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Decomposing Estonian Wages by Gender: A Quantile Regression Approach of the Juhn, Murphy and Pierce Methodology

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Abstract

This paper analyses the development of the gender wage gap in Estonia between 1995 and 1999. The least squares based Juhn *et al.* (1993) decomposition reveals that the main cause for the increase in the pay differential of approximately 7% is the absence of improvement of the position of women within the male residual distribution. It has been found that the widening of the Estonian gender wage gap is counteracted by a decrease in overall wage inequality.
The performance of this decomposition technique at different quantiles of the wage distribution reveals that the development of the gap is not homogenous across quantiles.

Introduction

In 1990, at the outset of transition, the Estonian gender wage gap was small and the female participation rate was high by international standards. Women were in the advantageous position to be able to maintain their place in the labour market as their comparatively high level of education was a prerequisite for finding employment in the growing, high wage sectors such as the finance or the health sector. Indeed, Orazem and Vodopivec (1996) find that during the early phases of transition, women disproportionately benefited from the labour demand shifts towards high-skill jobs.

The present paper supplements this analysis by providing a follow-up investigation into the development of the gender wage gap starting from a more mature stage of transition. The stabilization of the main labor market indicators after 1995 can be viewed as a sign for a more settled labor market. It is believed that an analysis focusing on the later stage of transition can therefore offer a more accurate picture of the of the long run tendencies of the Estonian gender pay gap.

Initially, changes between the wages of Estonian men and women between 1995 and 1999 are decomposed via the Juhn *et al.* decomposition. After controlling for differences in human capital and socio-economic characteristics, an average increase of approximately 7% in the gender wage is found.

A disadvantage of this least squares based decomposition is that the model parameters are assumed to be constant over the entire distribution. Consequently, the gender wage gap is also assumed to be constant over the whole distribution.

This paper proposes an adaptation of the Juhn *et al*. (1993) methodology to quantile regressions. It is shown that the development of the gender wage gap differs across the conditional distribution of earnings.

The rest of the paper is constructed as follows. Section 2 provides a brief summary of the Estonian transition experience. This section summarises the main macroeconomic developments, gives an overview of the most important changes in the labour market and discusses the development of wages from a gender perspective. Section 3 provides a quick review of the literature concerned with the gender earnings gap in transition economies. Section 4 outlines the traditional Juhn *et al.*(1993) methodology, followed by an proposition of its application to quantile regressions. Thereafter, in section 5, the data and the variables employed in the analysis are introduced. Section 6 provides the empirical results that are summarised in the concluding section 7.

2. Estonia's Transition and the Labour Market

2.1 Macroeconomic Environment

Estonia's transition to a market economy began with the first economic reforms initiated in 1990, even before independence from the Soviet Union was declared in August 1991. The smallest of the three Baltic States opted for radical free market policies. Among the first battery of policies dropped on Estonia were price liberalisation and allowing for layoffs and bankruptcies.

Price liberalisation in 1990 resulted in a nearly tenfold increase in prices by 1991. By 1992 inflation had risen to a staggering 1076% (IMF, 1999). As most transition economies, Estonia experienced a slump in real GDP, reaching its all time low in 1992.

As a response to this highly fragile macroeconomic environment the Estonian government chose to implement very stringent monetary and fiscal policies. In June 1992 Estonia left the Ruble Zone and introduced its own currency (the Estonian Kroon) along with currency board arrangements and an annually balanced government budget.

The taming of inflation and the recovery of real GDP growth led to the belief that this medium term macroeconomic policy-mix was a success. Efforts to stabilise were also supported by the progress of privatisation and an extremely fast reorientation of the trade sector. Consequently, Estonia gained the reputation of a radical reformer and was promptly invited to be amongst the first wave of countries considered for EU accession. For most of the nineties Estonia continued to improve its macroeconomic position .[1]

In its Regular Report: Estonia 2000, the European Commission states that in terms of the Copenhagen criteria

"Estonia has continued to enjoy a broad political consensus on the principles of the market economy and macroeconomic policies, enabling a climate of economic stability."

[1] In 1999 the Estonian economy slipped into recession caused by the Russia crisis of August 1998. However, Estonia is recovering fast, real GDP increased by 6.5% in 2000 and inflation and the government budget remained at acceptable levels.

2.2 The Labour Market

However, the strain of transition is visible in the labour market. Declining participation rates and an increasing unemployment rate cast a gloom over the macroeconomic facade.

The severe changes in the Estonian labour market can be witnessed by eyeballing basic labour market statistics.

Table 1: Summary Statistics of the Estonian Labour Market

	Labour Force Participation Ratio between the Labour Force and the Working Age population; %			**Employment Rate** Ratio between the Employed and the Working-Age Population; %			**Unemployment Rate** Ratio between the Unemployed and the Labour Force; %		
	Total	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Male**	**Female**
1989	**76.9**	**82.6**	**71.7**	**76.4**	**82.1**	**71.3**	-	-	-
1990	75.5	82.1	69.5	75.0	81.6	69.0	-	-	-
1991	74.3	81.6	67.6	73.2	80.5	66.6	1.5	1.4	1.5
1992	72.2	80.5	64.7	69.5	77.4	62.5	3.7	3.9	3.4
1993	70.2	78.0	63.1	65.6	73.0	58.9	6.5	6.5	6.6
1994	70.1	77.9	63.0	64.8	72.2	58.0	7.6	7.3	7.9
1995	**68.5**	**75.9**	**61.7**	**61.8**	**67.9**	**56.3**	**9.7**	**10.6**	**8.8**
1996	68.1	75.0	61.8	61.3	67.0	56.1	10.0	10.7	9.2
1997	65.1	73.1	58.0	61.5	65.8	52.6	9.7	10.1	9.2
1998	64.4	71.9	57.8	58.1	64.2	52.7	9.9	10.8	8.9
1999	63.5	70.8	57.0	55.7	61.2	50.8	12.3	13.6	11.0
2000	**63.9**	**71.0**	**57.6**	**55.1**	**60.6**	**50.3**	**13.7**	**14.6**	**12.7**

Source: Statistical Office of Estonia; Data of the Estonian Labour Force Surveys
1989-1996: population aged 15-69;
1997-2000: population aged 15-74.

