STOCKHOLM SCHOOL OF ECONOMICS

Inequality indices, income shares and upper income groups in the public sector: surviving the crisis and the austerity measures

Master Thesis, Department of Economics

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Abstract: the paper documents development of income inequality in public sector using a panel of inequality measures and a unique dataset on monthly income of employees in 41 public sector entities in Latvia over 2006-2009. Calculated inequality measures are then used as dependent variables to analyze the determinants of changes in income inequality and in income distribution relying on OLS, IV-GMM and panel fixed effect IV regressions in empirical methods. The paper finds that in the public sector income inequality levels and dynamics differs a lot within two broad types of public entities, the state enterprises and public administration. Similarly, determinants of income inequality vary as well. The paper finds that income inequality in state enterprises is affected by external shocks (financial crisis, fiscal austerity measures), GDP growth and average wage growth rates, whereas none of these factors has an influence on income inequality in public organizations. This implies that most of the previous studies of determinants of income inequality that used country-level aggregate data might overestimate the effects of inequality determinants on income inequality in the public sector, and underestimate these effects on income inequality in the private sector.

Table of Contents

1. Introduction

Does economic growth benefit everyone, or are the fruits of economic development reaped by the few? And if the growth does not lifts all boats, is it true that everyone also falls in a different manner? Any attempt to answer these questions should build on a vast body of literature that links inequality and economic growth and thus addresses a fundamental issue of whether market forces have a tendency to foster or smooth out differences in economic outcomes on both macro- and micro-levels. A number of recent studies (e.g. Bourguignon, 2002) suggest that income inequality within country affects economic growth of that country as a whole, and thus importance of the issue outlined is hard to overestimate.

Still, a question as stated above is too broad for any credible attempt to answer it properly, and thus must be reformulated and made instrumental by splitting it to a few narrower ones. Is it the case that the poor gain more from economic growth, or is the case that the rich, entrenched in their positions, anticipate forthcoming changes and fully exploit them? Does the interaction between growth and inequality differ in the boom years as opposed to the bust years? Finally, are these processes similar across different sectors of the economy, i.e. the public and the private sector?

It's very difficult to resolve even these narrower kind of questions in pure theory since plausible models for both equalizing and diverging effects indeed do exists (extensive review is provided, for example, in Claessens and Perotti, 2007). Additionally, empirical research has been hampered by lack of suitable data, especially so on the micro-level, as well as by a number of econometric issues (Wooldridge, 2002). As a consequence, most of the empirical analysis in the field so far has been focused on cross-country comparisons, or on in-depth case studies of changes in aggregate income distribution in one particular country or in a reasonably small set of countries (Atkinson, 1996). These approaches are clearly limited in scope, suffer from unobserved heterogeneity, endogeneity and thus are questionable on the grounds of both internal and external validity of the conclusions.

Moreover, to the best of my knowledge, there are no studies directly concerned with analysis of inequality in the public sector that constitutes a crucial part of the economy and is most responsive to government policies (Cameron, 1978). This all brings forward a need for a new analysis and a better and deeper micro-level data to get a grasp on the underlying dynamics of

the interaction between growth, income inequality, the public sector, and the role of the government.

This paper aims to cover this gap by documenting and exploring changes that happened to the income distribution in the public sector in Latvia during and after the financial crisis of 2007, building on a unique micro-level dataset on individuals' compensation structure in state enterprises, ministries, municipal councils and in the Parliament, in regulatory bodies, government agencies and in the administration of special economic zones. The dataset originates from the State Revenue Service of Latvia. The *research objective* thus is threefold:

- firstly, to *document* development of income inequality in the public sector over time;
- secondly, to *provide an analysis* for the factors influencing inequality in the public sector;
- thirdly, to *examine uniformity* of the determinants of inequality across different public sector entities.

The case of Latvia provides a particularly rich material for the purposes of this paper due to a several reasons. The country is a member of the European Union and a small open service-based economy, typical in structure to that of most post-industrial economies. The country was exhibiting very high growth rates in the booming years before the crisis, thus allowing for testing of effects of growth on inequality. Additionally, the country was one of the economies most severely hit by the crisis, with about a quarter of GDP collapsing by the end of 2008 (Central Statistical Bureau of Latvia, 2012), thus providing an excellent material for testing of effects of crisis on inequality. What is more, the impact of the crisis was so hard that the government was forced to implement a 'fiscal consolidation plan', a packet of austerity measures that included slashing the salaries in the public sector by about 25 percent. That 'plan' had set only the target for cuts, leaving the exact design of the fiscal contraction measures at discretion of management of respective public entities. This provides an additional dimension for the analysis, namely an assessment of the impact of government actions on inequality.

