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Alexander M. **Danzer**

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Skill biased labour demand and the wage growth of younger workers: Evidence from an unexpected pension reform

Alexander M. Danzer
University of Munich (LMU), KU Eichstätt-Ingolstadt,
IZA Bonn, CESifo Munich, IOS Regensburg

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Address for correspondence:
Geschwister-Scholl-Platz 1, Department of Economics, University of Munich (LMU),
80539 Munich, Germany. Phone: +49-89-2180-2224, Fax: -3900. Email: a.danzer@lmu.de

Abstract
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Keywords: Pension increase, wage growth, labour substitution, returns to education, skill-mismatch, Ukraine, quasi-experiment

JEL Codes: J2, J31, J14, P23

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1 Introduction

Progressive population ageing poses threats and opportunities to the productive capacities of many industrialized and emerging economies: As waves of ageing workers leave the labour force into retirement (e.g., the baby boomers), relatively small cohorts of younger workers have to take over their tasks inducing some governments to worry about future labour shortages (Levine and Mitchell 1988). At the same time, young and recently trained workers embody new skills which elderly workers have never acquired. While firms and economies will adapt to these challenges gradually, labour markets may produce winners and losers in the short run.

This paper exploits a sudden retirement shock in an emerging economy to study redistributive labour market effects of social policies across age and education groups. The economy—Ukraine—is characterized by skill mismatch and suppressed returns to education which have been brought about by rapidly changing economic circumstances and relatively strict labour market regulations—two salient features of emerging labour markets (Fleisher, Sabirianova and Wang 2005; Gorodnichenko and Sabirianova Peter 2005; Kupets, Vakhitov and Babenko 2013). The retirement shock was induced by a politically motivated rise in pension benefits in late 2004, which reduced employment among elderly and predominantly low educated workers by 30 percent. As a consequence, the educational composition of the Ukrainian workforce changed profoundly: While 7% of workers held a low educational degree (defined as holding only a primary or incomplete secondary degree) before the pension reform (2002/3) their fraction halved thereafter (2006/7). The political implications are broad: What was initially intended as anti-poverty policy targeted on pensioners spilled-over to untargeted subgroups of the labour market. Bold and sizeable enough policy interventions seem to have side-effects seldom considered in the process of policy design.

To identify such spill-over effects of an exogenous negative labour supply (retirement) shock on non-elderly workers, I proceed in two steps: First, I estimate the short- to medium-run elasticity of substitution between more and less educated workers using a variant of the skill-group approach (Borjas 2003) in a quasi-experimental set-up. The results reflect the actual wage changes due to the pension policy for different subgroups of workers (defined by education and age). Using the labour force survey of Ukraine I find that older and less educated workers face a virtually flat labour demand curve implying no wage gains from the retirement of their most comparable peers. Quite differently, young workers with skills suitable for a modern market economy reap the greatest benefit from the retirement of older workers. A change in the generosity of pension benefits, hence, had a surprisingly positive effect on the wages of younger workers and probably also on the returns to education in general. Second, to rationalize the surprising result of a non-negative own price elasticity for older workers, I study the actual labour market conditions on the eve of the pension reform more closely. Specifically, a simple labour demand model with heterogeneous workers (defined by level of education) is estimated with a pre-reform sample of Ukrainian firms. Then, I simulate the expected wage effects for different groups of workers from a labour supply shock similar to the one in 2005. The predicted differences in wage growth across education groups are not distinguishable from the empirical reduced form estimates: Low educated workers face zero labour demand suggesting that the strict employment protection has retained them in jobs for which firms actually preferred younger workers.

This paper contributes to the literature on heterogeneous wage effects of labour supply shocks.[1] Recent research has tested substitution elasticities between old and young as well as high and low educated workers in the longer run, i.e. in the process of structural change (Ciccone and Peri 2005) or educational expansion (Card and Lemieux 2001). This paper turns to short-run effects of large social policy interventions, and exploits an exogenous change in the generosity of old-age pensions and subsequent retirement rates. Exogenous changes in the size of the labour force have proven fruitful for the identification of wage effects and most of the literature has relied on immigration to study wage effects in the destination country (Card 1990; Aydemir and Borjas 2007) or on emigration to study wage effects in source countries (Hanson 2007; Mishra 2007; Elsner 2013a; Elsner 2013b). I complement this literature by analysing an exogenous negative labour supply shock which was induced by a non-anticipated generous pension reform that incentivized one third of the eligible elderly working population to retire immediately. Similar to Mishra (2007) the current research focuses on an emerging economy thus shedding light on the labour demand implications in rapidly growing labour markets.

This paper also adds to the literature on the demand for skills and the returns to education in times of structural change (Card and Lemieux 2001; Fleisher, Sabirianova and Wang 2005; Gorodnichenko and Sabirianova Peter 2005; Kupets, Vakhitov and Babenko 2013). During the 2000s, Ukraine was facing rapid modernization: Average annual wage growth stood at 8-9% already before the retirement shock—putting remarkable pressure on firms to compete for workers. My focus on an emerging economy adds a fascinating twist to the standard demand

[1] An earlier literature has tested the so-called lump of labour hypothesis to understand the causes of youth unemployment and provided evidence on the elasticity of substitution between age groups (for an overview see Gruber and Wise 2010).

analysis of heterogeneous labour: While labour demand models suggest a negative own-wage response to an increase in the supply of homogenously educated workers (Hamermesh 1993), this may no longer hold if outdated skills face zero demand in the presence of strict labour protection clauses. Many emerging (especially Socialist or post-Socialist) economies are characterized by strong protection of tenured workers which inhibits gradual price and quantity adjustments among workers with outdated qualifications. When those workers finally retire from the labour force, workers with comparable characteristics may not benefit at all. Indeed, firms apparently shift demand from old and unskilled workers to young and skilled workers.

The paper is structured as follows: Section 2 of this paper will document the substantial labour supply shock stemming from a pension policy reform that led to a significant increase in aggregate real wages. Section 3 offers details regarding the labour market inflexibilities in Ukraine, which give rise to substantial skill mismatch. Section 4 exploits a labour force survey to estimate the redistributive reduced-form wage effects across several education and age groups following the pension rise. Section 5 presents several robustness checks with respect to heterogeneity in wage responses and distributional aspects. In Section 6, I rationalize the heterogeneous wage effects using a simple inverse demand model for heterogeneous labour; this section characterizes substitution relations as well as winners and losers of the labour supply shock. Specifically, I use pre-reform firm level data to out-predict the demand responses for the post-reform period and specifically highlight the implications of skill-biased labour demand. Section 7 concludes.

2 The pension policy and the resulting labour supply shock

Pension policies that drastically change the generosity of benefits may spill over onto the labour market by altering retirement incentives and hence the size of the labour force. The retirement effects of such policy changes can be substantial and sudden (Liebman et al., 2009; Mastrobuoni, 2009; and for emerging economies de Carvalho Vilho, 2009; Danzer, 2013). Yet, little is known about how policy-induced labour supply shocks change the size and composition of the workforce and how they affect the price of labour for workers who are not directly eligible for pension benefits. Understanding such general equilibrium effects of social policies is important as they potentially impact the production function of firms and the welfare distribution of societies (Acemoglu, 2010). Unlike in structural analyses, the program evaluation literature remains relatively silent regarding wage spill-overs because their proper identification requires a well-defined 'experiment' that satisfies three relatively demanding conditions: (1) The initial policy needs to produce a large enough labour supply effect to spill-over to those not directly affected by the policy change. (2) The pension policy must not be financed through taxes or social insurance contributions which would directly affect the price of labour. (3) Those not directly affected from the pension policy should not face any other policy changes which might confound the estimated effects. The analysis of this paper fulfils all three conditions by studying the effects of a large unanticipated negative labour supply shock stemming from a change in pension generosity on the wages of prime age workers. It exploits an unusually clear quasi-experiment in the emerging economy of Ukraine where the economic and legal environment did not change for those who stayed in the work force.