The total annual labour force participation rate declined from 76.9% in 1989 to 63.9% in 2000. The decline in the participation rates appears to differ across gender. The male participation rate declined by 11.6% from 1989 to 2000, whereas the female participation rate declined by 14.1%. When only examining the period under consideration, i.e. 1995 until 1999, the changes in the participation statistics are far less pronounced and more equal across

gender. From 1995 to 1999 the male participation rate declined by 5.1% and the female participation rate by 4.7%.

Furthermore, the employment rates follow a significant downward trend. Between 1989 and 2000, the overall employment rate has decreased by 21.3%. This translates into a decrease of 21.5% for men and 21% for women. Again, when considering the changes starting from a more mature stage of transition in 1995, the changes are less substantial. The female employment rate decreased by 5.5% and the male employment rate by 6.7%. On the surface the unemployment rates also indicate that women cannot be categorised as the "losers" of transition. The male unemployment rate in 2000 is approximately 2% higher than the female rate. Moreover, between 1989 and 2000 unemployment has increased by 13.2% for men and by 11.2% for women.

The dramatic changes in the composition of the Estonian labour market over the process of transition do not come as a surprise and are a mirror image of the changes experienced by most other transition economies. What distinguishes transition labour markets is the choice of policy. Whether a government opts for a more regulated or deregulated labour market.

From the outset of transition the Estonian labour market was designed to be flexible. Separation costs and the minimum wage were set at very low levels. As output and real wages fell across the region, employers took advantage of the deregulation of the labour market and responded by reducing their workforce. The practice of overstaffing and labour hoarding common in planned economies was outdated and quickly replaced by the need to improve labour productivity. The Law of Employment Contracts introduced in July 1992 anchored the right of employers to fire employees with two months notice into the legal framework. This amalgam of economic necessity and policy not only encouraged the firing of excess labour, but also fostered the creation of temporary employment contracts.

A consequence of the aim of the Estonian government to keep the budget balanced is the lack of funds available to support those hit by unemployment. The level of income support was set

to be very low. Nevertheless, the unemployed were encouraged to take part in programs designed to facilitate the re-entering into the labour force. Additionally, active measures such as the training and retraining of the unemployed and the possibility to participate in public works were introduced.

2.3 Wages and Occupational Segregation

Along with labour market liberalisation came the deregulation of the wage setting process. At the beginning of 1990, the government still determined the minimum and maximum wage. By 1991 only the minimum wage was set. In times determined by the Soviet regime the minimum wage served as a common wage floor and was more or less identical to the average wage. The minimum set by the Estonian government at the beginning of transition was far below the Estonian mean wage. Nevertheless, about 14% of workers were paid the minimum wage or below in 1992 (Haltiwanger and Vodopivec , 1999).

As observed in other countries of the Former Soviet Union, the Estonian wage structure showed signs of decompression shortly after the introduction of the first reform policies. Mean gross monthly wages can be characterised by an upward trend, which is accompanied by an increase in the raw wage differentials between men and women.

Women in Estonia compare favourably to women in European Union countries in terms of educational attainment and labour market experience. Surprisingly, the degree of occupational segregation does not appear to take to take different forms than these experienced by most countries within the Union.

Table 2: Estonian Gross Hourly Gender Wage Ratio in 1995 and 1999

Occupational Group[2]	1995	1999
Legislators, Senior Officials and Managers	74.4	74.8
Professionals	76.2	73.9
Technicians and Associate Professionals	72.1	68.2
Clerks	75.8	**80.7**
Service Workers, Shop and Market Sales Workers	**61.9**	63.4
Craft and Related Trades Workers	80.9	81.1
Plant and Machine Operators and Assemblers	77.0	78.5
Elementary Occupations	**88.5**	**88.0**
All	73.3	73.5

Source: Statistical Office of Estonia; Data of the Estonian Labour Force Surveys
1995: population aged 15-69;
1999: population aged 15-74.

Table 3 shows that the gap between the average wage of men and women is a common phenomenon. The average wage of women in Estonia was 73.3% in 1995, which is similar to a differential experienced by women in Austria and Great Britain. Only Portugal, Greece and Holland have a higher differential. At the other end of the spectrum women earn on average 82% and 88% of average male wages in countries like Finland, Belgium, Sweden, Denmark.

Table 3: Selected Gross Hourly Gender Wage Ratios[3] (%) in 1995

	All	Legislators, Senior Officials and Managers	Professionals	Technicians and Associate Professionals	Clerks	Service workers, Shop and Market Sales Workers	Craft and Related Trades Workers	Plant and Machine Operators and Assemblers	Elementary Occupations
Austria	73.6	67.1	79.9	72.9	80.2	77.7	69.0	72.5	76.2
Belgium	**83.2**	73.0	82.0	85.5	83.9	79.5	83.4	78.8	84.0
Spain	74.0	70.2	78.4	82.8	77.1	78.0	70.7	73.3	82.5
Holland	70.6	**62.0**	74.0	72.0	75.3	71.1	74.9	68.1	76.0
Italy	76.5	73.8	83.7	82.0	78.8	81.8	76.7	74.9	83.9
Greece	68.0	77.9	70.7	73.4	78.1	**64.1**	**59.3**	70.9	80.7
Portugal	71.7	74.9	88.9	84.7	83.7	83.1	**62.9**	72.6	83.0
France	76.6	67.6	79.1	85.6	**91.4**	87.7	80.0	79.7	86.5
Sweden	**87.0**	78.5	87.8	86.5	**96.1**	**95.1**	**91.3**	**95.1**	88.5
Germany	76.9	68.7	80.4	73.2	79.7	69.1	75.7	78.8	81.4
Finland	**81.6**	**81.4**	84.0	78.2	**93.7**	86.0	81.3	81.7	82.7
GB	73.7	67.6	83.7	73.3	**92.7**	82.2	**62.1**	76.4	81.0
Denmark	**88.1**	74.9	86.5	80.1	84.9	84.6	**90.9**	88.5	83.9

Source: Statistics in Focus, 1999.

