS regression

Table D2.2. Results of the Hausman and Breusch and Pagan Lagrangian multiplier tests.

Tests	Test statistic	P-value
Hausman Test	6.77	0.0339
Breusch and Pagan Lagrangian multiplier	54.85	0.000

APPENDIX D3 ESTIMATION AND TEST RESULTS CONT'D

Table D3.1 Estimation of the 'structural' equation with TR_OPEN as a measure of trade policy.

Explanatory variables	**RE**	**RE**	**FE**	**OLS**
TR_OPEN	-.013 (0.447)	-.013 (0.463)	-.025 (0.490)	-.013 (0.463)
XR_CHAN	.202 (0.000)	.209 (0.000)	.210 (0.000)	.209 (0.000)
D_98	.134 (0.000)	.132 (0.000)	.133 (0.000)	.132 (0.000)
MONOP	.06 (0.115)	.057 (0.139)		.057 (0.140)
P_REG	.078 (0.000)			
const	.048 (0.000)	.062 (0.000)	.063 (0.000)	.062 (0.000)
R-square*	0.21	0.163	0.176	0.155
Number of observations	445	445	445	445
Number of cross sections	89	89	89	

PPI $_{it}$- is the dependent variable
p-values in parenthesis
* - the 'between R^2 ' is reported for RE model, the 'within R^2' for FE and adjusted R^2 for OLS regression, 'overall R^2' is shown for the second RE model

Table D3.2. Results of the Hausman and Breusch and Pagan Lagrangian multiplier tests.

Tests	Test statistic	P-value
Hausman Test	0.14	0.9860
LM Test	9.78	0.0018

APPENDIX D4 ESTIMATION AND TEST RESULTS CONT'D

Table D4.1. "Mandated wage" equation with OPEN_S as the dependent variable.

Explanatory variables	RE	FE	OLS
LABOR_S	.0096 (0.068)	.0042 (0.503)	.0195 (0.000)
CAP_S	-.0037 (0.228)	-.0048 (0.127)	.0032 (0.457)
CONST	.001 (0.261)	.0017 (0.032)	-.00065 (0.351)
R-squared*	0.0406	0.0078	0.04
Number of obs.	445	445	445
Number of groups	89	89	

$OPEN\_S_{it}$ – is the dependent variable
P-values in parenthesis
*- the 'within R^2' are maximum for both FE and FE models and are reported and the adjusted R^2 is shown for the OLS regression

Table D4.2.Results of the Hausman and Breusch and Pagan Lagrangian multiplier tests.

Tests	Test statistic	P-value
Hausman Test	5.73	0.0569
Breusch and Pagan Lagrangian multiplier	378.36	0.000