The pension system in Ukraine is simple: Since eligibility is *de facto* only determined by age (women qualify from age 55 and men from age 60) every worker is entitled to an old-age pension—irrespective of retirement. Pension benefits are computed according to a formula;

however, as documented in detail by Danzer (2013), almost all workers receive a flat benefit: the national legal minimum pension. In a surprising political manoeuvre, the government more than doubled the real minimum pension in order to win the general election of late 2004. This caused an immediate and significant increase in the retirement rates of the pension eligible elderly. One year after the reform, additional 413,000 workers or one third of the elderly had retired (Danzer 2013) implying a substantial dwindling of labour supply. Importantly, the higher pension generosity was financed through privatization revenues rather than through taxes or social insurance contributions. Hence, the labour market was exclusively affected through the negative labour supply shock. At the same time, no other large-scale policy reforms were staged in Ukraine that might have affected the labour market (Danzer 2013). Note also that pensions were raised suddenly during the president's election campaign in September 2004 while the process of legal amendments started only in 2005.[2]

The 'retirement shock' hit the economy at boom times with average wage growth of around 10%. While advertised vacancies surged by 35% after the pension rise; official unemployment declined by less than 9% during the same period (Ukrstat, 2012). The existence of unemployment during such high growth periods already suggest substantial mismatch between skill supply and skill demand in the labour market. Those who left the workforce were

[2] It is very unlikely that the "Orange Revolution" following the presidential elections had a positive effect on wages. Political turnover in settings with weak institutions tends to produce uncertainty and affect economic performance negatively (North, Wallis and Weingast 2009). In fact, Ukraine's legislative system became characterized by stalemate, especially after the new government of president Yushchenko had initiated the re-nationalization of Ukraine's largest steel company Kryvorizhstal. (Aslund 2009). GDP growth data show a slump between 2004:QIII (14%) and 2005:QIII (1.6%) (see Figure A-4). Investment data show stagnation in domestic investment and only deferred increases in FDI after the "Orange Revolution" (see Figure A-5). Limiting the main analysis on wage data before the FDI increase in the year 2006 yields results very similar to those in Table 3.

trained during the Soviet era where they had acquired skills that might be in comparatively low demand in a modern labour market.[3]

Do workers benefit from such a retirement induced labour shortage? Most likely, wages rise in the short- or medium-run because capital cannot easily substitute for missing labour. Figure 1 plots the identifying variation in the legal minimum pension (thick line) that led to a substantial increase in retirement and hence to a negative labour supply shock. Besides, it shows a time series of aggregated real wages in Ukraine between 2002 and 2007 and the local polynomial smooth of these data. To test for a change in wage growth as a consequence of the pension rise in September 2004, a simple test for structural breaks in time series could be applied. However, wages may respond with some lag to labour supply shortages. Therefore, I apply the unconditional unit-root test method developed by Zivot and Andrews (1992) to endogenously detect the structural break point in the wage data. This methodology suggests a breakpoint around January 2005, exactly the time when the Ukrainian government initiated the ex-post legislative amendments to the new pension law. At that moment the pension (and hence employment) changes became legally binding. Figure 1 confirms that wages grew substantially faster after the break point than they would have under the counterfactual scenario (illustrated by a broken line). Importantly, the change occurs in the slope rather than the intercept of the wage curve suggesting that the aggregated wage effects do not merely reflect a composition effect driven by the selective retirement of low-paid workers.

[3] Low educational degrees (elementary education and basic secondary education) can be found twice as often among those in the pension age compared to other age groups. Workers beyond the official pension age are more likely to hold very little education and to work in state-owned enterprises. Older workers are overrepresented in the health care and education sectors while younger workers are relatively more likely to be employed in services (especially, trade and transportation) (Figures A1-A3). A sudden retirement shock of older workers will, hence, hit an economy with strong educational and sectoral mismatches.

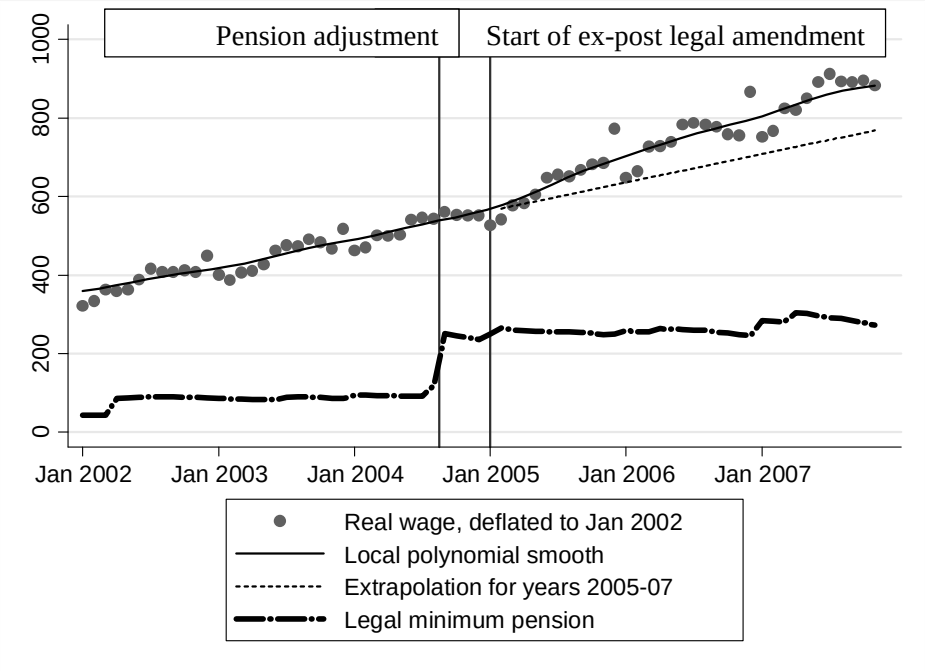


Fig. 1: Change in real wage growth after January 2005

Note: Local polynomial smooth using Gaussian kernel with bandwidth 4. Real wages and legal minimum pension are deflated to January 2002 using monthly CPI and expressed in Ukrainian Hryvnia. Extrapolation using OLS model for the time period Jan 2002-Dec 2004. Source: State Statistics Committee and Cabinet of Ministers of Ukraine; own calculations.

Albeit insightful on an aggregate level, this analysis reveals nothing about winners and losers from the pension change: Will wages of apparently close substitutes (i.e., older workers) increase, or rather those of young and recently trained workers? The labour market outcomes clearly depend on the structure of labour demand which is determined by labour market institutions.

3 Skill-biased labour demand with strict labour protection clauses

The Ukrainian labour market features many characteristics typical for inflexible labour markets in developing and emerging countries: strict labour protection clauses paired with relatively modest returns to education seriously complicate the recruitment of skilled workers

(Heckman and Pagés-Serra 2000; Freeman 2010). One reason for the compressed wage structure is the continuation of central wage bargaining in post-Soviet Ukraine where the government has kept significant influence on the determination of pay (World Bank 2009). Ukraine has relatively strict employment protection and high separation costs as a direct consequence of its adoption of the Soviet Labour Code after independence. Employers can achieve dismissals or redundancies only in consent with relatively strong labour unions thus naturally limiting the speed of modernizing the labour force (Gordnichenko and Sabirianova Peter 2005; Kheda 2013).