The data for the study, initially classified and unavailable for the general public, was leaked from the Electronic Declaration System of the State Revenue Service of Latvia and made available the over the internet in late 2009. Disclosure of the data caused a huge uproar in the media, criticizing high salaries paid in the public sector amidst the crisis and even during the austerity measures undertaken by the government (Domburs, 2010). This discontent was

strong enough to push for an official disclosure of the data on income received by employees in the public sector by the decision of the Parliament in June 2010 (State Administration Structure Law, 2010).

The rest of the paper is structured as follows: Chapter 2 provides an overview of the state of the literature on measuring of inequality and on recent developments in studies of determinants of income inequality, both from theoretical and empirical perspectives; Chapter 3 describes the dataset employed for the empirical analysis, gives a brief overview of the effects that financial crisis of 2007 had on the economy of Latvia, an overview of the 'fiscal consolidation plan' undertaken by the government of Latvia and the implications of the crisis and the austerity measures for the current analysis; Chapter 4 provides methodology for empirical strategy of the current paper; Chapter 5 documents development of inequality over time and reports the results from econometric analysis; and Chapter 6 concludes.

2. Literature Review

This section outlines important stages of study of wealth inequality in economic context. I start the discussion from the first attempts to document and measure inequality and proceed to recent contributions in the field, analyzing the effects and determinants of inequality. A reader well-acquainted with the subject might want to skip this section.

2.1. Documenting the issue

Crucial groundwork on the issue dates back to late 19th century. In a seminal paper by Vilfredo Pareto, power law-style of reasoning was applied to the income distribution, basing the reasoning on the study of land ownership in Italy and tax records in UK (Pareto, 1896). Importance of this study is hard to overestimate, as it laid down a structured mathematical basis for any succeeding study on the subject, as well as provided a powerful motivation to explore the field even further by placing the issue of income inequality in a broad socioeconomic context. This way of thinking was developed further in a number of succeeding studies (e.g. Theil, 1967) and resulted in generalization of power law to a class of Generalized Entropy (*GE*) indices applicable to a study of income inequality (Cowell, 1980). For that class of indices, choosing a value of a sensitivity parameter allows designing an index with greater or smaller sensitivity to differences in different parts of income distribution. The larger , the more sensitive is a resulting index to changes at the top of the income distribution.

A different approach to measure inequality was taken by Max Lorenz in 1905, assessing concentration of wealth in Prussia (Lorenz, 1905). He proposed to look at quantiles of population and a fraction of total wealth held by any given quantile. Graphically, complete equality in a society thus corresponds to a 45-degree line, and inequality is a distance from that line. Building on Lorenz's ideas, Corrado Gini in 1912 proposed a now-standard measure of inequality that summarizes information on income distribution within a given sample in a very simple and convenient way (Gini, 1912). The Gini coefficient is the area below the 45 degree line that corresponds to full equality less the area below the income-based Lorenz curve. Thus, in its simplest form, the Gini coefficient is given by $= 1 - 2\int ( )$, where $(\cdot)$ is the function for the Lorenz curve. Lower values of Gini coefficient represent a more equal spread of income across population, and higher values indicate greater concentration of income in the hands of the few. Recent developments in the field, as well as availability of better and richer data allowed for calculation of Gini coefficient without direct reliance on the Lorenz curve, as the need to specify the functional form was clearly an impediment (Deaton and Ng, 1997). Instead, calculations are built only on income data for quantiles of distribution. By construction, the Gini coefficient is most sensitive to differences in income in the middle of the distribution, or, more precisely, the mode.

Anthony Atkinson provided critique to the two abovementioned approaches and argued for an another way to measure inequality so as to overcome identified deficiencies (Atkinson, 1970). He showed that then-standard measures of income inequality (variance , the coefficient of variation / , the Gini coefficient and the standard deviation of logarithms belonging to GE family of indices) result in intransitive ranking of countries in terms of inequality due to implicit and different assumptions about the structure of the social welfare function. To tackle the problem, he proposed another class of measures that allowed incorporating desired properties directly in the inequality measure through a sensitivity parameter $[0, +\infty)$, the inequality aversion of the social welfare function. Resulting indices are more sensitive to changes in the lower part of the income distribution as increases, and more sensitive to changes in the upper part of the distribution as falls down to zero; a crucial advantage is that these indices at the same time avoid the intransitivity problems that arise due to different implicit assumptions about the social welfare function. This family of indices is widely known as Atkinson indices.

