Does Unmeasured Individual Ability Explain the Existence of Inter-Industry Wage Differentials? Evidence from Georgian Quarterly Household Data

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Abstract

A large volume of the literature documents the existence of large and persistent wage differentials among industries for workers of comparable skills. This thesis provides empirical evidence measuring the extent to which unobserved abilities explain the existence of highly persistent inter-industry wage differentials, based on Georgian quarterly household longitudinal data that allow us tracking workers over time. We find that inter-industry differentials that are measured on a cross-sectional basis reflect inter-industry variations in unmeasured labor characteristics. When estimated at longitudinal level the dispersion of inter-industry wage differentials measured by weighted standard deviation decreases roughly seven times and the actual differentials reduce 4-5 times, indicating that a substantial part of the differentials merely reflect differences in labor quality across industries. In addition, we check whether there is endogeneity of mobility within the longitudinal model by Instrumental Variables (IV) method, concluding that endogeneity of mobility is not a major source of bias in the model and the results of the test are fully consistent with our earlier findings.

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Introduction

The essential characteristic of a perfectly competitive labor market is that workers receive the compensation that is equal to their opportunity cost. It also assumes that the job attributes that do not directly affect the utility of a worker should not have any effect on the level of earnings. However, many studies, such as Krueger and Summers (1988) have shown that workers with similar measured characteristics can earn higher or lower wages depending on their industry of employment. These studies have also shown that these wage differences are quite large and persistent even after controlling for a wide range of individual and firm characteristics. A great deal of studies done on developed countries, such as Lucifora (1993) (Italian data) and Goux and Maurin (1999) (French data) have shown that this phenomenon is not only a transitory effect characterizing countries in transition, but the differentials of comparable magnitude are found in case of developed countries as well.

One possible way to explain persistent wage differences among observationally similar workers in competitive labor markets is that some key individual determinants of wages, so called “unobserved abilities” (physical endurance, innate ability, motivation, intellectual abilities, or any human trait that is missed out from the data set), may not be included in the regression. Workers with the greatest unmeasured abilities may be more numerous in some industries than in others. Industries that employ proportionately more high-ability workers pay higher average wages to observationally equivalent workers. If that is so, wages paid in these industries will very likely seem higher than in other industries, even when wages are set competitively. In sum, it may be that the only difference between the high-wage industries and the others is the particularly high (unmeasured) quality of their workforce. On the other hand, some authors such as Katz (1986) focus not on the nature of inter-industry wage differentials, but on their appropriate theoretical explanation. One category of model stresses the noncompetitive mechanisms of wage determination, such as differences in workers bargaining strength from one industry to another and the benefits to employers of securing a loyal, disciplined workforce through high wages.

Due to data deficiencies and absence of relevant research traditions, little empirical work has been undertaken in Georgia to measure the characteristics of workers and structure of wages. Data requirements that are necessary to estimate model of the type that is presented in this paper are quite high. Appropriate controls for individual characteristics, in addition to job and industry attributes, are absolutely necessary to be included in the analysis. The data set utilized in this study satisfies most of the basic data requirements and additionally allows us to track workers for sufficiently long period of time.

This thesis provides empirical evidence measuring the extent to which the unobserved individual abilities explain the existence of inter-industry wage dispersion in Georgia. The study does not aim to develop a new theory that would give a better explanation to the phenomenon of inter-industry wage dispersion, but merely attempt to measure actual magnitude and persistence of inter-industry wage differentials from Georgian quarterly household data and check the extent to which unobserved abilities explain this dispersion.

The paper is organized as follows. Since there are big differences among the conclusions derived by different authors about the question of interest, Chapter I summarizes the existing theories of inter-industry wage differentials and the empirical works done in support of these theories. In Chapter II we discuss basic features of data utilized in the study. The chapter discusses the methodology that was used in data-collection, and also discusses potential advantages and disadvantages of the data set that allows us to utilize certain econometric methods.

Chapter III focuses on the Georgian labor market setup and discusses the basic market indicators: unemployment rate dynamics across regions and industry composition of the economy. In addition, the chapter gives a simple analysis of inter-industry wage differential persistence by focusing on industry wage averages for the first and last years. Further in the chapter, following Keane and Prasad (2006), we make a simple decomposition of the wage dispersion into components attributable to changes across industries versus increases in inequality within industries. For this reason we focus on cross-sectional variance of log-wages and split it into two core components.

In Chapter IV we develop cross-sectional model of wages and estimating several wage equations in order to examine the importance of industry affiliation in explaining relative wages. In these estimations we control for the wide range of individual characteristics: human capital, demographic background, regional affiliation and so on. We also discuss endogeneity problems that arise from the fact that some individual abilities that affect wage rate determination, and could be correlated with industry affiliation, such as physical endurance, innate ability, motivation and intellectual abilities, are not controlled for in the regression and therefore the model yields potentially biased estimates.

In Chapter V we account for the fact that some of the important human characteristics affecting wage determination are not reflected in the data set, and set up a fixed-effects model that eliminates time-fixed factors influencing wage-determination for an individual. Since physical endurance and intellectual abilities are time-invariant, fixed-effects estimation removes this source of bias and yields less biased inter-industry wage differentials. This assumption would be valid only in case the inter-industry mobility is exogenous within the longitudinal model. If the inter-industry mobility and wage differentials have the same determinants, then fixed-effects estimates are potentially biased. Chapter VI checks for this potential bias by utilizing instrumental variable (IV) method developed by Murphy and Topel (1987).

In the final chapter we analyze the estimated results, comment on the problems faced during the estimation, explain potential biases and measurement errors associated with the methods used and make concluding remarks.

Chapter I. Theories of Inter-Industry Wage Differentials and Empirical Evidence

Standard competitive theory suggests that equally productive workers receive compensation schemes that would provide an equal level of utility. The remuneration would depend solely on workers abilities and would not be influenced by the characteristics of an employer. Inability to find relevant empirical evidence to support this theory would facilitate appearance of alternative theories stating that true wage differentials exist across industries, even for identical workers. Such industry wage differentials arise in the models of efficiency wages compensating differences, rent sharing, and in many others. In this section we discuss four basic theories explaining large and persistent wage differentials.

As mentioned above, one explanation of persistent wage differences among observationally similar workers in competitive labor markets rests on differences in workers' productive abilities that are not captured in individual-level data sets. High-ability workers earn higher average wages; industries that employ proportionally more high-ability workers pay higher average wages to observationally equivalent workers. This theory is supported by the empirical findings of Katz (1987), Helwege (1989), and Murphy and Topel (1987, 1990). It is worth noting that this hypothesis does not deviate from standard competitive theory of wage determination, since the reason for higher wages is workers ability that we can not capture in the estimation.

Goux and Maurin's (1999) findings also support the "unmeasured abilities" hypothesis. They estimate inter-industry wage differentials using new French longitudinal data that allow them to track workers and their firms over time. The authors find that, when measured on a cross-sectional basis, they primarily reflect the inter-industry variations in unmeasured labor quality. However, through the matched employer-employee data they control for firm-level effects and find that inter-industry wage differentials are only a minor component of inter-firm wage differentials. These findings are much closer to those of

Murphy and Topel (1987) than to those of Krueger and Summers (1988) that are discussed further in this chapter.

The second model explaining inter-industry differentials is efficiency wage theory. The theory holds on the assumption that some firms pay higher wage than the going wage for the workers of the type they attract. The rationale for doing so can be either these firms do not profit-maximize, or they find paying higher wages more profitable. The latter alternative is on what efficiency wage theory holds.

According to efficiency wages there are at least four reasons why employers pay wages above going wage levels. Firstly, it is believed that workers are paid in excess to avoid high turnover costs (Salop (1979), Stiglitz (1974) and (1985)). If turnover costs are responsive to wage rate increases, then there may be an incentive to pay higher remuneration. The second possibility is that increasing wages raise employee effort level (Shapiro and Stiglitz (1984)). Workers who are paid only their opportunity cost may have little incentive to perform well, since dismissal from the current job would not be costly. By larger wages employers may simply improve worker performance. The third reason states that workers loyalty to the firm increases with the extent to which the firm shares its profits with them. And lastly, the final reason is about selection: firms that pay high salaries attract a higher quality pool of applicants.