The economy has hence suffered from severe skill mismatch in which the demand for modern market-oriented skills cannot be met by older workers with outdated skills that were acquired in a planned economy (Commander and Kollo 2008). The shift from heavy industries to services and from technologically inferior state-owned enterprises to modern private companies suggests that older, low-educated workers command few of the skills that had actually come in high demand in the economy (Orazem and Vodopivec 1997). In fact, firms report their optimal workforce level at 110 percent of current staff, indicating a significant desire to expand employment (BEEPS 2004).[4] Table 1 shows that the fraction of firms which report difficulties in hiring qualified staff has sharply increased between 2002 and 2008. While slightly more than 50 percent of firms reported at least some difficulties in 2002, this rate increased to almost 85 percent six years later. This is almost 7 pp higher than expected from GDP weighted predictions using 2002 and 2004 data. The greatest increase can be seen for firms reporting that recruitment is a major obstacle for firm development, from 13 to almost 45 percent. Recruitment difficulties

[4] Job training is an alternative route to improve the skill composition of the workforce. Yet, with severe skill mismatch, the scope for training is naturally limited.

are concentrated among skilled workers: Filling vacancies for high qualified staff takes on average three times longer than for unskilled workers (BEEPS 2004).

Table 1: Firms reporting that the level of education and training of the workforce is an obstacle to firm's development (in %)

	(I) 2002	(II) 2004	(III) 2008	(IV) 2008 GDP weighted extrapolation 2002-2004	(III)-(IV)
	Data	Data	Data	2002-2004	Diff
No obstacle	45.6	38.6	17.8	24.5	-6.7
Minor obstacle	23.0	22.4	18.9	18.5	0.4
Moderate obstacle	18.4	19.2	18.7	18.0	0.7
Major obstacle	13.0	19.8	44.6	39.0	5.6
	100	100	100	100	

Note: GDP-weighted prediction takes into account that the GDP growth and hence labour demand slowed down after 2004. Source: BEEPS 2002, 2004, 2008.

4 The wage-growth effects of the pension reform

This section presents a reduced-form wage-growth model to learn more about the actual winners and losers of the pension policy.

4.1 Data and method

Data are taken from the Ukrainian Labour Force Survey / Household Budget Survey (UHBS) which contains annual information about employment / work relations and wages for a

representative sample of Ukrainian workers (see variable overview in Table A-1).[5] Only workers older than 25 are included in the analysis to circumvent potential confounding effects from educational incentives that may follow changes in the returns to education (see below). The sample is also constrained to workers up to age 65 (women) / 70 (men) to reflect the fact that the pension rise had negligible employment effects on the very old (Danzer 2013). The data cover the period 2002-2007, delivering sufficient numbers of observations before and after the pension change. The overall sample contains 91,732 observations. The micro data are grouped into 4,807 gender-age-education-region-year cells in order to construct a synthetic panel for estimating the following wage growth model:

$$\frac{y_{ijt+1}-y_{ijt}}{y_{ijt}} = \alpha + \delta post_t + \sum_{j=2}^{4} \mu age_{jt} \times post_t + \sum_{i=2}^{4} \beta educ_{it} \times post_t + X'\phi + \kappa + \lambda + \sum_{j=2}^{4} \theta age_{jt} + \sum_{i=2}^{4} \eta educ_{it} + \sum_{j=2}^{4} \sigma age_{jt} \times time_t + \sum_{i=2}^{4} \tau educ_{it} \times time_t + \varepsilon_{ijt} \quad (1)$$

in which *y* measures the real monthly wage of an observation (cell) with age *j* and education *i* at time *t.* Note that the wage growth variable is trimmed at the 3rd and 97th percentile. *X* comprises demographic and regional characteristics, κ are region fixed effects and λ are time fixed effects. The *post* dummy indicates all post-treatment years (2005-2007) and takes on the value of zero for all years prior to the pension rise. *Educ* are 4 dummies indicating educational attainments and *age* are 4 age category dummies, out of which the highest represents individuals above the pension eligibility threshold (women 55, men 60). The model includes age

[5] Note that the data include informal employment. In a separate analysis we find no evidence that informality can explain the negative results for elderly and low-educated workers (available upon request).

and education specific linear time trends to control for secular wage growth trends (the results are robust to the use of GDP-weighted or quadratic time trends).

This model deserves two clarifications: First, this specification is flexible enough to account for the fact that educational attainments and returns to education can differ across age groups (Card and Lemieux 2001). Second, the coefficients of interest, μ and β, which report the effects of the pension rise on the wage growth in different age or education groups, reflect deviations from secular wage growth paths. Initially, I base the estimation only on education groups (inter-education redistribution model), then I focus only on age groups (inter-generational redistribution model) and, finally, I combine both models. The estimation uses OLS and FE weighted by cell size.

4.2 Results and discussion

Before turning to the analysis of wages, I estimate model (1) with the employment ratio as outcome variable to confirm two individual-level results stressed by Danzer (2013): First, the pension increase reduced employment only among those in pension eligibility age and, second, the low educated were most likely to retreat from the labour market. Column 1 of Table 2 shows that the pension aged and those with basic education significantly reduced employment following the pension reform. At the same time the younger cohorts increased their labour market participation. Before turning to the remaining columns of Table 2 which focus on wage growth effects of the 'retirement shock' on different subgroups, note that the estimated policy effect on the wage growth of the highly skilled in a two skill group model (up to secondary education vs. more than secondary education) yields a coefficient of 0.056 (std. error 0.008). In section 6 I will estimate a simple labour demand model with firm data which produces a wage growth effect of very similar size.

In the detailed model of equation (1), the annual overall wage growth accelerated by 3-5 percentage points after the pension increase—an order of magnitude compatible with Figure 1.

The inter-educational redistribution model (column 2) and the inter-generational redistribution model (column 3) indicate that only workers up to their mid-40s and with high education enjoyed significant wage growth accelerations due to the labour supply shortage. Importantly, excess wage growth can be observed in these subgroups despite higher employment ratios which probably attenuated the wage effects (column 1). In fact, more generous pensions implied some inter-generational and inter-educational redistribution of economic benefits towards younger and better educated workers. These results also hold when combining the inter-educational and inter-generational model (column 4) and when controlling for unobserved heterogeneity (column 5). Note, however, that the negative FE estimates of the two least educated groups are larger than in OLS. The upward bias in OLS is fully consistent with average ability of observations (cells) being an omitted variable. According to the FE model workers in pension age were decoupled from the general wage growth trend (expressed by δ) and did not experience a significant change in the wage growth compared to the pre-reform period ($\delta + \mu_4$).