[2] Average gross hourly wages of women as percentage of male average gross hourly wages.

Overall, Estonia demonstrates similar patterns to other European countries in that the average wage of women has been lower than that of men throughout the 1990's. However, it should be noted that the figures for most EU countries represent an improvement in female mean wages relative to male average wages, whereas women working in Estonia experienced a widening of the differential. In 1989 the average wage for women in Estonia constituted 80% of that of men, while in 1999 it was only 74%.

Previous Literature

Reviewing previous empirical research on the gender wage gap shows that transition economies do not face a homogenous pattern of development of female wages and the gender pay gap over the period of reform.

Paternostro and Sahn (1999) investigate the structure of wages and associated gender discrimination in both rural and urban settings in Romania in 1994. The observed log differential of gross hourly wages in 1994 between men and women is 0.22 in urban areas and 0.16 in rural areas. This translates to women earning on average 80% and 85% of the male wage in urban and rural areas, respectively.

Hunt (1997) uses the German Socio-Economic Panel (GSOEP) to study the development of the gender pay gap after the year of the Monetary Union with Western Germany until 1994. She finds that female monthly wages have risen by 10 percentage points relative to male wages, but that female employment has fallen by 5 percentage points more than male employment. However, she also discovers that the withdrawal from employment of low wage earners can explain about 40 percentage points of the rise in relative female wages. Curiously, she finds that there is no evidence that reduction in childcare availability is a major factor in reducing female employment.

[3] Average gross hourly wages of women as percentage of male average gross hourly wages.

Ogloblin (1999) studies the gender earnings differential in Russia after the first three years of transition from a centrally planned to a market economy. Using the Russian Longitudinal Monitoring Survey (RLMS), he estimates a gender wage ratio of 71.7%. The major component in determining the pay gap is found to be the occupational and industrial labour market segregation by gender. It is argued that the comparatively lower pay in female dominated industries and occupations is determined by the interaction of the institutional framework inherited from the Soviet past and demand shifts emerging over the period of transition.

Newell and Reilly (1997) discovered a more pronounced rise in wage inequality in Russia than in other transition economies. Hence, according to the rational of Blau and Kahn (1994), the Russian gender wage gap should also be more pronounced.

Reilly (1999) explores the link between the rising Russian wage dispersion and the gender wage gap over the transition period from 1992 to 1997. As many other Former Soviet Union countries, Russia experienced a pattern of falling female participation, falling real wages and increased wage inequality. Reilly (1999) reports a 46 percent monthly wage advantage for men over women at the beginning of transition prior to controlling for human capital characteristics. After controlling for human capital characteristics, the analysis identifies increased wage dispersion as an agent for the widening of the gender wag gap in Russia. Conversely, the observed gap exhibits some degree of stability over the time span under consideration, whereas the degree of wage inequality has increased. Lehmann and Wadsworth (2001) take into account the large incidence of wage arrears and its effect on the wage distribution and measures of wage inequality. After allowing for arrears, they find that the mean Russian gender wage gap is 10 percentage points higher than the actual gap in 1996.

Newell & Reilly (2001) investigate the development of the gender earnings gap of seventeen transition economies with various reform experiences. They find that in the countries under

consideration there seems to be no conclusive evidence for an upward trend in the gender wage gap. A conventional decomposition based on least squares wage estimates suggests that a large component of the earnings gap is attributable to unobserved factors influencing average wages. Quantile regression analysis indicates that in all but one country, the ceteris paribus widening of gender wage gap occurs at the top end of the wage distribution.

A prior comparative study can be found in Brainerd (2000). The paper investigates whether women have maintained their previously advantageous position over the early stages of transition in seven formerly socialist countries using household surveys. The author finds that overall average wages for women have increased, except for women in Russia and the Ukraine. The Juhn *et al.* decomposition reveals that Russian and Ukrainian women suffer disproportionately from the widening of the earnings distribution. The observed increase in wage inequality has depressed female relative wages. However, those losses have been more than offset by gains in rewards to observed skills and an apparent decline in discrimination against women.

Orazem and Vodopivec (1996) conducted the only analysis with a specific focus on the Estonian gender wage gap. Their analysis is concerned with labour market outcomes in early transition in Estonia and Slovenia, i.e. from 1989 to 1994. This period is captured by the 1995 Estonian Labour Force Survey (ELFS 95), which includes retrospective wage information for the years 1989, 1992, 1993 and 1994. As noted earlier, Estonia opted for very market orientated labour market policies entailing low separation costs and a very weak social safety net. Slovenia, on the other hand, adopted a more protectionist approach. Workers were shielded from the labour market consequences of transition. An interesting question arising from these contrasting policy approaches is whether women fare better under a regulated or a free labour market. The authors found that in the early years of transition women lost less in terms of real wages relative to men in both countries. Moreover, Estonian as well as

Slovenian women benefited from shifts in the composition of labour demand toward more educated labour and away from low-skill jobs.

However, it is argued that these advantageous shifts in demand are not matched with the necessary labour supply. No substantial growth in female employment shares is observed in the growing sectors. Overall, female employment shares in Estonia have been declining over the period between 1989 and 1994. Consequently, Orazem and Vodopivec (1996) predicted relative wages of women to fall in the future if employment shares continued to fall.