In this respect it is necessary to mention Krueger and Summers (1988), who present estimates of the effects of industry switches on wages through a first-differenced regression on matched May Current Population Survey (CPS) data. After attempting to correct for false industry transitions, Krueger and Summers (1988) estimate that the industry wage differentials from the first-differenced regression are significant, of the same sign, and close in magnitude to the cross-section regression estimates. In this way they reject the competitive wage determination hypothesis and conclude that their empirical finding casts "serious doubt on 'unmeasured labor quality' explanations for inter-industry wage differences". In other words, (after controlling for other observables) workers moving from high- to low-wage industries experience a wage decrease, while those moving from low-to high-wage industries experience a wage increase. Moreover, the size of these wage changes is similar to the difference between the relevant industry wage differentials estimated in a cross-section.

The third model postulates that the finding of stable inter-industry wage differentials could be explained by pointing to compensating differentials. The compensating differentials argument is that agreeable and disagreeable job attributes vary systematically with one's industry of employment, and therefore necessitate wage differentials to compensate employees for non-wage aspects of the industry. Attempts to find empirical evidence supporting this theory can be found in Brown (1980) and Smith (1979).

The final model of rent sharing is based on the numerous empirical findings stating that profitable firms pay higher wages even when controlling for human capital characteristics and firm fixed effects. In other words, the rent-seeking model predicts a positive correlation between profitability of the firm and the wage rate paid to the employees. Based on this model we would expect that industries with high profit margin would be paying higher wages compared to the industries with lower profit margins. Empirical evidence for this theory can be found in Plasman, Rycx and Tojerow (2006), who utilized the Belgian firm-worker matched data set.

The empirical findings on inter-industry wage differentials are very diverse, and pointing to different explanations of wage dispersion. The data set that is utilized in this thesis does not allow checking non-competitive explanations of wage dispersion, and therefore we solely focus on unobserved ability theory of inter-industry-wage differentials and try to find empirical evidence from Georgian household data in support of this hypothesis.

Chapter II. Data Description[1]

The sample utilized in the paper is derived from the Quarterly Household Survey (QHS) conducted by State Statistics Department of Georgia (საქართველოს სახელმწიფო სტატისტიკის სამმართველო) for the period 2002-2006 (18 quarters). The Quarterly Household Survey “Shinda” (შინდა) is one of the essential surveys of the Georgian statistical system and is used in particular as the source for official annual statistics on jobs, employment and poverty monitoring. The QHS project was set up and implemented at the Statistics Department during 1995-97. Actual surveying activities started in July 1996 covering the entire country, excluding only the Abkhazia and Tskhinvali regions (due to unresolved territorial conflicts). Therefore the sample is representative of the Georgian population.

Selection criterion for the QHS households is based on randomly pre-selected addresses. This ensures that the QHS sample satisfies IID condition. The entire number of such addresses is 3,351. Selection is based on a two-step procedure. The first step includes choosing survey districts. According to the Georgian Population Survey of 2002, the entire territory of Georgia was divided into 16,600 such districts, 1.2 million households and 4.4 million inhabitants. 300 out 16,600 districts are chosen on a regional basis and at the second step 3,351 households from selected districts are asked to fill out the questionnaire. 2002-2006 period survey includes 170,221 observations distributed among 12 industries and 9 different occupations.

The QHS includes a limited panel element. The chosen districts are divided into 12 rotational areas on regional basis. 8.3% of the pool of surveyed individuals is renewed monthly by including new households; therefore the data set is totally renewed during one year and each household stays at most for one year in the data set. The structure of the data allows us to track a significant number of individuals for 2-4 successive quarters. However,

[1] The chapter is based on information from the web site of State Statistics Department of Georgia

the panel loses individuals who move to a new address or refuse to cooperate with the interviewers.

Restricting ourselves to the observations without missing educational information, having wage above nine Georgian Laris (a minimum wage for the study period) and also removing observations with typo mistakes (such as observations with numbers indicating incorrect education level), we are left with 10,426 individuals. We also exclude self-employed people with zero wages that are mostly concentrated in agricultural sector.

The data set has several strengths and weaknesses. The obvious advantage of the data is that for each worker, the QHS covers the data items that are standard in surveys of this kind: age, sex, nationality, educational attainment, industry, sector, occupation, region of residence and so on. The QHS contains detailed information on sources and amounts of income from hired employment for individuals within each household received in the month prior to the survey. Total labor income is broken down into three main components: salary from the primary job, bonus received from primary employment, and income received from an additional job. A potential source of measurement error for wages is that the value of in-kind benefits is incorporated into the salary of an employee. As Keane and Prasad (2006) indicate, the in-kind payments from employers to workers have been an important part of worker's compensation in many transition economies. Individuals are asked to make a valuation of the received in-kind benefits in monetary terms and indicate it in the questionnaire. Since such evaluations are very subjective, it creates room for potential errors.

Another strength of the data is that although the survey is conducted quarterly and therefore each individual is traced at most for 4 quarters, there is large variation in industry (2,303 industry-changers, out of which 641 individuals change industry twice), in occupation (4,109 occupation-changers) and in the sector of employment (3,502 sector of employment changers). The large variation in these variables allows us to account for unobserved individual abilities that are not measured through standard questionnaires by utilizing panel features of the data. Such a large variation of the quarterly data may be due the fact that some industries of the Georgian economy are still experiencing a restructuring process and therefore inter-industry mobility of the labor force is still at high levels even a decade after the transition. On the other hand, another reason for the existence of large number of industry changers could be classification errors that was described by Mellow and Sider (1983). They used direct evidence obtained from the employers of a subset of a CPS (Current Population Survey) sample to estimate the extent of measurement error in answers to CPS questions about industry of employment. In addition, Murphy and Topel (1987) also argue that individuals in CPS are subject to measurement and coding errors, so the sample of individuals who change reported industry may vastly overstate the frequency of true transitions in the data. The evidence presented by Mellow and Sider (1983) suggests that the large fraction of reported industry switches do not reflect labor mobility from one industry to another, but are merely the result of classification errors.

The disadvantage of the data is that it contains absolutely no information about a firm the individual is employed at (such as size). Due to the lack of relevant variables, the data do not allow us to account for the fact that there may be high-wage and low-wage companies within each industry and wage differences among individuals may be largely due to inter-firm differentials, rather than due to inter-industry differences. Unfortunately it is impossible to account for firm specific effects with the QHS data as Goux and Maurin (1999) do through matching employees to employer and achieving high levels of precision. One more drawback of the data is that it does not contain information about an individual's tenure with the current employer that can account for large part of the wage differentials.

Another disadvantage of the data is that wage is measured with large measurement errors. During 2002 to 2006 social and income tax rates were quite high (31% and 22%

respectively). This, along with poor law enforcement, created strong incentives to evade taxes and therefore wages were often underreported. It is reasonable to conclude that individuals would report the wage rate that is officially reported at the tax department, rather than the rate that is actually received. In this estimation it is assumed that the wages are underreported in the same way across industries and are convergent. If this is the case then the entire wage distribution moves to left and this should not affect the magnitude and the sign of the coefficients from the estimation and not cause a bias in measuring inter-industry wage differentials.

One more disadvantage of the data is that the sample size is small and the number of observations for each two-digit industry does not allow us for the estimation of inter-industry wage differentials for them; therefore the focus is on one-digit aggregated industries that may cause aggregation bias. This problem is discussed later in further detail.