While the scarcity of labour (induced by the pension rise) accelerated wage growth, not all subgroups in the labour market were able to reap economic benefits: firms substituted away from low skilled workers in pension age towards better-paid young and well-educated workers. This wage growth pattern is observable at different parts of the income distribution. Splitting the

sample into low and high income earners (as of the base year 2002) yields very similar wage growth patterns.[6]

Table 2: The effect of the pension increase on employment and real wage growth

Dependent variable	(1) Employ-ment ratio	(2) Real wage growth	(3)	(4)	(5)
	OLS	OLS	OLS	OLS	FE
PPI × Incomplete higher education (β_2)	0.000	-0.032***		-0.030**	-0.031***
	(0.003)	(0.012)		(0.012)	(0.012)
PPI × Complete secondary education (β_3)	0.011***	-0.061***		-0.064***	-0.064***
	(0.002)	(0.010)		(0.010)	(0.010)
PPI × Basic general educ or below (β_4)	-0.014**	-0.170***		-0.131***	-0.178***
	(0.006)	(0.026)		(0.027)	(0.020)
PPI × Age 25-34 (μ_1)	0.037***		0.086***	0.084***	0.079***
	(0.002)		(0.010)	(0.010)	(0.011)
PPI × Age 35-44 (μ_2)	0.027***		0.011	0.010	0.009
	(0.002)		(0.009)	(0.009)	(0.011)
PPI × Pension age (μ_4)	-0.037***		-0.076***	-0.068***	-0.056***
	(0.002)		(0.013)	(0.014)	(0.011)
Implied growth in post pension increase period (PPI) (δ)	+0.6%	+5.4%	+0.9%	+3.5%	+3.4%
Personal and regional controls	Yes	Yes	Yes	Yes	Yes
Year and region FE	Yes	Yes	Yes	Yes	Yes
Skill specific linear time trend	Yes	Yes	Yes	Yes	Yes
Age specific linear time trend	Yes	Yes	Yes	Yes	Yes
Number of observations (cells)	4,807	4,807	4,807	4,807	4,807
R-squared	0.747	0.055	0.055	0.056	0.056

Note: Omitted categories: Age 45-pension age and higher education. Personal controls: age and education dummies, gender, marital status, work experience; regional controls: region, settlement type, population share retired. Regressions weighted by cell size. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Source: UHBS 2002-2008; own calculations.

[6] This confirms that the observed wage growth was certainly not driven by increases in the national legal minimum wage in Ukraine. The Ukrainian minimum wage rose slightly during the period 2002-2007 (Fig. 1). However, unlike the pension level that changed discontinuously in September 2004, the legal minimum wage increased smoothly during the entire observation period. Furthermore, average wages grew much stronger than the minimum wage, so that the replacement rate actually fell from 60% to 50% between 2002 and 2006. Consequently, the bite of the minimum wage weakened.

These results suggest that employers changed the structure of their workforce in a sense that young and well-educated employees came in high demand while the elderly who resisted retirement despite the increase in pension generosity were 'punished'. The returns to an additional year of schooling as measured in a simple Mincer regression framework increased from 5.5 log points before the pension rise by almost ten percent to 6 log points thereafter.

While the 'retirement shock' aggravated the general excess demand for modern skills it apparently reduced part of the persistent skill-mismatch prevalent in the Ukrainian labour market (World Bank, 2009). In the medium to longer run, the pension policy will influence educational incentives and the factor allocation on the Ukrainian labour market by increasing the wage gap between high and low skilled workers. However, these second order effects materialize only slowly and hence do not confound the aforementioned results which are based on individuals beyond university graduation age. Quite remarkably, a pension policy induced greater wage flexibility in Ukraine, a country in dire need of higher returns to skills and of effective corrections of labour market rigidities (World Bank 2009).[7]

[7] According to World Bank data, the tertiary gross enrollment rate (ISCED 5 and 6) has risen to over 70% in the late 2000s, after having stagnated between 40% and 50% in the 1990s. This will lead to a reduction in returns to education if the supply of skills grows substantially faster than their demand. As a consequence, the increase in the returns to education might be temporary; nevertheless, it might provide incentives for the Ukrainian youth to invest more into education, thus further raising the supply of highly educated workers. Even in the absence of an expansion of tertiary education in Ukraine, the increasing returns to and greater incentives to invest in education might remain temporary as the supply of skills changes.

5 Heterogeneity in wage responses and distributional aspects

I perform four robustness checks and further analyses on the main results: The first investigates wage responses in the public vs. private sector; the second traces wages in the low vs. high skilled sector; the third compares the development in the Eastern vs. Western part of Ukraine; and the fourth compares sectoral changes in the workforce composition.

First, wage setting in the public sector is considered less flexible than in the private sector and wage responses to labour market challenges have often been comparatively muted (Katz and Krueger 2012). Ukraine's public sector with its still active wage grids (World Bank 2009) might show little flexibility with respect to inframarginal wage growth (i.e., among those workers already employed), but highly educated new hires might replace retired low educated workers. Consequently, the wage growth response could differ between the public and private sector with the latter plausibly experiencing greater wage dispersion across skill groups.[8]

Second, the median skill content in the finance, science, education or material-technical engineering is far above the median skill content in the Ukrainian labour market in general. In order to test whether wage responses differ between high-skill vs. low-skill sectors I split the sample by skill-content of the sector of employment and define high-skilled sectors as those exceeding the countrywide median education content. In the early 2000s, these skill-hungry sectors have suffered most strongly from labour market rigidities and the low pace of skill modernization. Hence, these sectors should become more education-intensive after the labour supply shock.

[8] Another reason for splitting the sample between public and private firms can be found by the prevalence of unreported informal earnings in the public sector (Gorodnichenko and Sabirianova Peter 2007). While these might impact the level of earnings, it is unlikely that they affect wage growth differentially by subgroups.

Third, Ukraine's economic structure is geographically diverse: industrial production is more concentrated in the eastern part (East: 24% vs. West: 13% of employment), while agriculture is stronger in the western part (East: 6% vs. West: 12% of employment) of the country. Hence, I test for differences in wage growth patterns between these economic regions.

Figure 2 shows the negative wage growth premia for different educational groups benchmarked against workers with completed higher education. Irrespective of whether subgroups are defined by public vs. private sector, skill content or geography, the general pattern holds: Changes in wage growth due to the pension rise are positively related to education. There are virtually no differences between the East and West of Ukraine and relatively modest differences between low and high-skill sectors. Greater variation exists between the private and the public sector with the latter exhibiting the lowest of all wage growth differentials across educational groups. This reflects the compressed wage setting in the public sector.

Figure 3 illustrates how these growth differences relate to the overall wage dispersion. It compares normalized wage distributions between the years 2003 (before the pension rise) and 2006 (after the pension rise) for the six subgroups defined above. Note that changes in the wage distribution may not exclusively result from the labour supply shock, but might also reflect secular trends in the returns to education. In other words, the results presented in Figure 3 should not be interpreted as being caused by the pension rise. Overall, the wage distribution widened across all subgroups—implying less mass at the median. The expansion at the top of the distribution is disproportionally larger in the private and high-skill sectors, while the distributions have become relatively thicker at the bottom in the public and low-skill sectors as well as in the West of Ukraine.