4. Methodology

4.1 The standard Juhn, Murphy and Pierce Decomposition

The Juhn *et al.* methodology (1993) decomposes the Estonian gender wage gap into four components. Two can be labelled gender-specific and the remaining two gender-neutral. Gender-specific factors refer to differences in the distribution of explanatory variables as well as differences in the distribution of the residuals of the two sexes over time. One obvious cause for unequal wages between men and women are differences in the diversity and level of labour market skill, such as the degree of education and further training, for example.

The gender-neutral components emphasise the influence of the change in Estonian rates of return to observed and unobserved skills over the time period under consideration. The male rates or prices are used as an indicator or index for the changing pattern in the Estonian wage structure.

The Juhn *et al.* (1993) decomposition can be viewed as an extension to the Oaxaca (1973) decomposition. Both decomposition techniques hinge on the basic premise that in absence of labour market discrimination the wage structure faced by men also applies to women. The difference between the two approaches lies in the unexplained component. The Oaxaca (1973) method attributes the whole unexplained component of the gender wage gap to

discrimination, whereas Juhn *et al.* (1993) also consider changes in the rewards to observables and unobservables as a possible cause for uneven pay between men and women.

Assuming that the Estonian male wage equation in period t takes the form:

$$\ln W_t^m = X_t^m \beta_t^m + \sigma_t^m \theta_t^m \tag{1}$$

Where $\ln W_t^m$ stands for the mean natural log of male hourly wage, X_t^m is a vector of explanatory variables, β_t^m is a vector of male coefficients, σ_t^m is the standard deviation of male wage residuals and θ_t^m is the standardised male residual, i.e. $\theta_t^m = e_t^m / \sigma_t^m$ where $\theta_t^m \sim (0,1)$.

Assuming that Estonian females are rewarded according to male prices, the constructed female wage equation takes the form:

$$\ln W_t^f = X_t^f \beta_t^m + \sigma_t^m \theta_t^f \tag{2}$$

Where $\ln W_t^f$ stands for the mean natural log of female hourly wage, X_t^f is a vector of explanatory variables, β_t^m is the vector of Estonian male coefficients, σ_t^m is the standard deviation of male wage residuals and θ_t^f is the standardised female residual, i.e. $\theta_t^f = e_t^f / \sigma_t^m$. Note that the mean of the standardised female residual is not zero, as this term is again computed. The term is constructed by first obtaining the hypothetical female wage residual in period t, $e_t^f = \ln W_t^f - X_t^f \beta_t^m$, which is then divided by the male residual standard deviation.

Hence, the gender wage gap in period, t, can be written as follows:

$$\ln W_t^m - \ln W_t^f = (X_t^m - X_t^f)\beta_t^m + (\theta_t^m - \theta_t^f)\sigma_t^m \tag{3}$$

Following Blau and Kahn (1994), the change in the Estonian gender wage gap over the period from 1995 to 1999 may be stated as:

$$D_{99} - D_{95} = \begin{array}{l} (\Delta X_{99} - \Delta X_{95})\beta_{99}^{m} \\ + \Delta X_{95}(\beta_{99}^{m} - \beta_{95}^{m}) \\ + (\Delta\theta_{99} - \Delta\theta_{95})\sigma_{99}^{m} \\ + \Delta\theta_{95}(\sigma_{99}^{m} - \sigma_{95}^{m}) \end{array} \tag{4}$$

Where Δ stands for the mean difference between men and women. Blau and Kahn (1994) labeled the first term of equation (4) the "observed- X's effect". This term reflects changes in observed labour market skill between men and women and its impact on the gender wage gap. If women invest less in education than they used to, ceteris paribus, then the gender gap would widen. The following term, has been labeled the "observed-prices effect". It mirrors the contribution of changes in rewards to labour market skill to the Estonian gap, holding constant the mean difference in male-female observables at the 1995 level. For example, an increase in demand for labour in traditionally "female" jobs, such as jobs in the service sector, for example, would narrow the gender wage gap. Men would on average benefit less from such a shift in demand if women were clustered in these particular sectors of the economy. The third term, called the "gap effect", measures the contribution of changes in the relative position of females within the male residual wage distribution. If unobserved labour market skills of women improve relative to men's or if discrimination decreases, then the position of the average woman in the 1999 male residual distribution will be in a higher percentile than previously in the 1995 male residual distribution. Consequently, such a movement would reduce the gender wage gap. If this were the case, the term labelled the "gap effect" should have a negative sign. The last term, the "unobserved prices" effect holds the position of the average women in the male residual distribution constant and isolates changes in the male residual distribution. An increase in male residual inequality, all else equal, would imply a widening of the gender wage gap. This last term together with the "observed price effect" are

the components of the decomposition, which reflect changes in the relative wage structure over time. The crux of this argument lies in the assumption that in absence of labour market discrimination the wage structure faced by men also applies to women.

If we take a look at equation (2), we can see that even if women have more favorable labour market endowments from one period to the next, this does not necessarily imply that the average wage of women increases. The overall change in wage structure has the potential to counteract the theoretically positive effect of this improvement on mean wages via β_t^m and σ_t^m. However, one should not forget that it is not only the wage structure that can hinder women catching up with male wages, but also discrimination. Although the Juhn *et al.* decomposition allows for further insights into the movements of the unexplained component, it does not isolate the wage structure effect from discrimination, making any judgement about the degree of discrimination or the influence of the wage structure on the gender earnings gap a subjective matter.