Finally, with broader and better micro-level data on income distribution becoming increasingly available towards the end of the 20th century, shares of income held by different percentiles of the population became employed as a measure of inequality. Significant advantage of these measures (clearly in line with reasoning provided by Max Lorenz) is intuitive understanding and easy interpretability. Moreover, with micro-level data at hand, income shares allow to decompose changes in income distribution by income brackets and assess what parts of population gained or lost their relative income positions over time (Piketty and Saez, 2006).

To sum up, by now there is a full methodological apparatus that enables compiling a panel of income inequality measures tailored to identify and trace over time dynamics in income inequality for a specific part of the income distribution. Furthermore, it is important to note that if a specific metric fails to pick up changes in inequality within a given entity and a given time period, by no means this is an indication that inequality in general stayed constant. Rather, this might be a poorly chosen metric that does not allow capturing the underlying dynamics of the particular distribution under examination.

2.2. Inequality, Growth and Determinants of Inequality

The crucial question in the study of income inequality is that of causation. Does inequality foster (or hamper) growth, or is it growth that is driving changes in inequality? Early structured attempts to analyze this issue date back to the famous Kuznets inverted-U hypothesis that tried to explain the rise and fall in income inequality with labor market imperfections and changes productivity that happen due to fluctuating nature of economic growth (Kuznets, 1955). Essentially, at core of the hypothesis is a notion of structural change in economies as countries undergo industrialization at the expense of agricultural sector. Given that change, inequality will rise due to stakeholders of fast-to-adapt enterprises reaping most of the benefits of the structural shift, and stakeholders of more rigid enterprises relatively losing in income. Similarly, upon reaching a certain level of economic development (i.e. a certain level of GDP per capita) and stabilization of the economy, inequality will fall due to the welfare state policies and trickle-down effects. That seminal paper, alongside with neoclassical growth and distribution models (Stiglitz, 1969) provided the basis for subsequent discussion and analysis of the issue.

Further studies tried testing the inverse-U relationship between inequality and growth against the data and found that predictions of the hypothesis held in simple cross-country

comparisons, at least in the data covering the period of up to 1970s (Chenery et al, 1976; Deininger and Squire, 1996). However, availability of better and broader datasets and introduction of panel data analysis methods shattered the inverted-U hypothesis empirically. It turned out that most of the high-inequality observations were coming from Latin America, and once this factor has been controlled for, the inverted-U can no longer be traced as a universal pattern (Fields, 2001; Deininger and Squire, 1998). These new datasets also raised the issue of intertemporal structure and the chain of causation, something that could not be addressed properly in cross-sectional comparisons before (see, for example, Li, Squire and Zou, 1998; and Lundberg and Squire, 2003 for a thorough discussion on causality issues).

Along the same lines, François Bourguignon provides an excellent discussion of the Poverty-Growth-Inequality triangle, arguing that (i) poverty is in fact a function of growth, distribution of income and changes in that distribution, and that (ii) there exists a two-way relationship between growth and distribution of income (Bourguignon, 2002). He also shows that there is a multitude of channels for inequality to affect growth (allocation of resources across sectors of the economy, productive factor rewards, relative prices, factor endowments of economic agents, etc.). Conceptually, behind all these channels is a reasoning that in turn dates back to Kuznets and Lewis, a methodical examination of the effects of growth on income distribution through one or several direct channels. Apart from these direct influencing factors, Bourguignon argues that there also exists an indirect channel that works through institutions. Here, growth is perceived as a factor that shapes institutions, and institutions in turn alter the distribution of income, even though with a considerable lag (Bourguignon, 2002).

In turn, this implies that alongside natural pattern of historical co-development of inequality and growth, institutions and direct policy measures can significantly alter the resulting path. Disappearance of inverted-U pattern clearly does not imply that growth is not a determinant of inequality; rather, this is an indication that the interaction is much more complex than thought before, and that policy measures and country-specific effects have to be taken into account. Another point illustrated by the papers discussed above is that conflicting unidirectional models in fact present a false dilemma: for growth and inequality, there is nothing like a ‘chicken-and-egg’ paradox; conversely, they should be treated as endogenous, and models must be built to account for that.