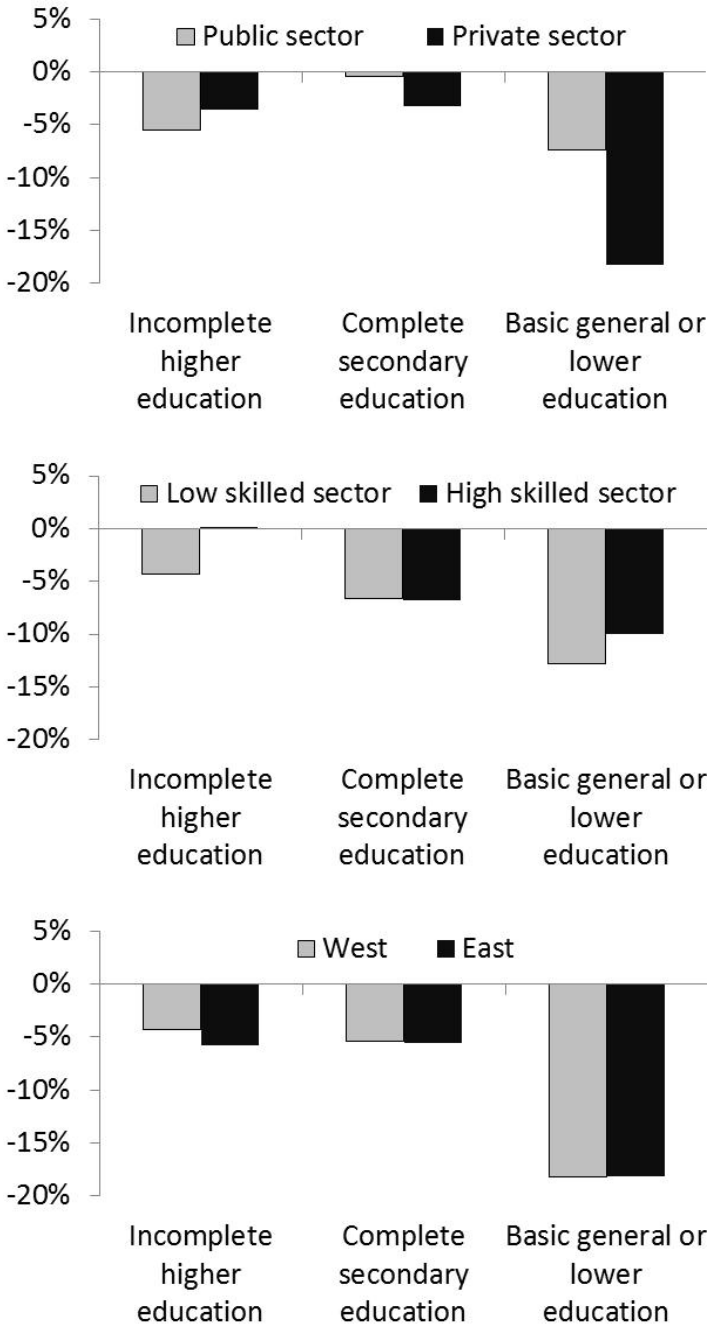
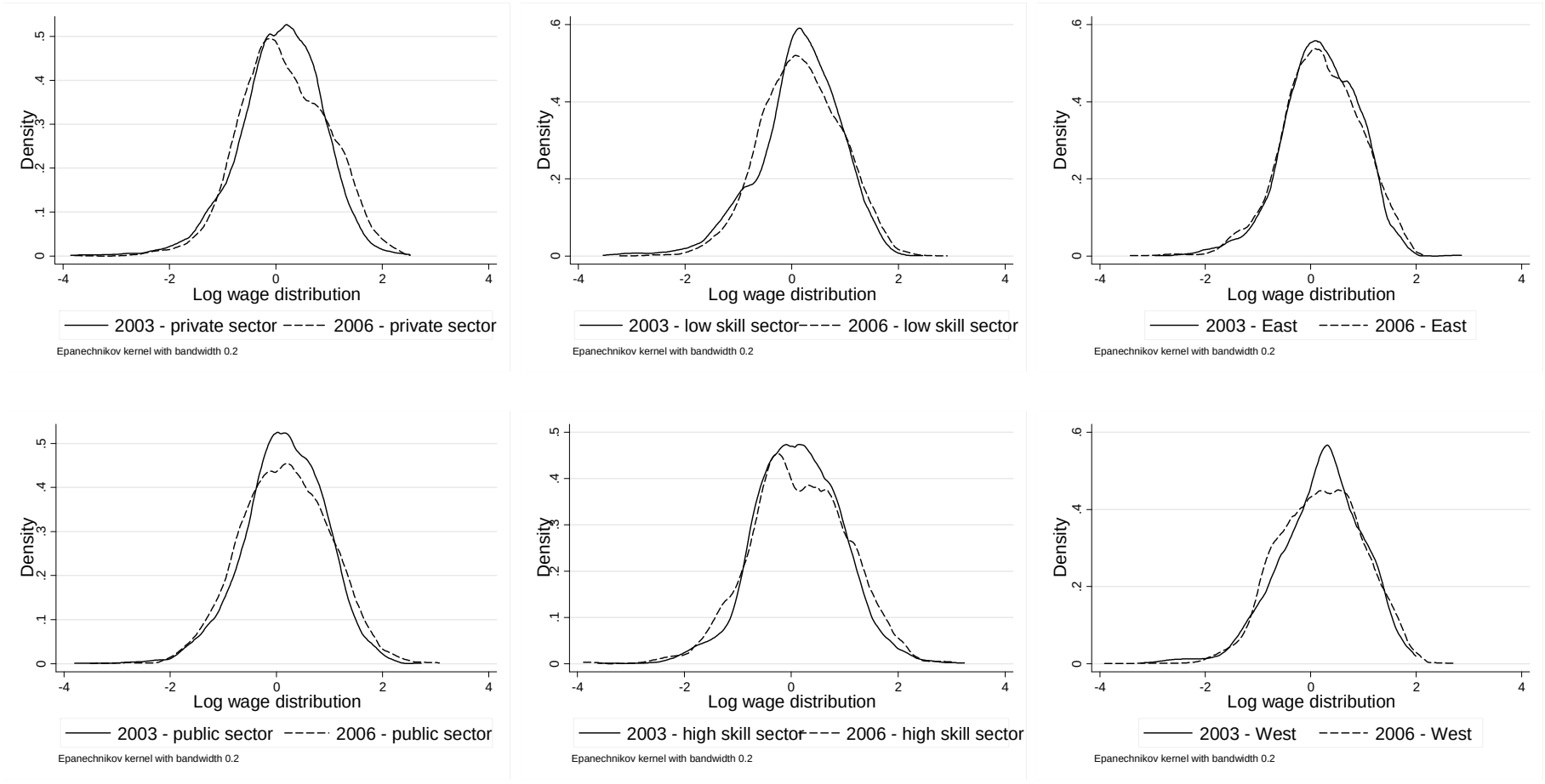


Fig. 2: Heterogeneous effects on wage growth after the pension rise

Note: Estimates stem from the following triple interaction setup: $\frac{y_{ijt+1}-y_{ijt}}{y_{ijt}} = \alpha + \delta post_t + \sum_{i=2}^{4} \beta educ_{it} \times post_t + \sum_{i=2}^{4} \vartheta educ_{it} \times post_t \times group_{it} + \rho post_t \times group_{it} + X'\phi + \kappa + \lambda + \sum_{j=2}^{4} \theta age_{jt} + \sum_{j=2}^{4} \mu age_{jt} \times post_t + \sum_{i=2}^{4} \eta educ_{it} + \sum_{j=2}^{4} \sigma age_{jt} \times time_t + \sum_{i=2}^{4} \tau educ_{it} \times time_t + \varepsilon_{ijt}$, with group referring to public vs. private sector, high skilled vs. low skilled sector, or East vs. West. Source: State Statistics Committee of Ukraine; own calculations.



Panel 2a: Public vs. private sector Panel 2b: High skill vs. low-skill sector Panel 2c: East vs. West

Fig. 3: Normalized wage distributions before and after the pension rise

Note: Epanechnikov kernel density distributions with bandwidth .2 and weights according to cell size. Real wages are deflated to January 2002 and standardized with mean zero and standard deviation one. Source: State Statistics Committee of Ukraine; own calculations.

Finally, the workforce composition across sectors changed markedly around the date of the pension reform. Attributing such changes in the workforce to the pension rise is problematic as Ukraine has been undergoing sectoral restructuring for two decades. However, as Figure 4 illustrates, annual (y-o-y) changes in the workforce shares of different economic sectors were modest before the pension rise (between 2003 and 2004). In fact, only the health care sector showed a strong contraction. Quite differently, the workforce composition became very dynamic after the pension rise: Traditionally strong sectors like agriculture & fishing, state administration and education started to shrink while service sector employment expanded massively, predominantly in trade & transportation, finance & real estate as well as in other service.