An alternative to considering the male wage structure as the reference point is to compute the decomposition with female prices as the index. As in the absence of discrimination, the wage structure currently faced by women would also applies to men (Oaxaca, 1973) the decomposition can be computed to be:

$$D_{99} - D_{95} = \begin{array}{l} (\Delta X_{99} - \Delta X_{95})\beta_{99}^f \\ + \Delta X_{95}(\beta_{99}^f - \beta_{95}^f) \\ + (\Delta\theta_{99} - \Delta\theta_{95})\sigma_{99}^f \\ + \Delta\theta_{95}(\sigma_{99}^f - \sigma_{95}^f) \end{array} \tag{5}$$

As it is assumed that in a non-discriminatory world, men and women face an identical wage structure, so that the difference between the four terms in equation (4) and (5) could be interpreted as labour market discrimination.

4.2 The Quantile Regression Approach

Equation (1) and (2) are estimated via least squares. Dropping the gender index, the fitted curve is a prediction of the mean of $\ln W_i$ given a vector of explanatory variables, X_i, implying constant model parameters throughout the whole distribution of the dependent variable. In other words, the marginal effect of an explanatory variable on gross monthly wage is assumed to be constant over the entire wage distribution.

An alternative tool to explore the distributional effects of the change in the gender wage gap over time is the Quantile Regression Method (QRM). [4]

Instead of minimizing the sum of squared residuals, the sum of absolute residuals is minimized. The special case of the median regression estimator leaves 50% of the observations above the median and the remaining 50% below the median. Other conditional quantile functions are estimated by minimising an asymmetrically weighted sum of absolute errors.

Assuming that the ϕth quantile of the conditional distribution of $\ln W_i$ given X_i is linear, the wage equation of interest can be written as:

$$\ln W_i = X_i \beta^{\theta} + u^{\theta}{}_i \quad , \tag{6}$$

$$Q_{\phi}(\ln W_i \mid X_i) = \ln W_i^{\theta} = X_i \beta^{\theta}$$

where X_i is a vector of explanatory variables and β^{θ} is a vector of coefficients. Equation (6) shows the conditional quantile of $\ln W_i$ given X_i. Additionally, it is assumed that u_i^{θ} takes the form

$$u_i^{\theta} = \ln W_i - X_i \beta^{\theta} \tag{7}$$

[4] Furthermore, it has been found that in the presence of non-normal disturbances and influential outliers, least squares is not a robust estimation method (Koenker and Bassett, 1978, Buchinsky, 1994).

From equation (9) it follows that

$$Q_{\phi}(u_i^{\theta} \mid X_i) = 0$$

The minimization problem can be stated as

$$\psi_{QRM} = \phi \sum_{i|\ln W_i \geq X_i\beta^{\theta}}^{n} |\ln W_i - X_i\beta^{\theta}| + (1-\phi) \sum_{i|\ln W_i < X_i\beta^{\theta}}^{n} |\ln W - X_i\beta^{\theta}| \qquad (8)$$

It can be seen from equation (8) that this method potentially generates distinct $\beta's$ at different quantiles. The unequal returns to characteristics can be interpreted as variations in the response of log wages to changes in the explanatory variables at different positions in the conditional distribution of the dependent variable.

As the least squares version of the decomposition, the QRM version also relies on a human capital based Mincerian earnings function, which is estimated separately for men and women. Assuming that the Estonian male wage equation of the ϕth percentile in period t takes the form:

$$\ln W_m = X_m\beta_m^{\theta} + \sigma_m^{\theta}\theta_m^{\theta} \quad , \qquad (9)$$

where the variables are defined in the same way as before, but referring to a particular quantile of the wage distribution.

By the same token, the female wage equation at the ϕth percentile can be written as:

$$\ln W_f = X_f\beta_f^{\theta} + \sigma_f^{\theta}\theta_f^{\theta} \qquad (10)$$

Where again the variables are defined as before, but refer to different quantiles.

Since in the absence of discrimination men and women are rewarded to the same wage structure, observed and unobserved:

$$\ln W_f^* = X_f\beta_m^{\theta} + \theta_f^{\theta}\sigma_m^{\theta} \qquad (11)$$

The gender wage gap at the ϕth percentile can be decomposed into:

$$\ln W_m - \ln W_f = (\ln W_m - \ln W_f^*) + (\ln W_f^* - \ln W_f) \tag{12}$$

After rearranging and substituting, the gender wage gap can be further decomposed into:

$$\ln W_m - \ln W_f = \begin{array}{l} (X_m - X_f)\hat{\beta}_m^\theta \\ + (\hat{\beta}_m^\theta - \hat{\beta}_f^\theta) X_f \\ + (\theta_m^\theta - \theta_f^\theta)\sigma_m^\theta \\ + (\sigma_m^\theta - \sigma_f^\theta)\theta_f^\theta \end{array} \tag{13}$$

Where the first term of the decomposed wage gap reflects the difference in mean labour market characteristics between men and women in the sample. The following term accounts for the difference in rewards for those characteristics at the ϕth percentile. The third term corresponds to the difference in percentile positions of men and women within the residual distribution of Estonian men at the ϕth percentile. The last term reflects the difference in unobservable prices or the difference in spread of the distribution of unobservables at the ϕth percentile.

5. The Data

The wage equations in this paper are estimated using data from the Estonian Labour Force Survey in 1995 (ELFS 1995) and the Estonian Labour Force survey in 1999 (ELFS 1999). The ELFS 95 is the first of a series of continuos labour force surveys that have been carried out in Estonia according to the methodology of the International Labour Office to date. It covers the labour market histories of 9608 individuals between the age of 16 and 75 as of the 1st January 1995. For the ELFS 99, 12703 residents of Estonia between the age of 15 and 75

have been interviewed. Both surveys have a retrospective section in which information about employment changes is recorded. Including this retrospective part, the ELFS 95 ranges from 1989 to 1995, and the ELFS 99 ranges from 1998 to 1999. Although the retrospective section enables one to follow individuals over time, it should be noted that it is not possible to track the full labour market history of individuals from 1989 to 1999 as different individuals were selected for interviews in all four surveys. Nevertheless, these extensive datasets all include information about employment, unemployment and inactivity during the survey week, as well as a rich subset of other demographic and personal characteristics.