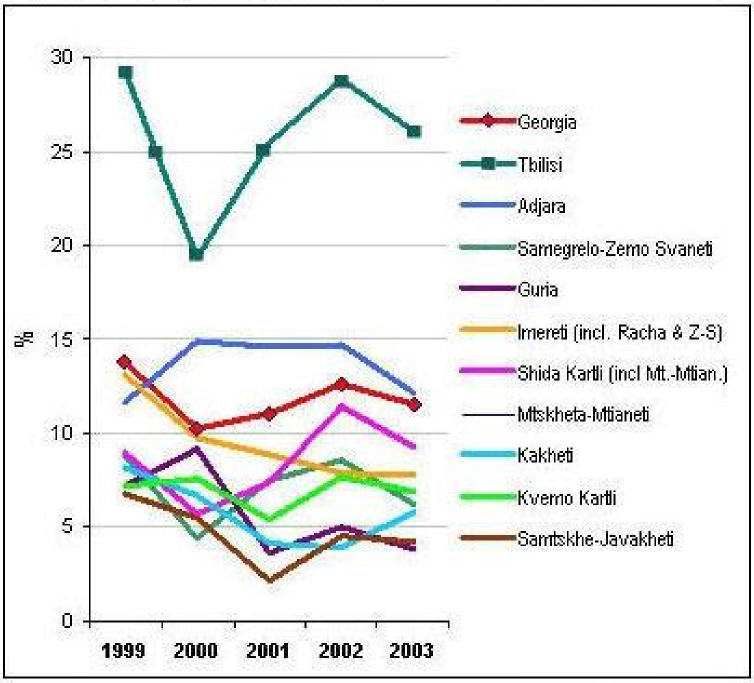
The data contain a large number of people with zero reported wages that are excluded from the estimation. At each date these group of workers, by construction, include (1) employers and self-employed, (2) the unemployed and (3) individuals out of labor force. In this case excess number of zero-waged individuals is probably reflecting the high unemployment level in the country during the study period and large number of self-employed people engaged in agriculture. Excluding observations with zero reported wage from the regression could result in a selection. As Goux and Maurin (1999) discuss, this is a partial selection that may result in potentially biased cross-sectional estimates. It would be logical to check cross-sectional estimates with Heckman two-stage regression that estimates employment probability probit model at the first stage and in this way accounts for large number of zeros at the second stage of the estimation. This is supposed to correct for the selection bias, if there is any. Unfortunately, the QHS sample contains no relevant controls to be used in first stage probit model, therefore we are unable to run regression of this type.

Besides, since we also estimate fixed-effects model, this allows us to get rid of part of the potential bias that is time-invariant.

Chapter III. Georgian Labor Market Setup[2]

After the collapse of the Soviet Union, Georgia experienced a rapid decline in national economy, the appearance of an import oriented a trade policy, limited potential to increase exports and a flourishing shadow economy. Underemployment, hidden and disguised unemployment, and salaries below the minimum subsistence level were the problems that Georgian labor market faced. At the first stage of transition great hopes were pinned on the privatization process. It was believed that it would facilitate appearance of new enterprises, as well as restructuring of the existing ones. As a result this would create new employment opportunities and reduce large scales of unemployment. However it turned out that all those hopes were unfounded. Contrary to expectations, a significant number of existing enterprises were closed down and liquidated, because either these firms were unable to meet modified demand and participate in the supply-side adjustment for the economy, or simply the new owners found it more profitable to sell out assets of the company than to continue operating on the market.

Figure 1. Unemployment by regions



Source: Investment Guide of American Chamber of Commerce

During the study period a large number of the working wage individuals were underemployed, or unemployed; however the registered unemployment rate was generally similar to that of other transitional economies. Figure 1 shows the registered unemployment rates of Georgian regions across years. The graph shows that the unemployment rate recorded in Tbilisi (where

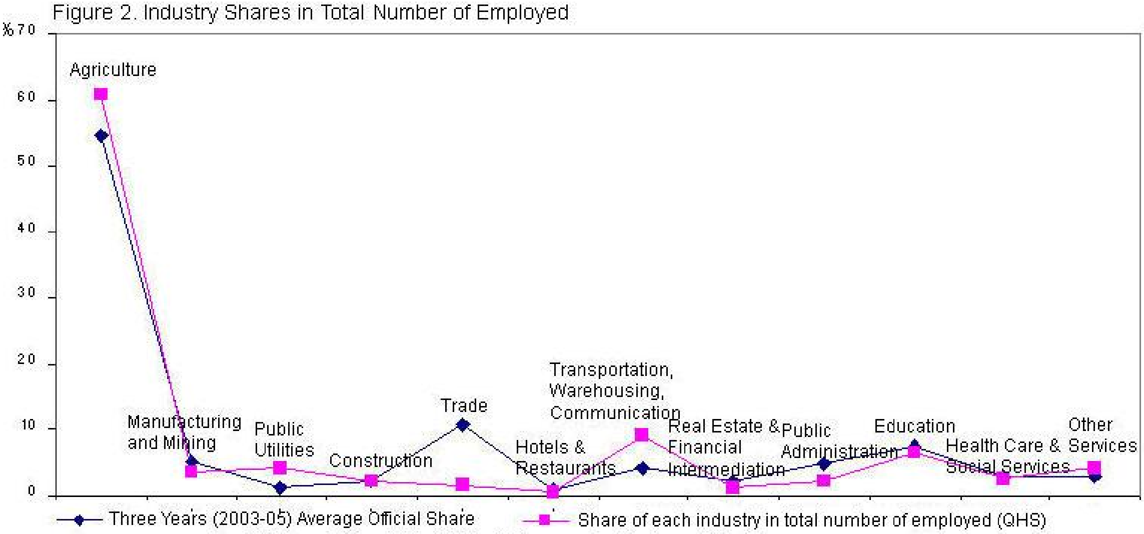
[2] The chapter uses the information from the web site of Investment Guide of American Chamber of Commerce

roughly one-third of the country's population resided) is twice [or even more in some cases] as large as the same figure from the other regions. Since Tbilisi holds large weight in the calculation of total unemployment level, it strongly influences the countrywide rate. The logical explanation of such a large concentration of labor force in one particular area lies behind the enormous internal migration of economically active part of population to Tbilisi in the mid-nineties with the hope of escaping widespread unemployment in the regions. Since the labor force was heavily concentrated in Tbilisi, the unemployment level grew in this city, while other regions experienced much lower unemployment rates due to large number of self-employed and economically inactive people in the local population. In addition, the rural population could register as unemployed only at the nearest regional center/town that was often quite far from the actual place of residence and this created certain inconvenience for the people. Since the unemployment benefits were low and number of vacancies few, lower regional unemployment levels in Figure 1 may simply reflect the fact that under these circumstances it was hardly worth registering as unemployed (Georgian Economic Trends (1995)).

The share of employment in agriculture was the largest in the labor market. Many people employed in agriculture were engaged in low paid unofficial or unregistered activities. This fact is also reflected in the QHS data sample. There are 42,801 observations associated with the agricultural sector, however only 1,221 (~2%) of them record a non-zero wage.

Figure 2 plots the official three-year average industry shares in total number of employed (including self-employed) and compares it to the similar figures from the QHS sample. The graph indicates that industry shares are quite similar in both cases except for Agriculture, Trade and Transportation, where the QHS sample and actual figures differ significantly. As a whole the analysis indicates that the group of employed individuals from the QHS sample is representative of the Georgian labor force.

Figure 2. Industry Shares in Total Number of Employed



** The underlying table (Table A1) is presented in* Appendix I

We also analyze the persistence of inter-industry wage differences based on average industry wages. Many empirical findings, such as Lucifora (1993) that analyzes Italian data, suggest that the pattern of inter-industry wage differentials is both remarkably persistent over time and comparable among different countries. On the other hand, Murphy and Topel (1987) argue that shocks to labor demand across industries may generate short-run wage differences in the presence of mobility costs and specific human capital.