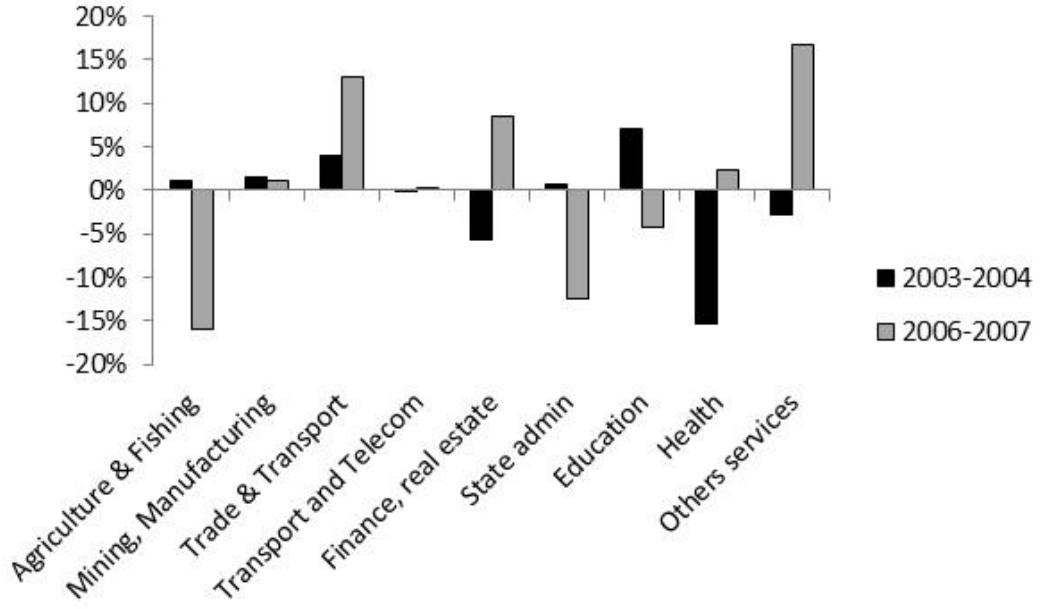


Fig. 4: Annual changes in the sectoral composition of the workforce before and after the pension rise.

Source: State Statistics Committee of Ukraine; own calculations.

6 Rationalizing the wage effects in a stylized model with heterogeneous labour demand

To rationalize the surprising finding of a non-negative own price elasticity for older workers I sketch labour demand in the presence of skill mismatch more formally. The objective of this exercise is to out-predict hypothetical wage growth implications of the retirement of predominantly unskilled workers on wages of skilled and unskilled workers. Therefore I estimate a simple labour demand model using Ukrainian firm data of the year 2004—just before the pension rise—and combine the resulting wage elasticities with actual labour supply shifts due to the pension rise of 2004/5. Since the available firm data are not overly rich—i.e., they do not disclose employment counts or labour costs by age categories—I will adjust the common methodology of the skill based approach (see Appendix) in order to directly estimate own- and cross-wage elasticities. I use the simplest version of a conditional heterogeneous labour demand model with two types of education s (capitalising on the fact that the retired elderly were almost exclusively drawn from the lower part of the educational distribution; see Danzer 2013). The resulting demand curve represents an estimate of supply-demand equilibrium points conditional on regional labour supply (according to the location of the firm) and technology of the firm.

The model is estimated with a cross-section of Ukrainian firm data—the Business Environment and Enterprise Performance Survey (BEEPS) collected by the European Bank for Reconstruction and Development (EBRD). The 2004 survey contains detailed information on more than 300 Ukrainian manufacturing and service firms (operating in 33 different economic ISIC Rev.3.1 fields; see Table A-2) and specifies the size of the labour force by two levels of education in full-time equivalents (up to secondary education vs. more than secondary education). Further important variables are labour costs as well as technology parameters such as age, import exposure, export behaviour and technological innovations of firms (see variable

overview in Table A-1). Using labour cost values for high and low-educated workers in each firm, I estimate a reduced-form inverse labour demand model for two education groups:[9]

$$logw_{hi} = \alpha + \frac{1}{\delta_h} logL_{hi} + \frac{1}{\gamma_h} logL_{li} + X'\phi + \varepsilon_{si} \quad (2a)$$

$$logw_{li} = \alpha + \frac{1}{\delta_l} logL_{hi} + \frac{1}{\gamma_l} logL_{li} + X'\phi + \varepsilon_{si} \quad (2b)$$

in which *h* (*l*) indicates high (low) education class and *i* indicates firm. The vector *X* contains indicators of firm technology like firm age, an indicator for export orientation, import competition, technological innovations, and region.[10] The own-price elasticities δ_h and γ_l measure the reaction of labour costs/wages of a specific education group to an expansion in the size of their group, while δ_l and γ_c measure the cross-price elasticities. The main difficulty is that the employment count across firms is endogenous, i.e. the observed workforce is the result of a joint determination of supply and demand. Therefore, I instrument the number of low vs. high educated staff using three instruments: The share of domestic sales which go to multinational enterprises in the sector of operation, the operating hours of the plant per week and the interaction of both.[11] The relevance of the instruments will be illustrated at the bottom of Table 3. Correct weak instrument diagnostics for multiple endogenous regressors are based on minimum eigenvalues (Stock and Yogo 2005). Based on the degree of overidentification (the number of instruments is 3) for our two endogenous regressors and the accepted maximal bias of IV, the critical test statistics is 19.9. Hence, the instruments can be considered strong in both equations. The identifying assumption is that both instruments and their interaction do not

[9] Missing labour cost values were imputed for some firms; see Danzer 2014.
[10] Firm capital is not included as it is missing for a large number of observations.
[11] An alternative might be an instrument referring to power outages in the public grid. However, one concern is that firms with outdated electrical infrastructure falsely attribute their power outages to the public grid. Yet, firms with outdated infrastructure could also be paying lower wages, hence directly influencing the outcome variables.

directly affect a firm's wages since the estimation is conditional on region fixed effects, export exposure and production technology. Both instruments are measured as mean values within a firm's economic activity, such as "manufacture of food products and beverages D15", "manufacture of fabricated metal products, except machinery and equipment D28" or "construction F45" (according to ISIC Rev.3.1). Hence, they reflect typical characteristics of an economic branch rather than of a particular firm. The exogeneity of the instruments rests on the following ideas: Sectors that sell their products to multinational enterprises operating in Ukraine will produce more technology and skill intensive than otherwise comparable sectors which sell only to domestic firms. Hence, one can suspect that firms belonging to these sectors employ relatively more highly educated staff: in fact, the raw correlation between sales to multinationals and the log of highly educated full-time equivalents is highly significant and almost +0.3, while the correlation with the low educated is -0.0024. Since the equation controls for firm technology and plant location there is little reason to believe that sectoral sales to multinational enterprises directly affect firm wages. The second instrument: long operating (not working!) hours per week—which range between 15 and 168 hours in our sample—are indicative of automated production activities. Plants in such economic branches will employ relatively more workers with comparatively low skill requirements: the correlation between operating hours and low skilled full-time equivalents is highly significant +0.25, while the comparable statistic for the high skilled is +0.09—barely significant at the 10% level. Since working hours and operating hours are independent, operating hours of a firm's economic activity should not have any direct effect on wages within the firm, conditional on production technology. Sargan overidentification tests never reject the null hypothesis at 5% that all instruments are exogenous. Standard errors

are produced by 250 bootstrap replications with bias correction which is more accurate than standard bootstrap or the delta method in small samples (Kilian 1998).