Providing additional dimensions to the discussion, there is a rich and ever-growing body of literature attributing changes in inequality to factors other than growth per se: *globalization*

(IMF, 2007; Atkinson and Piketty, 2009; Harrison, 2006; Cornia, 2003; Gerschbach and Schmutzler, 2007; and Bardhan, Bowles and Wallerstein, 2006), the state of *financial development* (to name a few, Claessens and Perotti , 2005; Galor and Zeira, 1993; and Beck, Demirgüç-Kunt and Levine, 2007), and reaction to *crises* and *government policies* unequally affecting different parts of population (Easterly, 2005; Piketty and Saez, 2006; Cornia, 2012; and Roine, Vlachos and Waldenström, 2009). The latter is of particular importance in the context of the current paper and is discussed in details later on in this section.

Globalization is found to affect inequality mainly through universal drive towards liberal market reforms. Atkinson and Piketty document differences in patterns for inequality globally, again failing to find support for Kuznets curve and instead providing an indication that in Anglos-Saxon countries a U-shaped pattern can be traced over time instead of the inverted-U (Atkinson and Piketty, 2009). Andrea Cornia, using a panel of 73 developing and transition economies in the time period of 1980-2000 finds that in between-country comparisons it is not possible to single out any distinctive global trend in inequality as measured by the Gini coefficient, but at the same time within-country comparisons clearly show that inequality is rising as a consequence of domestic deregulation and external trade liberalization (Cornia, 2003). Ann Harrison defines globalization as exposure to trade and international capital flows, and considering general equilibrium effects shows that the poor are able to benefit much more from globalization in the presence of proper governance and institutions that increase social mobility and skill transfers; moreover, there are clearly identifiable winners (employed in FDI-related sectors) and losers (employed in imports-competing sectors), but overall effect of globalization on poverty is clearly negative (Harrison, 2006). Contrary to this, Gerschbach and Schmutzler build a theoretical model that defines globalization as integration of product markets and labor (i.e. management) pools; they show that an increase in globalization leads to an increase in wage differences among top management of companies because of different ability of the managers to adapt to changes (Gerschbach and Schmutzler, 2007).

Development in *financial markets* influences inequality mainly through lifting the credit constraint for the poorer fraction of population, but that channel is also subject to barriers erected by insiders, i.e. the rich. As Claessens and Perotti argue, inequality influences division of political power, and thus financial regulation might become captured by political incumbents, broadening instead of shrinking the gap between the poor and the elites. They find that financial development and liberalization in the absence of proper institutions

decrease stability in the economic system and thus may give rise to an increase in inequality (Claessens and Perotti, 2007). These ideas are further tested by Beck, Demirgüç-Kunt and Levine. They use panel GMM methods to account for endogeneity and assess whether the benefits of financial developments are captured by the rich, or if the poor are benefiting as well. They find that actually the poor disproportionally benefit from financial development, and that of the two main channels, the aggregate growth and the changes in income distribution, about 60% of the effect comes from aggregate growth increase, and about 40% come from changes in the income distribution development (Beck, Demirgüç-Kunt and Levine, 2007). Galor and Zeira argue that wealth distribution is affected by imperfections in capital markets and investments in human capital and show that overall it is an initial level of income inequality that significantly alters the speed of adjustments to external macroeconomic shocks (Galor and Zeira, 2003).

Much of the discussion about *government policies* and *crises* having an effect on inequality and income distribution is centered on (i) institutions and (ii) taxation and redistribution mechanisms. William Easterly provides an excellent discussion of how government actions influence economic growth; in turn, economic growth translates into changes in income distribution, and thus the whole body of literature is extremely relevant for the current paper. He argues that discretionary government policies have little effect on growth if institutions are controlled for (Easterly, 2005); this implies that the change of income distribution will follow changes in government policies with a considerable lag needed to enable transition of the effect through institutions channel. Piketty and Saez, using a long series of U.S. personal income data, show that most of the changes in inequality are stemming from changes in income shares of top deciles of population, specifically the top 0.1%; they also argue that this is due to an increase in marginal income and capital taxation for the top income earners (Piketty and Saez, 2006). Andrea Cornia, using a data for Latin America countries finds that fiscal policies in a form of more progressive taxation do indeed have a negative effect on inequality; he also shows that growth has a moderate, but negative effect on income inequality, and that measures of inequality are strongly and significantly correlated to own past levels, thus clearly indicating an autoregressive process (Cornia, 2012). Roine, Vlachos and Waldenström combine rationale from financial development and government policies affecting inequality. They examine the effects on inequality coming from financial development, openness, government spending and changes in marginal tax rates, as well as changes introduced by banking and currency crises. They find that (i) over the 20th century,

growth and financial development has been clearly pro rich, i.e. that top income earners benefited from them disproportionally, that (ii) government spending and top marginal tax rates decrease inequality and disproportionally benefit lowest 90% of the income distribution, and that banking crises have had an a negative impact on top income shares (Roine, Vlachos and Waldenström, 2009).