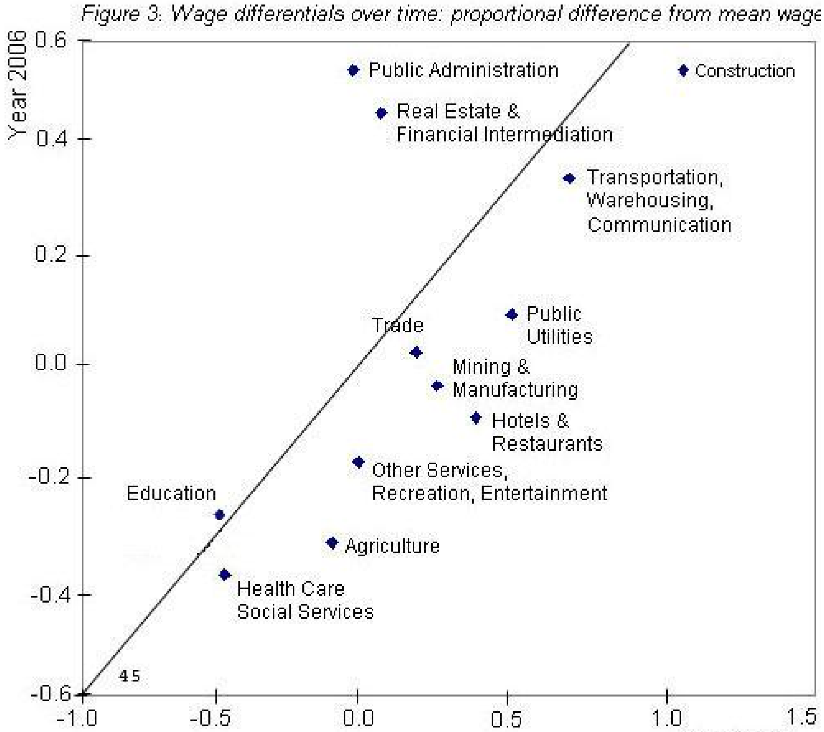
To check for these effects we analyze average wage rates in the industries and compare them to weighted-average wage of all industries. Figure 3 plots proportional deviation from industry averages from yearly mean wage for the first (2002) and last (2006) years of the data set. Deviations from the mean are calculated by the following formula:

$$(w_{jt} - \overline{w}_t) / \overline{w}_t \qquad (1)$$

where w_{jt} denotes industry average wage at time t and $\overline{w}_t$ - overall average wage at time t.

The results are fully comparable to the evidence on Italian manufacturing industry presented by Lucifora (2004). The graph of wage-differentials shows that both years 2002 and 2006 show large differences in industry average wages and does not seem to be a short-

Figure 3: Wage differentials over time: proportional difference from mean wage



* The underlying table (Table A2) is presented in Appendix I

run transitory effect discussed by Murphy and Topel (1987). On the other hand, there is a certain variation in the magnitude of the deviations for both "high-wage and "low-wage" industries from the first year to the last. Only three out of twelve are "winning" industries that lie above the 45-degree line, indicating that the wage differential for these industries increased from 2002 to 2006, while the same figure decreased for the rest of the industries. Public Administration and Real Estate & Financial Intermediation are two outlier industries that have considerably higher wage differential in 2006 compared to 2002. In case of Public Administration such a difference can be explained by the overall large wage increase in this sector. Difference in differentials at Real Estate & Financial Intermediation is probably a reflection of the rapid increase in the volume of the assets held by financial sector during a study period. Large changes in differentials in these two sectors, as well as the fact that "winning" industries jointly constitute to 41% of all employed people that receive non-zero wage in the data set could be explained by the fact that most of the industries lie below the 45-degree line.

Lastly, as one more illustration of the persistence of wage differentials, following Keane and Prasad (2006), we make a simple decomposition of the wage dispersion into across-industry and within-industry components. For this reason we focus on cross-sectional variance of log-wages and split it into two core components. Consider the following decomposition:

$$\sigma_t^{\ 2} = \sum_j s_{jt} \sigma_{jt}^{\ 2} + \sum_j s_{jt} (w_{jt} - \overline{w}_t)^2 \qquad (2)$$

where $\sigma^2{}_t$ is a cross-sectional variance of log wages, s_{jt} is the employment share of industry j, $\sigma_{jt}^{\ 2}$ is the within-industry variance of earnings, w_{jt} is industry j mean earnings, $\overline{w}_t$ is grand mean earnings in the sample and subscript t is a time index. The first part of left-hand side of the equation measures within-industry share of dispersion, while the second part reflects the share of inter-industry dispersion in total earnings dispersion. The results of the decomposition is presented below:

Table 1
Variance Decomposition for log wages

Year	***Total Variance***	***Within Industry***	***Between Industry***
2002	0.698	0.556	0.142
2003	0.630	0.496	0.134
2004	0.660	0.554	0.106
2005	0.736	0.609	0.127
2006	0.750	0.615	0.135

		Within Industry		***Between Industry***	
Period	***Total Change in Variance***	***Change in Variance***	***Composition Effect***	***Change in Variance***	***Composition Effect***
2002-2006	0.051	0.060	-0.002	-0.002	-0.005

* Derivation of underlying formulas is presented in Appendix IV

Table 1 shows variance decomposition for each year in our study period. The results show that roughly one-fifth of total variation in earnings is attributable to the inter-industry component that is persistent across years. This indicates that across-industry share has significant weight and is important element affecting wage dispersion. The bottom part of Table 1 presents the share of each component in the change in earnings variance, which somewhat surprisingly, indicates that, the between-industry part had only slight effect (negative) on overall change in variance and the change mostly derived from within-industry component.

Chapter IV. Basic Cross-Sectional Results

To look at inter-industry wage differences more formally we develop a cross-sectional model and estimate several wage equations in order to examine the importance of industry affiliation in explaining relative wages. The estimation controls for a wide range of individual characteristics: human capital, demographic background, regional affiliation and so on. Following Goux and Maurin (1999) we utilize a standard earnings equation:

$$w_{it} = \alpha + X_{it}\beta + S_{it}\gamma + \varepsilon_{it} \qquad (3)$$

w_{it} is the logarithm of monthly earnings from the primary job of the individual i at time t. X_{it} is a vector of measured individual characteristics of individual i at time t. The variable S_{it} stands for a vector of industry dummies. α and ε_{it} are intercept and error term for the regression, while β and γ are vector of coefficients to be estimated. Since wage regressions include a constant, following Krueger and Summers (1988) one of the industries (Manufacturing and Mining) is omitted from the regression and used as a base category. Since the test shows existence of heteroskedasticity in the model we use heteroskedasticity consistent White standard errors. Industry dummies prove to be jointly significant and in most cases individually significant as well. We then use *OLS* estimates to calculate employment-weighted average and normalize the estimated industry wage differentials as deviations from the weighted mean differential. Therefore the resulting statistics are the proportionate difference in wages between an employee in a given industry and the average employee in the economy.

Table 2 presents the results for the model (3) estimation for one-digit industries. The model was estimated separately on the sub-samples formed by 2002 and 2006 observations, as well as the entire 5-year sample. The individual characteristics include potential experience and its square, education, sex, marital status, occupation an individual holds within a company, sector of employment, region of residence and so on. The basic analysis shows that there is roughly an equal number of male and female workers in the data, two-thirds of the individuals have higher education, and one-third lives in Tbilisi (capital). The data is composed of 90% of ethnic Georgians and 70% of married individuals.[3]

Before turning to the estimates of industry wage differentials we briefly discuss the effects of standard human capital variables. Coefficient on experience suggests that each additional year of labor market experience is associated with an average increase of 0.7% in the remuneration. However the returns are marginally decreasing and become negative after 18 years of accumulated experience. Since we excluded the lowest educational group from the regression, education dummies are positive, indicating that individuals with higher education levels have higher salary, than individuals from the reference group. Female dummy indicates that female workers have lower wages than males of (observable) comparable skills. Several interaction terms with the female dummy have been introduced; however they proved to be individually and jointly insignificant and were excluded from the model.[4]

As the results from Table 2 indicate, the industry variables have a substantial effect on relative wages. Like the time series data that was presented in the fourth chapter the cross-sectional estimates show that inter-industry wage differences are highly persistent over time. The results show that the deviations from the weighted mean have the same sign when estimated on 2002 and 2006 sub-samples. In addition, the sign remains the same when the entire, 5-year data is pooled. Besides sign, the magnitude of the deviations is also comparable from one year to another in some cases. For instance, the coefficient on Real Estate and Financial Intermediation sector indicates that the average worker in this industry in 2002 received 8% higher salaries than average employee in the economy, 7% more in 2006 and 9%

[3] For the more detailed description of the data refer to the Table B1 in Appendix II.
[4] For more details refer to Table C1 in Appendix III.

more throughout the whole sample. As an extension to Figure 3, Table 3 also presents the standard deviation of wage differentials for the years 2002 through 2006. The reported standard deviations are comparable from year to year and prove that wage differences across industries are persistent.

These findings significantly differ from those of Krueger and Summers (1988) (US data) and Goux and Maurin (1999) (French employee-employer matched sample). Their findings suggest that durable manufacturing products and chemicals tend to be high wage industries, while industries with high concentration of small businesses, such as wholesale, retail, service industries prove to have lower wage rates. On the contrary, the cross-sectional results from Georgia suggest that the Manufacturing and Mining industry that has been excluded from the underlying *OLS (Ordinary Least Squares)* regression and used as a base industry for the estimation does not prove to be high-wage paying industry.