OLS and IV estimates differ markedly in size. The effect of an expansion of the low-educated workforce (γ) carries a negative sign for high and low-skilled wages in OLS; however, the effect is imprecisely estimated for the own-price elasticity and even becomes positive in the IV estimation (col. 2). So, while a retirement shock of the low educated would increase wages for the high educated, low educated peers who remain in the labour force would not benefit from their relative scarcity. The effect of expanding high educated employment is negative for the low and high educated. The cross-price elasticity in IV (col. 2) is –1.5, similar to the substitution elasticities in other contexts (Ciccone and Peri 2005).

Table 3: Inverse labour demand model – wage elasticities

	(1)	(2)	(3)	(4)
Dependent variable	Log wage Low educated	Log wage Low educated	Log wage High educated	Log wage High educated
Estimation	OLS	IV	OLS	IV
$\frac{1}{\delta}$	-0.194**	-0.676**	-0.203***	-0.136*
	(0.0703)	(0.276)	(0.0327)	(0.0725)
$\frac{1}{\gamma}$	-0.0937*	0.359*	-0.171***	-0.376**
	(0.0515)	(0.191)	(0.0451)	(0.152)
Exporting	-0.446	0.0472	1.085***	2.086***
	(0.719)	(0.735)	(0.141)	(0.519)
Technology	0.112	-0.161	1.422***	1.493***
	(0.158)	(0.217)	(0.0905)	(0.0850)
δ	-5.2	-1.5	-4.9	-7.4
γ	-10.7	2.8	-5.8	-2.7
Cragg-Donald F		44.3		24.3
Stock-Yogo (2005) weak test statistics		19.9		19.9
Observations	289	289	305	305
R-squared	0.193	0.551	0.588	0.765

Note: Bootstrapped standard errors clustered at regional level in parentheses. Stock-Yogo test statistic for two endogenous variables, three exogenous instruments and 10% maximal IV size. *** p<0.01, ** p<0.05, * p<0.1. Source: BEEPS 2004; own calculations.

Based on previous evidence (Danzer 2013) that all additionally retired pensioners were drawn from the lower end of the educational distribution, one can bound the effect of the pension policy based on the labour demand of Ukrainian firms as of the year 2004. Averaged across gender, the additional retirement among those at old-age (and low education) amounts to 30 percent (Danzer 2013). Multiplying this figure with the inverse of the cross-wage elasticity of high income earners (between –0.171 and –0.376), suggests that in a two-skill economy the highly skilled should earn between 5.1% and 11.3% above their medium-run trend. Remember that the estimated wage growth effect in the two-skill reduced form model was 5.6% above trend which falls in the band predicted by the demand model using BEEPS data. At the same time, low skilled workers do not gain from the retirement of older low educated workers, as evidenced by their non-negative own-wage elasticity.

7 Conclusions

A unique quasi-experiment in Ukraine illustrates that the labour shortage induced by a sudden increase in pension generosity accelerated the wage growth path of young and well-educated workers. The increasing demand for modern labour market skills was illustrated using a cross-section of Ukrainian firms. Consequently, the retirement shock of 2004 benefitted young and well-educated workers much more than older workers with outdated skills acquired during the Soviet era. The changes in the wage structure boosted the returns to education and hence contributed to the otherwise slow modernisation of the Ukrainian labour market. The results suggest that large-scale social policies have significant general equilibrium effects and spill over to other markets and population subgroups that are not directly targeted by the policy.

Since Ukraine is one of the countries expecting a quick shrinkage of the pool of available working-age adults due to population ageing and low fertility (Kupets, Vakhitov and Babenko 2013), the results of this research have two implications: On the downside, the unbalancing of the population composition is a threat to the economic potential of the country. On the upside, this imbalance will endogenously change economic rewards for modern education and hence strengthen the incentives to acquire modern market-oriented skills. However, the government could foster policies to support these incentives (e.g., in public sector wage setting) and at the same time keep an eye on the poverty risk of the losers of this development: the low-skilled elderly.

The political implication of this paper complements the literature indicating that the emigration of predominantly young workers significantly raises the younger generation's wages (Elsner 2013). Some (transition) economies are characterized by both—high emigration rates and rapid population ageing—and, hence, face potentially severe skill scarcities. However, migration of skilled young workers will respond much quicker to economic incentives than the (rather slow moving) ageing process: As population ageing pushes up returns to educations, some of the well-educated young workers may forgo emigration and stay at home, thus providing a rather flexible margin for workforce adjustment.

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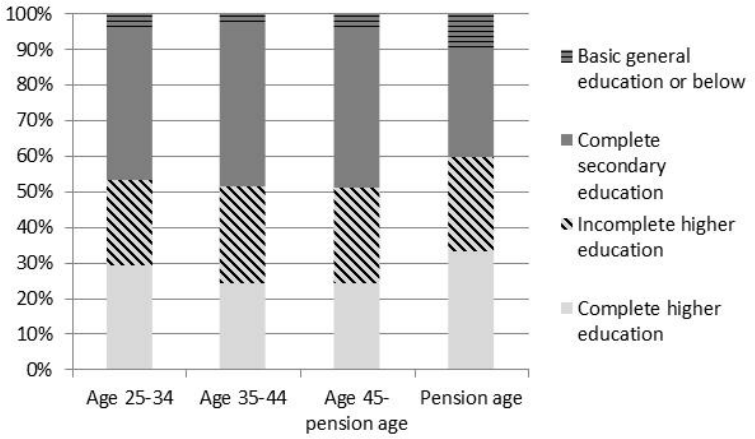
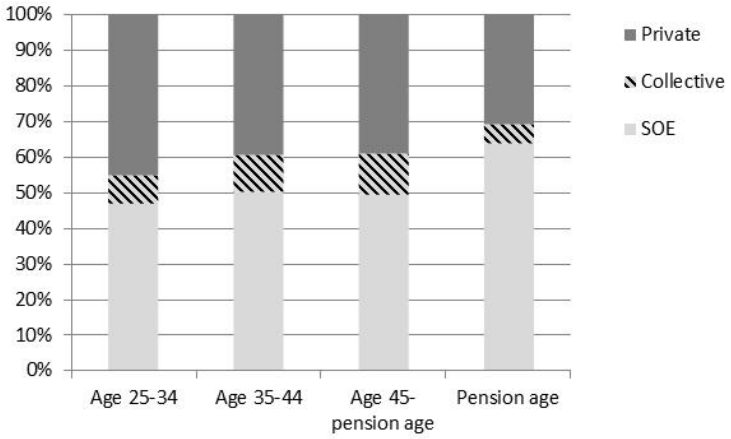
Appendix of Figures



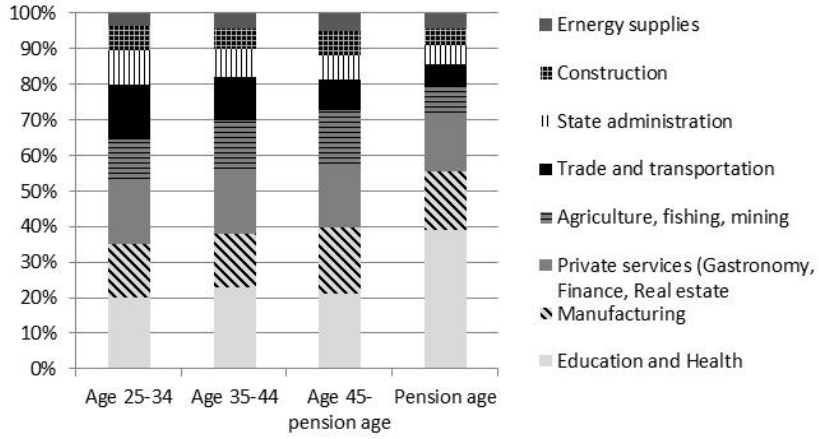
Source: UHBS 2002-7

Fig. A-1: Composition of workforce by age and education.