As the present analysis is of a comparative nature, some clarification about the comparability of the data has to be made. First, the sample size of the two different surveys was different. 9608 persons, constituting about 1 percent of the working-age population of Estonia were interviewed during the ELFS 95. Whereas 12703 persons, about 1.2 percent of the Estonian working population were interviewed during the ELFS 1999. According to the Statistical Office of Estonia, the ELFS 99 can be considered more accurate and reliable than the ELFS 95. Furthermore, the sample frame of the ELFS 95 was the database of the 1989 population census, which considering the population changes in the meantime, was outdated. A lot of persons had left Estonia, had died or it was impossible to locate them due to a change of the place of residence. As the sample frame for the ELFS 99, the population database of the Andmovara Ltd. or the so-called population register was used.

For the human capital based wage regression a sub-sample of employees working full-time was selected. In both surveys part-time workers are those employed whose overall working time per week is less than 35 hours. An employee is defined as a person who is employed either full- or part-time in an enterprise, organisation or other employer and who receives payment in money or kind [5]. The 1995 subsample consists of 7495 observations of which 48

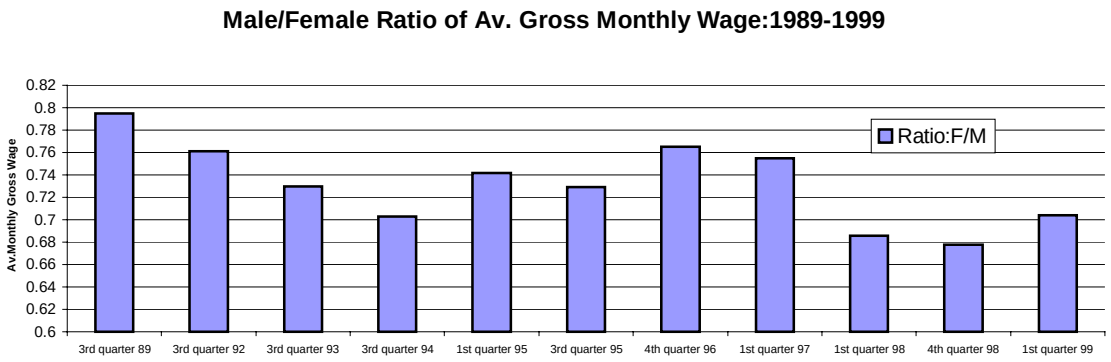
[5] Officers, non-commissioned officers and people earning their living doing odd jobs are also considered to be employees.

% are men and 52% are women. The 1999 subsample consists of 2661 observations of which 50 % are men and 50% are women. The following standard independent variables were chosen: educational dummies coded according to the ISCED 97, a marital status dummy, tenure, tenure squared, experience, experience squared, a set of firm size dummies, a full set of occupational dummies coded according to ISCO-88, a full set of economic activity dummies coded according to NACE REV.1, six locational dummies, and a dummy for Estonian language. Although the majority of variables are identical in definition, and are therefore comparable over the two periods under consideration, some "smoothing" was necessary to accommodate several changes in the formulation of interview questions in the two labour force surveys. In the tables of the section on education of the ELFS 95 the ISCED 76 codes have been used, whereas for the ELFS 99 the education levels were categorised according the ISCED 97 codes. In order to make the education levels comparable over the two time periods, the educational dummies for both years were coded using the ISCED 97 codes. There is also a minor difference in the possible answers to the question ‘‘How many persons were employed at this enterprise?’’ In the ELFS 99 there are ten possible sizes to chose from, but there there are only eight in the ELFS 95 and, instead of subdividing the groups starting from 10 employees (ELFS 95), they started from 11 in the ELFS 99.

As there is quite a substantial percentage of ethnic Russians residing in Estonia (approximately 30%) it is of interest to investigate the effects of ethnicity on wages. Unfortunately, unlike in the ELFS 95, the direct question of ethnic origin was not included in the 1999 survey questionnaire. Therefore, instead of controlling for the individuals' ethnic origin, Estonian language proficiency was controlled for. As the Estonian Labour Market board distinguishes jobseekers on the basis of their first language and not their ethnicity, it was felt that the definition was appropriate.

6. Empirical Results

Figure 1: Development of the Mean Wage Ratio between Men and Women in Estonia



Source: Estonian Labour Force Surveys

Figure 2 shows the development of the male/female ratio of average gross monthly wages between 1989 and 1999[6]. The ratio does not seem to have reached some form of "steady-state", but is visibly fluctuating during the 1990's. Nevertheless, the figure reflects a slight downward trend in female wages relative to male wages. However, as can be easily depicted, an analysis of the development of the gender wage gap will have different results depending on the time period under consideration.

Two separate hourly adjusted human capital based earnings equation were estimated for men and women in order to compute the different components of the decompositions à la Blau and Kahn (1994). The explanatory variables included in the regression equation and their definition can be found in the Appendix in Table A.5.

The results of the traditional Juhn *et al.* (1993) wage gap decomposition are presented in Table 4.

Table 4: Mean Gender Wage Gap Decomposition (1995-1999)

Sum	0.0678
Gender Specific	
Observed X's	0.0276
Gap Effect	0.1096
Wage Structure	
Observed Prices	-0.0351
Unobserved Prices	-0.0342

Gender specific effects relate to the first and third term of equation (4). The development of the difference in observed and unobserved labour market endowments over time. The wage structure effects relate to the second and fourth term of equation (4), capturing changes between 1995 and 1999 in the gender wage gap which are due to changes in the rewards or prices of the observed and unobserved sample characteristics.

The first row of table 4 shows that the mean Estonian gender wage gap has increased by 0.0678 log points, which translates to an increase of approximately 7%. Blau and Kahn (1994) suggested that the labour market progress of women in the United States was impeded by an increase in wage inequality. In Estonia the reverse is the case. The sum of the components accounting for changes in the wage structure has a negative impact on the growth of the gender wage gap between 1995 and 1999.