This seems logical since the data utilized in this paper comes from a country-in-transition, while the above mentioned authors utilize the data from stable, developed economies. The suspension of the economic links that had been formed during Soviet Union led to a substantial change in external and internal demand for Georgian goods and services. This led to a tendency of large number of two-digit industries (especially in manufacturing and heavy industry) becoming highly unprofitable. Postponed privatization of large number of enterprises led to a delayed restructuring of economy, inefficiency and low wages rates in many sectors. On the other hand, Construction, Hotel & Restaurants, Real Estate & Financial Intermediation, Trade and Transportation, Warehousing, Communication industries adapted to the new environment and rapidly developed afterwards.

It is important that we also set up a model, where the dependent variable is total income from the hired employment (salary + bonus). The aim is to check whether the inter-industry wage differences are merely due to different compensation schemes across

TABLE 2
Estimated Cross-Sectional Wage Differentials For One-Digit Industries

Industry	*(1)* *2002*	*(2)* *2006*	*(3)* *Entire Sample*
Agriculture	-0.226**	-0.068	-0.105**
	(0.076)	(0.059)	(0.026)
Manufacturing and Mining	0.019[Base]	0.025[Base]	0.100[Base]
	--	--	--
Public Utilities	0.300**	0.174	0.246**
	(0.052)	(0.061)	(0.023)
Construction	0.517**	0.297	0.355**
	(0.054)	(0.047)	(0.023)
Trade	0.077**	0.095	0.113
	(0.044)	(0.045)	(0.018)
Hotels & Restaurants	0.034**	0.199	0.303**
	(0.067)	(0.067)	(0.028)
Transportation, Warehousing, Communication	0.270	0.200	0.250**
	(0.045)	(0.047)	(0.019)
Real Estate & Financial Intermediation	0.080**	0.073	0.091
	(0.055)	(0.052)	(0.023)
Public Administration	0.078**	0.419	0.155**
	(0.041)	(0.046)	(0.019)
Education	-0.283**	-0.295	-0.248**
	(0.042)	(0.045)	(0.019)
Health Care & Social Services	-0.346**	-0.356	-0.339**
	(0.047)	(0.050)	(0.021)
Other Services, Entertainment, Recreation	-0.201**	-0.201	-0.185**
	(0.048)	(0.052)	(0.023)
Weighted Standard Deviation of Inter-Industry Wage Differentials	0.064	0.073	0.051
Sample Size	5362	5215	27734

[a] *F test rejects the hypothesis that wage differentials are jointly equal to zero*

[aa] *The other explanatory variables are quarter dummies, 3 education dummies, experience and its square, 8 occupation dummies, female dummy, 9 regional dummies, rural dummy, 3 sector dummies, married dummy and female x married dummy.*

[aaa] *The stylized individual, chosen as a reference term in the underlying regressions, is an unmarried male worker living in Tbilisi, employed at a manufacturing & mining firm in the private sector, holding lowest position in the company, with minimum education and no labor experience,*

[aaaa] Although the model shows presence of heteroskedastic error terms, the heterostedasticity consistent standard error do not differ substantially from normal OLS ones and do not affect significance of any variable

[aaaaa] Standard Errors presented in the table are unadjusted cross-sectional White standard errors

[aaaaaa] Nominal wages were deflated by aggregate CPIs (2002Q1=0), source: Department of Statistics

industries. In other words, it may be the case that in some industrial sectors wages are low, however the workers receive generous bonuses that equilibrates total remuneration from the job across industries. The rationale for such a compensation scheme is that according to the legislation of Georgia, bonuses are exempted from social tax (20-31%) and a high proportion of bonus-type remuneration in total compensation could be less costly for the employer. The results of the new regression are presented in Table C1 (Appendix III), indicating that the results do not substantially differ from those presented in Table 2. The conclusion that can be derived is that the bonuses are not concentrated in a particular industry, but rather evenly distributed across industries. There may be a potential problem with this rationing, since the number of bonus receivers are quite few (less than 5% of all observations) in the data set and this may be the reason why results of two regressions do not differ much.

TABLE 3
Persistence of Inter-Industry Wage Differentials between 2002 and 2006

Year	Number of Observations	Weighted Standard Deviation of Differentials
2002	4803	0.067
2003	5311	0.052
2004	5043	0.038
2005	4963	0.077
2006	4650	0.083
Entire Sample	24770	0.056

[a] Weights are employment shares in the sample

[aa] Male and Female wage differentials are normalized to percentage deviations from the mean using overall weighted average of all observations

Since half of the individuals in the sample are females, we can run two separate regressions on males and females. This allows us to account for the potential bias coming from gender discrimination that arises from the fact that some of the occupations are considered to be so called "female careers" and tend to be traditionally low-paid. Although the occupations are accounted for in the regression, it may not capture this effect anyway. On the Georgian market that is still immature, this factor may be of a high importance. The estimation shows that weighted standard deviation of wage differentials for females is 1.5 larger than for males indicating that female wages are more dispersed across industries, than the wages for male workers. In addition, the differentials for male workers, in most cases are significantly larger, than that for female workers. (See details in Table A3, Appendix I)

Card (1996) finds empirical evidence that there is a positive relationship between an individual's union membership and his/her wage. He also finds that this relationship is especially strong for the workers with the lower measured personal characteristics. One of the wage theories suggests that the inter-industry wage dispersion may be due to differences in the bargaining power of workers across industries. Omitting this effect from the regression may result in biased cross-sectional estimates and over-estimated coefficients. However, several empirical studies done on transitional countries have shown that the role of unions in wage determination is insignificant. Pollert (1999) evaluates progress towards independent trade unionism in the post-command economies of Poland, Hungary, Slovakia and Czech Republic. The conclusion derived is that although the unions have made substantial progress in establishing the institutional frameworks of labor representation; the collective bargaining is still weak. The same effect is expected to prevail in Georgia, since the labor market is still in its infancy. After the collapse of the Soviet Union most of the old Soviet-type unions were liquidated; however free-market based unions have not appeared yet. Therefore the rudimentary organisations calling themselves as labor unions that still exist in Georgia, are not expected to play an active role in wage determination process.

Chapter V. Unmeasured Individual Abilities Explanation of Inter-Industry Wage Differentials

Perhaps the most logical competitive explanation of the results from model (3) is that there are unmeasured aspects of labor quality across industries. Goux and Maurin (1999) state that there is a possibility that some key determinant of wages, such as physical endurance, innate ability, motivation and intellectual abilities, may not be measured in individual-level data sets and workers with greatest unmeasured abilities might be more concentrated in some industries than in others. If this is so, then provided that wages are set competitively, overall wage rate in some industries may be higher than in some other industries. If this is the case, then the difference between "high-wage" and "low-wage" industries is just quality of the labor force.

To further address the problem of unobserved labor quality we utilize the longitudinal features of the QHS data set. This allows comparing wages of the same person before and after the change of industry. This, in theory, should eliminate the problem of unobserved that we face in the cross-sectional model. However the longitudinal method is not without potential problems that we discuss further in the section. To estimate the panel data model we restate model (3) in a different way as Goux and Maurin (1999) do:

$$w_{it} = X_{it}\beta + S_{it}\gamma + u_i + \varepsilon_{it} \qquad (4)$$

where u_i stands for the unmeasured fixed abilities of individual i. X_{it} includes eight occupation dummies, three sector dummies and quarter dummies. If model (4) is valid, then the results obtained from model (3) could be valid only in case unobserved abilities were not correlated with right hand side variables, or their effect was negligent. To estimate the model we use fixed-effects method and focus on the people that change industries in the sample. The results of this estimation are given in Table 4.