Source: UHBS 2002-7

Fig. A-2: Composition of workforce by age and ownership type of firm.



Source: UHBS 2002-7

Fig. A-3: Composition of workforce by age and economic sector.

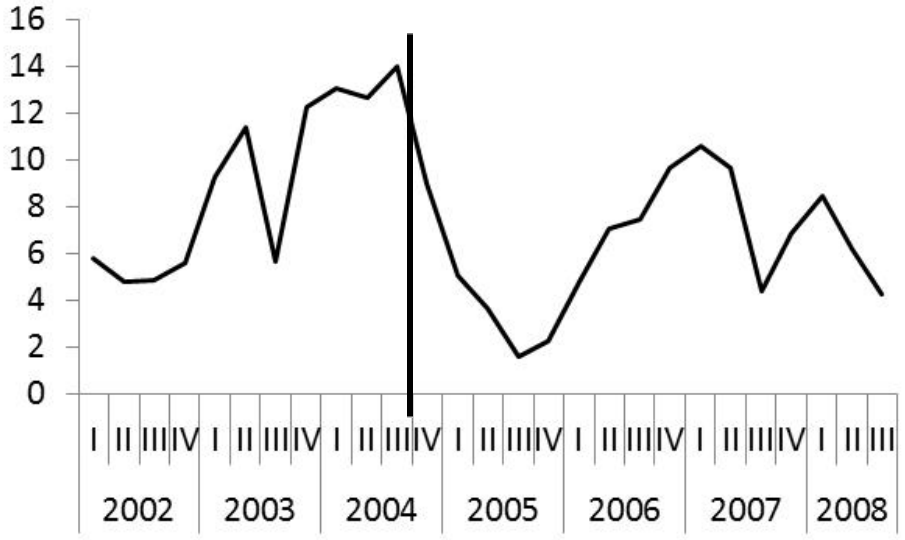


Fig. A-4: Quarterly y-o-y GDP growth
Source: State Statistics Committee of Ukraine (Ukrstat); September 2014.

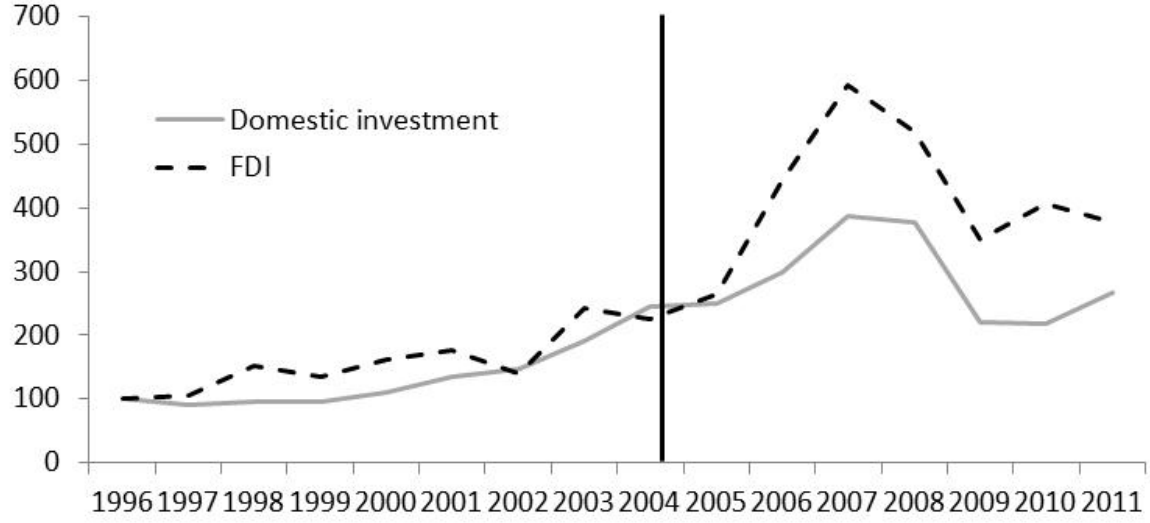


Fig. A-5: Domestic investment and FDI in Ukraine (adjusted for re-nationalization)
Source: State Statistics Committee of Ukraine (Ukrstat); September 2014.

Table A-1: Descriptive statistics

Data set: UHBS (N = 4,807)

Variable	Mean	SD
Share working	0.572	0.255
Wage growth	0.122	0.361
Education: Basic general educ or below*	0.197	0.397
Education: Complete secondary education*	0.275	0.447
Education: Incomplete higher education*	0.247	0.431
Education: Higher education*	0.281	0.449
Age: 25-34*	0.261	0.439
Age: 35-44*	0.265	0.441
Age: 45-pension age*	0.285	0.451
Age: pension age*	0.189	0.392
Female*	0.519	0.500
Married*	0.764	0.236
Years of work experience	21.7	10.9
Regional share of pensioners	0.263	0.043
Settlement: Rural*	0.285	0.270
Settlement: Town*	0.302	0.250
Settlement: City*	0.413	0.312

Cont.

Cont.

Data set: BEEPS (N = 305)

Variable	Mean	SD
Log full time equivalents high education	2.50	1.21
Log full time equivalents low education	2.81	1.41
Log wage high education	4.97	0.99
Log wage low education	4.59	0.85
Export share of production	0.074	0.181
Import competition*	0.191	0.395
Technology modernized during the past 36 months*	0.475	0.501
Log firm age	2.26	0.750
Years since privatization (including zeros)	1.51	3.53
Operating hours per week, 36 months ago	49.5	26.4
Percent of sales to multinationals located in Ukraine	4.33	13.43

Note: * indicates dummy variables. Low education is defined as up to complete secondary education, high education is defined as above complete secondary education.

Table A-2: Economic activities according to ISIC Rev.3.1

14,15,16,17,18,19, 20,21,22,24,25,26,27,28,29, 33,36,37, 45, 50,51,52,55, 60,63,64, 70,71,72,73,74, 92,93

Appendix: A simplified model of heterogeneous labour demand

I follow conventions in the existing literature and define aggregate output Y at time t as a combination of capital K_t, labor L_t and total factor productivity A_t with a fraction α of labor income in aggregate income

$$Y_t = A_t L_t^{\alpha} K_t^{1-\alpha} \qquad \text{(A-1)}$$

Labour L_t is a CES aggregation of several types of workers which is defined as

$$L_t = \left[\sum_{k=1}^{2} \theta_{kt} L_{kt}^{\frac{\delta-1}{\delta}}\right]^{\frac{\delta}{\delta-1}} \qquad \text{(A-2)}$$

Where L_{kt} is another CES aggregation of workers with education level k, which designates either up to complete secondary education or above secondary education:

The two different education groups each contribute θ_{kt} to the overall output such that $\sum \theta_{kt} = 1$. In order to simulate the implications of an exogenous labour supply shock, I need estimates of the substitution elasticities between education ($\delta > 1$) groups.

The labour market equilibrium of profit-maximizing firms can be characterized by differentiating aggregate output with respect to L_{kt} and taking logs, i.e. by estimating the demand for each group of workers at time t. In effect, one equates wage changes for a specific group with their marginal productivity:

$$logw_{kt} = log\alpha A_t + (1-\alpha) logK_t + log\theta_{kt} + \left(\alpha - 1 + {}^{1}/_{\delta}\right) logL_t - {}^{1}/_{\delta}\, logL_{kt} \qquad \text{(A-3)}$$

with $1/\delta$ being the slope coefficient of the labour demand curve. The wage of a specific education group does not only depend on own-group labour supply, but also on the amount of labour supplied by the other group.

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