In conjunction with the finding that wage inequality has decreased over the two periods (table A.1), it can be argued that the effect of the development of the wage structure on the gender wage gap works in favor of women. In fact, the wage structure components counteract the gender specific components, which contribute to a widening of the gap.

When looking at the proportion of the four components in explaining the overall development of the gender wage gap, the size of the "Gap effect" stands out. This term measures the change in the percentile position of women between 1995 and 1999 within the male residual

[6] The ratio representation was chosen, because the 1989 wage was paid in Ruble and is therefore not directly comparable.

distribution of 1999. Hence, this result can be viewed as the absence of improvement of the position of women within the male residual distribution or an increase in discrimination.

Another interesting finding is that there appears to have been a widening in the gap between male and female observables. This is indicated by the positive sign of the term labeled "Observed X's" and can be interpreted as a deterioration of female labour market skills relative to male skills.

The next step of the analysis is to determine whether the development of the gender wage gap is constant over the entire conditional wage distribution.

Table 5: Quantile Regression Estimates of the 1995 Estonian Gender Wage Gap

	Men 2243 Obs.	Women 2043 Obs.	Gap
10th Percentile			
Predicted	1.31975	1.27145	0.04830
Residual	0.81815	0.68705	0.1311
Sum	2.13790	1.9585	0.179401
25th Percentile			
Predicted	1.74934	1.65434	0.09499
Residual	0.38856	0.30416	0.0844
Sum	2.13790	1.9585	0.179401
50th Percentile			
Predicted	2.17058	1.98681	0.18377
Residual	-0.0327	-0.0283	-0.061
Sum	2.13790	1.9585	0.179401
75th Percentile			
Predicted	2.57817	2.29959	0.27858
Residual	-0.4403	-0.3411	-0.0992
Sum	2.13790	1.9585	0.179401
90th Percentile			
Predicted	2.91062	2.59492	0.31571
Residual	-0.7727	-0.6364	-0.1363
Sum	2.13790	1.9585	0.179401

Table 5 shows the predicted hourly wage for Estonian men and women in 1995 at different percentiles. In the column labeled "Gap" it can be clearly observed that the gap between male and female predicted wages increases as we move up the wage distribution.

The table also gives an empirical impression of the properties of the QRM estimators. Unlike the least squares estimators, the hourly wage predicted at the average vector of explanatory variables of the sample is not equal to the average hourly wage within a particular quantile.

Table 6 shows the predicted wage at different percentiles for Estonian men and women in 1999.

Table 6: Quantile Regression Estimates of the 1999 Estonian Gender Wage Gap

	Men 1210 Obs.	Women 1231 Obs.	Gap
10th Percentile			
Predicted	2.296052	2.224034	0.072019
Residual	0.633641	0.4584246	0.175216
Sum	2.929693	2.682458	0.247235
25th Percentile			
Predicted	2.607037	2.441299	0.165738
Residual	0.322656	0.2411588	0.081497
Sum	2.929693	2.682458	0.247235
50th Percentile			
Predicted	2.962611	2.673951	0.28866
Residual	-0.03292	0.0085069	-0.04143
Sum	2.929693	2.682458	0.247235
75th Percentile			
Predicted	3.236646	2.938468	0.298178
Residual	-0.30695	-0.25601	-0.05094
Sum	2.929693	2.682458	0.247235
90th Percentile			
Predicted	3.526824	3.178855	0.347969
Residual	-0.59713	-.4963971	-0.10074
Sum	2.929693	2.682458	0.247235

A similar picture than in 1995 emerges: The gap widens as the upper parts of the wage distribution are reached.

Table 7 summarises the gender wage gap at different percentile positions for the two time periods under consideration.

Table 7: Development of the Estonian Gender Wage Gap

	1995	1999	Development of Gap
Mean	0.1794	0.2472	0.0678
10th Percentile	0.0483	0.0720	0.0237
25th Percentile	0.0949	0.1657	0.0707
50th Percentile	0.1838	0.2887	0.1049
75th Percentile	0.2786	0.2982	0.0196
90th Percentile	0.3157	0.3479	0.0323

The last column illustrates that the development of the gender wage gap is not homogenous across the conditional wage distribution as the decomposition at the mean values suggests. Although the gap is growing at all positions of the wage distribution, above average growth occurs at the 25th percentile and at the median. Moving further up the distribution, the gap at the 75th percentile grew at a third of the mean value, whereas at the top quantile the gap grew by approximately 3%.

The result of the Juhn *et al.* decomposition at different quantiles for both years can be found in table 8.

Table 8: Quantile Regression based Juhn *et al.* Decomposition

	1995	1999	Magnitude of Component 1995	Magnitude of Component 1999
10th Percentile				
Observed X's	0.049	0.03749	27.652	15.167
Observed Prices	-0.0013	0.03452	- 0.275	13.962
Gap Effect	-0.4519	-1.6249	-251.943	-657.235
Unobserved Prices	0.5831	1.8001	325.018	728.105
Sum	0.1794	0.2472	100	100
25th Percentile				
Observed X's	0.0554	0.0401	30.856	16.253
Observed Prices	0.0396	0.1255	22.097	50.783
Gap Effect	-1.3054	-2.2441	-727.659	-907.720
Unobserved Prices	1.3898	2.3255	774.706	940.683
Sum	0.1794	0.2472	100	100
50th Percentile				
Observed X's	0.0632	0.0854	35.238	34.552
Observed Prices	0.1205	0.2032	67.194	82.203
Gap Effect	-2.1400	-2.9101	-1192.878	-1177.061
Unobserved Prices	2.1357	2.8686	1190.444	1160.306
Sum	0.1794	0.2472	100	100
75th Percentile				
Observed X's	0.0602	0.0714	33.537	28.878
Observed Prices	0.2184	0.2268	121.743	91.726
Gap Effect	-2.958	-3.4722	-1648.970	-1404.415
Unobserved Prices	2.8591	3.4213	1593.690	1383.810
Sum	0.1794	0.2472	100	100
90th Percentile				
Observed X's	0.1155	0.0487	64.358	19.7099
Observed Prices	0.2002	0.2992	111.619	121.0344
Gap Effect	-3.5679	-4.075	-1988.778	-1443.117
Unobserved Prices	3.4316	3.9744	1912.800	1607.578
Sum	0.1794	0.2472	100	100