TABLE 4
Estimated Fixed Effects Wage Differentials For One-Digit Industries

Industry	*Weights*	*Entire Sample*
Agriculture	0.037	0.085
		(0.034)
Manufacturing and Mining	0.137	0.056[Base]
		--
Public Utilities	0.040	0.072
		(0.041)
Construction	0.090	0.139
		(0.031)
Trade	0.099	0.000
		(0.027)
Hotels & Restaurants	0.024	0.051
		(0.047)
Transportation, Warehousing, Communication	0.085	0.005
		(0.028)
Real Estate & Financial Intermediation	0.109	0.001
		(0.029)
Public Administration	0.148	-0.013
		(0.026)
Education	0.102	-0.210
		(0.035)
Health Care & Social Services	0.045	-0.038
		(0.037)
Other Services, Entertainment, Recreation	0.079	-0.042
		(0.031)
Weighted Standard Deviation of Inter-Industry Wage Differentials	---	0.008

[a] *F test rejects the hypothesis that wage differentials are jointly equal to zero*

[aa] *The other explanatory variables are 8 occupation dummies, 3 sector dummies and quarter dummies*

[aaa] *Weights are based on employment shares of each sector*

[aaaa] *Full results of estimation are presented in Table C1, Appendix III*

After controlling for time invariant unmeasured abilities through longitudinal features of the data, the newly estimated deviations prove to be jointly, and in most of the cases individually, significant as well. However fixed-effects estimates are much narrower than those from the cross-sectional model. In addition, weighted standard deviation from fixed-effects model is seven times smaller than the standard deviation from cross-sectional model, indicating that that the inter-industry wage differential dispersion is lower for fixed-effects estimates.

The large difference between cross-sectional and panel-data estimates of inter-industry wage differentials is a strong argument supporting “unobserved abilities” hypothesis.

It indicates that although at cross-sectional level we control for a wide range of personal characteristics of an individual affecting the wage determination, some aspects of human physical endurance, innate ability, motivation and intellectual abilities) are simply missed out from the regression. In addition, these variables are correlated with industry affiliation and this endogeneity in the model results in upward biased cross-sectional estimates.

The advantage of panel data methods is that since human abilities that create endogeneity at cross-sectional level are time-invariant, the fixed-effects estimation simply eliminates them from the estimation by comparing pre and post change earnings of the workers that move between industries. Therefore while the differentials estimated at the cross-sectional level primarily reflect uneven distribution of high quality workers across industries, estimates at panel level measure less biased inter-industry wage differentials that are existent across industries.

A potential drawback of the longitudinal method is the existence of possible classification errors in industry affiliation in the data set. Goux and Maurin (1999) correct for such errors using distinctive features of the matched employee-employer data set. Since the authors are able to link workers to the specific firms, they check for the industry affiliation information provided by an employee through firm-level data and eliminate the errors. This type of bias could be a problem for the QHS sample, but since we work on highly aggregated industry classification, we assume that this minimizes extent of such bias and therefore ignore this problem.

On the other hand, by merging small industries into larger groups, we face the risk of facing an aggregation bias. Goux and Maurin (1999) indicate that aggregation bias may cause two problems. First of all it ignores the unmeasured diversity of workers that makes cross-sectional estimates biased, and second it ignores the diversity of specific wage policies in sub-industries that may bias fixed-effects estimates. The QHS sample limits us to using highly aggregated industries and therefore creates the potential problem of aggregation bias. In addition, Goux and Maurin (1999) find that actually large part of "pure" inter-industry wage differentials is explained by at firm-level effect.

Chapter VI. Endogeneity of Mobility

Model (4) that was developed in the previous chapter accounts for the unmeasured individual characteristics of the reference person by removing time-fixed effects and significantly improves the results as compared to the cross-sectional regression. However, the estimates from the fixed-effects estimation are valid only in case if the inter-industry mobility of labor is exogenous in the regression. To check for the exogeneity of mobility we implement a method employing instrumental variables.

Let us consider the model that was used for the longitudinal estimation:

$$\Delta w_{it} = \Delta X_{it}\beta + (S_{it} - S_{it-1})\gamma + \varepsilon_{it} \qquad (5)$$

If ε_{it} is correlated with inter-industry mobility $(S_{it} - S_{it-1})$, then the fixed-effects estimates will be biased. In other words, if dynamics of individual wages and inter-industry mobility have the same determinants, then the fixed-effects estimates are potentially biased.

To check for this, we utilize the Instrumental Variables (IV) method that was initially developed by Murphy and Topel (1987) for correcting measurement and coding errors associated with industry affiliation. Goux and Maurin (1999) use the same method to calculate the pure inter-industry wage differentials as a fraction of cross-sectional estimates. In our case we possess no external sources (as Goux and Maurin (1999) and Krueger and Summers (1988) do) to correct for the potential measurement error and therefore we only focus on the endogeneity of mobility.

The test involves replacing the vector of industry dummy switches with a single variable, constructed by including differences in industry specific coefficients that were obtained from the cross-sectional wage equation for the sample of industry non-changers. The new model that is estimated on the sub-sample of industry changers is

$$\Delta w_{it} = \Delta X_{it}\beta + (\theta_{it} - \theta_{it-1})\delta + \varepsilon_{it} \qquad (6)$$

where θ_{it} denotes the estimated industry effect (coefficient from OLS regression) and δ denotes the fraction of the pure inter-industry wage differentials with respect to cross-sectional estimates.

There are two main messages that we aim to derive from the above-discussed test. Firstly, by estimating δ first with Ordinary Least Squares (OLS) method and then with the instrumental variables (IV) method and comparing them, we could identify the extent of the endogeneity bias (if there is any). Following Murphy and Topel (1987) we use current industry of employment (S_{it}) as an IV in the regression. By construction S_{it} is correlated with industry mobility and uncorrelated with ε_{it}.

Secondly, the model also allows us to measure the true nature of the cross-sectional inter-industry wage differentials. If cross-sectional differentials are "pure" inter-industry differentials, then δ will be close to one. On the other hand, if they simply reflect differences in labor quality and merely derive from unobserved abilities of the individuals, then δ must be close to zero.

TABLE 5
OLS vs. Murphy Topel Instrumental Variables Method

	One-Digit Industries	
Explanatory Variable	*OLS*	*IV*
Intercept	0.052	0.051
	(0.012)	(0.012)
Experience	0.0004	0.0004
	(0.0002)	(0.0002)
δ	0.161	0.202
	(0.050)	(0.074)

Table 5 presents the results of our calculation that led to OLS estimate of around 0.16 and IV estimator of 0.20. The difference between two estimators is not large and therefore they do not support the hypothesis that endogenous mobility is major source of bias. In addition, the estimates are very close to those, obtained by Murphy and Topel (1987) and

Goux and Maurin (1999). On the other hand, the results obtained from the regression also confirm the hypothesis of weak pure inter-industry differentials, since δ is much closer to zero, than to the unity.

Conclusion

The large volume of literature documents the existence of large and persistent wage differentials among industries for the workers of comparable skills. Bearing in mind several caveats of the data set that were discussed in data section, the thesis provides empirical evidence measuring the extent to which the unobserved abilities explain the existence of inter-industry wage differentials based on Georgian quarterly household longitudinal data that allow us to track workers over time.

The analysis of a five-year period showed that the deviations of industry average wages from overall average are quite stable over time and does not seem to be a short-run transitory effect discussed by Murphy and Topel (1987). In addition, the figures derived from Georgian data are fully comparable to the evidence on the Italian manufacturing industry presented by Lucifora (2004). On the other hand, the analysis indicates that small deviations still take place that creates group of "winning" and "losing" industries.

Our main findings suggest that substantial part of inter-industry differentials that are measured on cross-sectional basis primarily must be reflecting inter-industry variations in unmeasured labor quality, since when estimated at longitudinal level the dispersion of inter-industry wage differentials measured by weighted standard deviation decreases roughly seven times and the estimates also drop 4-5 times. These findings are more similar to the results derived by Goux and Maurin (1999), rather than to Krueger and Summers (1988), who find the estimates of equal magnitude for both cross-sectional and panel models.

In addition to estimating the main models, we also conduct a test to check for the endogeneity of mobility within the longitudinal model. Using a method employing IVs that was originally developed by Murphy and Topel (1987) we conclude that the results of the test support our earlier findings that unobserved abilities explain a large part of measured inter-industry wage differentials. In addition, a comparison of *OLS* and *IV* estimates leads us to conclude that the endogeneity of mobility is not a major source of bias in longitudinal model.

A major issue that was not addressed in this work is finding a relevant explanation of wage differentials that emerged in the fixed-effects model after controlling for the time-invariant unmeasured personal characteristics. As mentioned in the introduction, a wide range of literature does not stress on the nature of inter-industry wage differentials, but rather on their appropriate theoretical explanation. This study was not able to extend in this direction, since the data set does not include appropriate controls. The QHS data lack information on individual's working conditions, such as whether individual deals with machinery or not, or to what extent the job is hazardous. According to compensating differentials hypothesis, positive wage differentials should be associated with unpleasant working conditions at the work place (Lucifora (1993)). Also QHS does not reflect the characteristics of a firm an individual is employed at that prevents us to check whether the nature of wage differentials is consistent with non-competitive explanations of wage differentials. These issues are subject for future research and should be addressed with a richer data set that will allow us to check whether the non-competitive hypotheses explain the existence of inter-industry wage differentials.

Appendix I

Table A1. Industry Shares in Total Employment		
	Three Year Average	*Data Set*
Agriculture	54.5	60.7
Manufacturing and Mining	5.2	3.73
Public Utilities	1.2	4.39
Construction	2.3	2.28
Trade	10.9	1.69
Hotels & Restaurants	0.9	0.8
Transportation, Warehousing, Communication	4.1	9.2
Real Estate & Financial Intermediation	2.2	1.15
Public Administration	4.8	2.31
Education	7.5	6.67
Health Care & Social Services	3	2.6
Other Services, Entertainment, Recreation	2.8	4.29

Table A2. Wage Differentials over time: proportional difference from the mean		
	2002	**2006**
Agriculture	-0.15	-0.32
Construction	1.05	0.55
Education	-0.46	-0.43
Health Care & Social Services	-0.45	-0.37
Hotels & Restaurants	0.34	-0.09
Manufacturing & Mining	0.21	-0.03
Other Services, Entertainment, Recreation	-0.06	-0.17
Public Sector (governing, defence)	-0.08	0.55
Public Utilities	0.46	0.1
Real Estate & Financial Intermediation	0.02	0.47
Trade	0.14	0.03
Transportation, Warehousing, Communication	0.66	0.35

Table A3. Ordinary Least Squares regressions for males and females		
	Male	**Female**
Agriculture	-0.166	-0.272
Manufacturing and Mining	0	0
Public Utilities	0.124	0.293
Construction	0.264	0.176
Trade	0.059	-0.1
Hotels & Restaurants	0.148	0.185
Transportation, Warehousing, Communication	0.194	0.022
Real Estate & Financial Intermediation	0.076	-0.147
Public Administration	0.119	-0.095
Education	-0.342	-0.45
Health Care & Social Services	-0.315	-0.528
Other Services, Entertainment, Recreation	-0.181	-0.446
Weighted Standard Deviation	***0.033***	***0.054***

Appendix II

TABLE B1
Variable Definitions and Means & Standard Deviations **Total Number of Observations: 27734**

Controls	*Data Set Variable*	*Description*	*Freq.*	*Mean & Sd.Dev*
Education	Inc. Secondary	Incomplete secondary education, 8-9 years of schooling	0.02	Dummy
	Vocational	Vocational education, 10 years of schooling	0.09	Dummy
	Secondary	Secondary (gymnazium, school), 11 years of schooling	0.23	Dummy
	Higher	University, or specialized education, 15 years of schooling	0.64	Dummy
Experience	Pot. Experience	Potential working experience defined as age-education-6	--	25.33 (12.86)
Gender	Male		0.52	Dummy
	Female	1 if female, 0 otherwise	0.48	
Marital Status	Married	1 if a person is married, 0 otherwise	0.69	Dummy
	Unmarried		0.31	
Nationality	Non-Georgian	1 if ethnic Georgian, 0 otherwise	0.10	Dummy
	Georgian		0.90	
Urban / Rural	Rural	1 if person lives in rural area, 0 otherwise	0.41	Dummy
	Urban		0.59	
Industry	1	Agriculture, Forestry , Fishing	0.04	Dummy
	2	Manufacturing and Mining	0.10	Dummy
	3	Public Utilities (Electricity Generation and Water Provision)	0.03	Dummy
	4	Construction	0.04	Dummy
	5	Trade	0.09	Dummy
	6	Hotels and Restaurants	0.02	Dummy
	7	Transportation, Warehousing, Communication	0.07	Dummy
	8	Real Estate and Financial Intermediation	0.05	Dummy
	9	Public Administration (Governing, Defense)	0.14	Dummy
	10	Education	0.22	Dummy
	11	Health Care and Social Services	0.08	Dummy
	12	Other Services, Entertainment, Recreation	0.06	Dummy
Occupation	1	Managers	0.07	Dummy
	2	High-skilled specialists	0.29	Dummy
	3	Medium-skilled specialists	0.17	Dummy
	4	Bookkeeping staff	0.03	Dummy
	5	Service-sector employees	0.12	Dummy
	6	Agricultural Employees	0.02	Dummy
	7	High-skilled manufacturing workers	0.10	Dummy
	8	Cameraman, Drivers, technical staff	0.06	Dummy
	9	Unskilled workers	0.10	Dummy
Region	1	Adjaria	0.09	Dummy
	2	Guria	0.04	Dummy
	3	Imereti	0.14	Dummy
	4	Kakheti	0.11	Dummy
	5	Mtskheta-Mtianeti	0.05	Dummy

	6	Kvemo Kartli	0.08	Dummy
	7	Samegrelo	0.05	Dummy
	8	Samtskhe-Javakheti	0.04	Dummy
	9	Shida Kartli	0.07	Dummy
	10	Tbilisi	0.29	Dummy
Sector	Joint	Joint foreign enterprise or international organization	0.52	Dummy
	Private	Private enterprise or organization	0.02	Dummy
	SOE	State-owned enterprises	0.27	Dummy
	Budgetary	Budgetary organization	0.17	Dummy

Appendix III

Table C1
Cross-Sectional Regressions

	Entire Sample	2002	2006	Bonus	Fixed Effects
Constant	4.374	4.602439	-0.128679	-0.44884	4.128376
	0.037	0.076151	0.079893	0.037675	0.03149
QUARTER					
Quarter2	0.042	0.050429		0.030068	0.033025
.	0.025	0.02424		0.024921	0.013518
Quarter3	0.078	0.072241		0.081026	0.052246
	0.025	0.024311		0.024893	0.015081
Quarter4	0.089	0.087034		0.103289	0.071738
	0.024	0.023754		0.02416	0.016307
Quarter5	0.061			0.073546	0.113997
	0.024			0.024225	0.018031
Quarter6	0.113			0.134625	0.164995
	0.023			0.02362	0.019387
Quarter7	0.118			0.133004	0.192866
	0.023			0.023376	0.020626
Quarter8	0.169			0.17389	0.240758
	0.024			0.02399	0.021791
Quarter9	0.193			0.185197	0.269443
	0.024			0.023916	0.023015
Quarter10	0.229			0.223551	0.313166
	0.024			0.024251	0.024176
Quarter11	0.273			0.2664	0.33396
	0.025			0.024901	0.025376
Quarter12	0.295			0.285158	0.371754
	0.025			0.025187	0.026416
Quarter13	0.367			0.360588	0.435998
	0.025			0.02513	0.027567
Quarter14	0.453			0.43866	0.532513
	0.025			0.025206	0.028506
Quarter15	0.489			0.46882	0.566454
	0.025			0.025345	0.029498
Quarter16	0.575			0.552173	0.607764
	0.025			0.024959	0.030361
Quarter17	0.615			0.58917	0.66363
	0.026			0.026068	0.031405
Quarter18	0.673		0.061815	0.650333	0.721783
	0.026		0.026156	0.026078	0.032421
Quarter19	0.807		0.135757	0.779107	0.787215
	0.026		0.027938	0.025726	0.033426
Quarter20	0.835		0.160476	0.807689	0.824267
	0.026		0.028126	0.026453	0.034553
EXPERIENCE					
Experience	0.007	0.00172	0.012219	0.008082	
	0.001	0.002556	0.002929	0.001198	
Experience2	0.000	-9.62E-05	-0.00033	-0.000237	
	0.000	4.31E-05	5.24E-05	2.06E-05	