Due to the properties of the QRM estimators the interpretation of the different components differs from the least squares based decomposition. For example, the “Observed Prices” effect measures the difference in mean labour market characteristics between men and women in either 1995 or 1999 and not the development of these characteristics over time.

There appears to occur a decrease of the magnitude of the “Observed X’s” effect between 1995 and 1999 at every quantile. This development is particularly strong at the 90th percentile. The difference in the magnitude of the “Observed Prices” effect between 1995 and 1999 is mostly visible in the lower quantiles. For example, at the 10th percentile the component had a negative impact on the gender wage gap in 1995, whereas in 1999 it had a positive impact. Looking at the components concerned with the unobservables of the Estonian wage distribution, it could be argued that the biggest change occurred at the lower quantiles.

Although further research is necessary in order to clarify the interpretation of the different components of the decomposition, it is evident that the magnitude of the different components changes across the distribution of wages.

Conclusions

The present investigation into the development of the gender earnings gap between 1995 and 1999 in Estonia revealed that the movement from the mature state of transition to a functioning market economy entailed changes in the distribution of wages that were not homogeneous across gender. By means of the least squares based Juhn *et al*. methodology, the increase of the Estonian gender wage gap of approximately 7% was decomposed into four components. It was found that the main cause for the increase in the pay differential is the absence of improvement of the position of women within the male residual distribution. However, the magnitude of the influence of this so-called "Gap effect" on the change in the pay differential was reduced by the counteracting sum of the wage structure components. In other words, the fall in observed wage inequality between 1995 and 1999 has a negative impact on the widening of the gender gap.

The extension of the analysis to quantile regressions provided remarkable insights into the dynamics of the differential over the entire distribution. It was shown that the wage gaps between men and women for both years increase in size as we move up the wage distribution. Performing the Juhn *et al.* decomposition at different quantiles for both years reveals that the magnitude of the gender specific and wage structure effects are not homogeneous across the distribution.

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Table A.1: Inequality Measures of Hourly (Gross) Wages of Full-Time Employees in Estonia

	1995	1999
Relative mean deviation	0.2818	0.2375
Gini coefficient	0.4019	0.3333
Theil entropy measure	0.3611	0.1898

Source: Estonian Labour Force Surveys

Table A.12 Variable Definition List

lnwage	*Natural log of hourly gross wages of a full time employee*
Regional Dummies	
Tallinn	=1 if individual lives in Tallinn- **Base category**
South	=1 if the individual lives in Vorumaa, Valgamaa or Polvamaa
Nrthcntl	=1 if individual lives in Raplamaa, Laane-Virumaa or Jarvamaa
Sothcntl	=1 if individual lives in Viljandimaa, Tartumaa, Jogevamaa or Ida-Virumaa
West	=1 if the individual lives in Saaremaa, Parnumaa or Laanemaa
Harjumaa	=1 if the individual lives in Harjumaa
NACE Rev.1	
ind_o	=1 if individual works in community, social & personal service activity
ind_n	=1 if individual works in health & social work
ind_m	=1 if individual works in education
ind_l	=1 if individual works in public administration and defence; compulsory social security
ind_k	=1 if individual works in real estate, renting and business activities
ind_j	=1 if individual works in financial intermediation
ind_i	=1 if individual works in transport, storage & communications
ind_h	=1 if individual works in hotels & restaurants
ind_g	=1 if individual works in wholesale & retail trade; repair of motor vehicles, motorcycles & personal & household goods
ind_ef	=1 if individual works in electricity, gas & water supply & construction
ind_d	=1 if individual works in manufacturing
ind_c	=1 if individual works in mining & quarrying
ind_ab	=1 if individual works in agriculture, hunting & forestry & fishing- **Base category**
ISCO 88	
occup_9	=1 if individual works in Elementary occupations- **Base category**
occup_8	=1 if individual works as Plant or machine operator and assembler
occup_7	=1 if individual works as Craft and related trades worker
occup_6	=1 if individual works as Skilled agricultural or fishery worker
occup_5	=1 if individual works as Service worker or shop and market sales worker
occup_4	=1 if individual works as Clerk
occup_3	=1 if individual works as Technicians or associate professional
occup_2	=1 if individual works as Professional
occup_1	=1 if individual works as Legislator, senior official or manager
Firm Size	
large	=1 if individual works in an enterprise with >200 employees
medium	=1 if individual works in an enterprise with 50-199 employees
small	=1 if individual works in an enterprise with 11-49 employees
micro	=1 if individual works in an enterprise with 11-10 employees- **Base category**
expsq	Age when entered the labour market minus age at time of survey squared
exp	Age when entered the labour market minus age at time of survey squared
ten95sq	Number of years of tenure at time of survey squared
ten95	Number of years of tenure at time of survey
marr95	=1 if individual is married/cohabiting
Education Level	
educ_7	ISCED 97 level category 7
educ_6	ISCED 97 level category 6
educ_5	ISCED 97 level category 5
educ_3	ISCED 97 level category 3
educ_2	ISCED 97 level category 2
educ_1	ISCED 97 level category 1- **Base category**
Est_lan	=1 if individual writes and speaks Estonian