EDUCATION					
Vocational	0.089	0.000918	0.046136	0.109252	
	0.026	0.067726	0.068782	0.028996	
Secondary	0.108	-0.009517	0.009457	0.094118	
	0.029	0.06054	0.062731	0.026472	
Higher	0.188	0.092817	0.11856	0.193934	
	0.027	0.062884	0.064859	0.027247	
GENDER					
Female	-0.349	-0.300444	-0.34646	-0.34322	
	0.016	0.036611	0.036461	0.016191	
Female*Married	-0.035	-0.018496	-0.115986	-0.047728	
	0.018	0.040891	0.041621	0.018126	
INDUSTRY					
Agriculture	-0.205	-0.416989	-0.093743	-0.199023	0.029295
	0.027	0.076106	0.059153	0.026942	0.034932
Public Utilities	0.255	0.110129	0.148783	0.143419	0.083259
	0.024	0.052007	0.061882	0.022969	0.031442
Construction	-0.349	0.327084	0.271641	0.246065	-0.26665
	0.019	0.054817	0.047577	0.023516	0.035613
Trade	-0.440	-0.112434	0.069523	0.016735	-0.09516
	0.021	0.044505	0.045805	0.01881	0.037041
Hotels and Restaurants	0.203	0.151288	0.173984	0.228964	-0.00522
	0.028	0.067627	0.067425	0.028007	0.047142
Transportation	-0.286	0.079869	0.175007	0.172697	-0.09911
	0.024	0.045695	0.047914	0.01941	0.03169
Real Estate & Financial Intermediation	0.055	-0.110002	0.048339	0.009365	-0.07011
	0.020	0.0558	0.052969	0.023216	0.026868
Public Administration	0.146	-0.11145	0.393983	0.076048	0.016058
	0.023	0.041694	0.046568	0.019595	0.041095
Education	-0.009	-0.474323	-0.320959	-0.351962	-0.05483
	0.023	0.042823	0.045715	0.019114	0.029205
Health Care and Social Services	0.013	-0.536359	-0.382072	-0.381509	-0.05577
	0.019	0.047324	0.050527	0.021235	0.027569
Other Services	0.150	-0.391663	-0.227099	-0.278675	-0.05102
	0.020	0.048484	0.052326	0.023752	0.028172
NATIONALITY					
Non-Georgian	-0.033	0.007875	0.000173	-0.03526	
	0.013	0.029864	0.034561	0.013517	
OCCUPATION					
Managers	-0.041	0.305756	0.523632	0.370297	0.058824
	0.031	0.043405	0.052037	0.021707	0.021435
High-skilled specialists	-0.013	0.244464	0.475011	0.358672	0.046799
	0.026	0.03686	0.04055	0.017743	0.018366
Medium-skilled specialists	0.357	0.171889	0.142655	0.165446	0.052912
	0.018	0.037293	0.040432	0.017544	0.017597
Bookkeeping staff	0.369	-0.074645	0.113301	-0.008614	0.030429
	0.022	0.05043	0.06024	0.025668	0.023574
Service-sector employees	0.177	0.176013	0.018527	0.106059	0.067239
	0.019	0.036892	0.042261	0.017443	0.018535
Agricultural Employees	0.161	0.406324	-0.186341	-0.02834	-0.02923

	0.017	0.10227	0.065297	0.031031	0.022757
High-skilled manufacturing	0.106	0.115686	0.189176	0.182086	0.059963
	0.017	0.042193	0.043548	0.018631	0.018215
Cameraman	0.220	0.206774	0.199115	0.2445	0.06079
	0.022	0.04786	0.049441	0.02134	0.02355
REGION					
Adjaria	-0.092	-0.014415	-0.191141	-0.089922	
	0.016	0.033176	0.037926	0.016025	
Guria	-0.464	-0.39099	-0.432115	-0.474688	
	0.023	0.042832	0.056285	0.022639	
Imereti	-0.342	-0.387465	-0.227617	-0.341977	
	0.014	0.031176	0.029546	0.013933	
Kakheti	-0.415	-0.481937	-0.404347	-0.423275	
	0.017	0.036095	0.036971	0.01692	
Mtskheta-Mtianeti	-0.143	--	--	-0.1597	
	0.020	--	--	0.019695	
Kvemo Kartli	-0.110	-0.104156	-0.060109	-0.135172	
	0.016	0.036881	0.033529	0.015559	
Samegrelo	-0.377	-0.333275	-0.281299	-0.368066	
	0.018	0.03536	0.043476	0.018113	
Samtskhe-Javakheti	-0.338	-0.553375	-0.151648	-0.372501	
	0.020	0.041322	0.048922	0.020419	
Shida Kartli	-0.325	-0.417227	-0.163166	-0.33306	
	0.018	0.031158	0.041254	0.017786	
RURAL / URBAN					
Rural	-0.045	-0.02614	-0.056291	-0.054068	
	0.010	0.020729	0.02195	0.010085	
SECTOR					
Joint	-0.323	0.410648	0.341578	0.347532	0.018382
	0.014	0.062503	0.082984	0.025104	0.020696
SOE	0.351	-0.124608	0.038965	-0.144147	0.002819
	0.025	0.032532	0.033241	0.014095	0.010459
Budgetary	-0.159	-0.345069	-0.13397	-0.315138	-0.05342
	0.014	0.030864	0.036285	0.014145	0.01201
MARITAL STATUS					
Married	0.054	0.084358	0.078274	0.064197	
	0.015	0.035303	0.03248	0.014537	

Appendix IV

The formula for a Weighted Mean:

$$\bar{x}_w = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$$

The formula for Weighted Standard Deviation:

$$s_w^{\ 2} = \frac{\sum_{i=1}^{n} w_i (x_i - \bar{x}_w)^2}{\frac{(n-1)\sum_{i=1}^{n} w_i}{n}}$$

Variance Decomposition:

$$\sigma^2 = \frac{1}{N}\sum_i (w_i - \bar{w}_i)^2 = \sum_j \frac{1}{N}\sum_{i\in j}(w_i - \bar{w}_i)^2 = \sum_j \frac{1}{N}\sum_{i\in j}\left[(w_i - \bar{w}_j) + (\bar{w}_j - \bar{w})\right]$$

$$= \sum_j \frac{1}{N}\sum_{i\in j}\left[(w_i - \bar{w}_j)^2 + 2(w_i - \bar{w}_j)(\bar{w}_j - \bar{w}) + (\bar{w}_j - \bar{w})^2\right] =$$

$$= \sum_j \left[\sum_{i\in j}\frac{1}{N}(w_i - \bar{w}_j)^2 + 2(\bar{w}_j - \bar{w})\frac{1}{N}\sum_{i\in j}(w_i - \bar{w}_j) + \sum_{i\in j}\frac{1}{N}(\bar{w}_j - \bar{w})^2\right] =$$

$$= \sum_j \left[\sum_{i\in j}\frac{1}{N}(w_i - \bar{w}_j)^2 + \sum_{i\in j}\frac{1}{N}(\bar{w}_j - \bar{w})^2\right] = \sum_j s_{jt}\sigma_{jt}^{\ 2} + \sum_j s_{jt}(w_{jt} - \bar{w}_t)^2$$

Change in variance between two periods:

$$\sigma_1^{\ 2} - \sigma_0^{\ 2} = \sum_j s_{j1}\sigma_{j1}^{\ 2} - \sum_j s_{j0}\sigma_{j0}^{\ 2} + \sum_j s_{j0}\sigma_{j1}^{\ 2} - \sum_j s_{j0}\sigma_{j1}^{\ 2} + \sum_j s_{j1}(w_{j1} - \bar{w}_1)^2 - \sum_j s_{j0}(w_{j0} - \bar{w}_0)^2 +$$

$$+ \sum_j s_{j0}(w_{j1} - \bar{w}_1)^2 - \sum_j s_{j0}(w_{j1} - \bar{w}_1)^2 =$$

$$\sum_j s_{j0}(\sigma_{j1}^{\ 2} - \sigma_{j0}^{\ 2}) + \sum_j (s_{j1} - s_{j0})\sigma_{j1}^{\ 2} + \sum_j (s_{j1} - s_{j0})(w_{j1} - \bar{w}_1)^2 + \sum_j s_{j0}\left[(w_{j1} - \bar{w}_1)^2 - (w_{j0} - \bar{w}_0)^2\right]$$

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