To summarize empirical studies discussed above, there are several factors affecting developments in inequality at most:

- First, inequality appears to be 'sticky', and current levels strongly depend on the starting and past values of inequality. Along the same lines, inequality tends to vary more across entities rather than in time within the same entity, and individual specificity plays a great role;
- Second, growth is so far the strongest single factor influencing income distribution, but it must be handled with care in empirical analysis due to endogeneity issues;
- Third, government policies have both a short-term direct impact on inequality through taxation and redistribution mechanisms, but also a long-term effect on income distribution through institutions that must also be taken into account;
- Finally, crises and external shocks also affect income distribution and demand a careful analysis.

3. Data Description

This chapter is structured as follows: Section 3.1 describes the raw dataset employed for the current analysis, Section 3.2 discussed the timing of the data and external shocks that might affect the income distribution and Section 3.3 sums up the reasoning why the dataset presented is extremely relevant for the purposes of the current paper.

3.1. Raw dataset

This paper draws upon a unique dataset on individuals' gross salaries paid in the Latvian public sector. The data originates from the State Revenue Service of Latvia of Latvia (SRS), but was not obtained directly from that organization. Since September 2002, SRS collects and stores electronically the data on salaries of employees in the public sector; this used to be classified information not available for the general public up until de-classification by the decision of the Parliament on 15 June 2010 (State Administration Structure Law, 2010).

However, in 2009, due to a malfunction in the Electronic Declaration System, the data on salaries was leaked from the SRS and collected by members of self-proclaimed 'Fourth Army of National Awakening' (Ceturtā atmodas tautas armija, or 4ATA), a hacker group that in a short period managed to download over 120 gigabytes of data, or 7409565 documents containing, among others, digitally signed income declarations and data on employees' monthly salaries in the largest public entities of Latvia (Domburs, 2010). This data was partially anonymised and made available over the internet in several batches during the Fall 2009 and Spring 2010 (see a detailed list in Appendix 1), causing a wide media coverage and a huge popular uproar due to anecdoctical evidences on extremely high salaries paid to some individuals in the public sector amidst the financial crisis.

I have collected this data and whenever possible checked the data for consistency. There were two types of checks: (i) comparing not anonymised (usually, top management of state enterprises and highest paid officials) income data that was provided by 4ATA to the web-based income declaration data service provided by SRS since June 2010, and (ii) checks of total number of employees in public enterprises according to the 4ATA data to the numbers provided in annual reports of the said public enterprises. For the former, individual income data was always matched exactly to the data provided by the SRS; for the latter, numbers fluctuated within 5% of the total number of employees of each particular public organization. That difference is likely to be due to 4ATA data tracing employment over the whole year, but annual reports of the companies only providing the end of the period information. Based on these checks I can conclude that while it is generally possible that some portion of the data could be misplaced or misrepresented, overall the 4ATA database provides a fair insight into income distribution in public organizations. Naturally, not all public entities are included in the database, but for those entities that are in the database I have true income data and employment and income histories without exclusions.

The raw dataset is an unbalanced panel tracing monthly gross salaries paid in 41 public entities in 6 broad categories (state ministries, municipal councils and the Parliament, government agencies, regulatory bodies, the free ports of Riga and Ventspils (special economic zones), and state enterprises). The data covers a time period from September 2002 to December 2009, and contains data on income of 27544 unique individuals anonymised for the purposes of the current paper, and 479310 month-individual observations. To smooth out the noise from seasonal fluctuations, I average the individual income data over a 3 month period for the subsequent analysis.

Thus, the raw dataset used for the current paper contains only 4 variables: *id*, a personal panel identifier, *inst*, identifier of the public entity where the person is employed, *tq*, panel time identifier corresponding to a quarter of the year, and *comp*, average salary in EUR that the person received in that particular quarter. For the latter, missing values are treated just so, and average is computed using the available data (i.e. the average is computed on three points in case there are no missing values, on two points if there is one missing value, and so forth). Furthermore, the data is not evenly spread over time; periods of up until the third quarter of 2006 contribute less than 18% of the total number of observations; Figure 1 below illustrates the raw data spread over time by quarters:

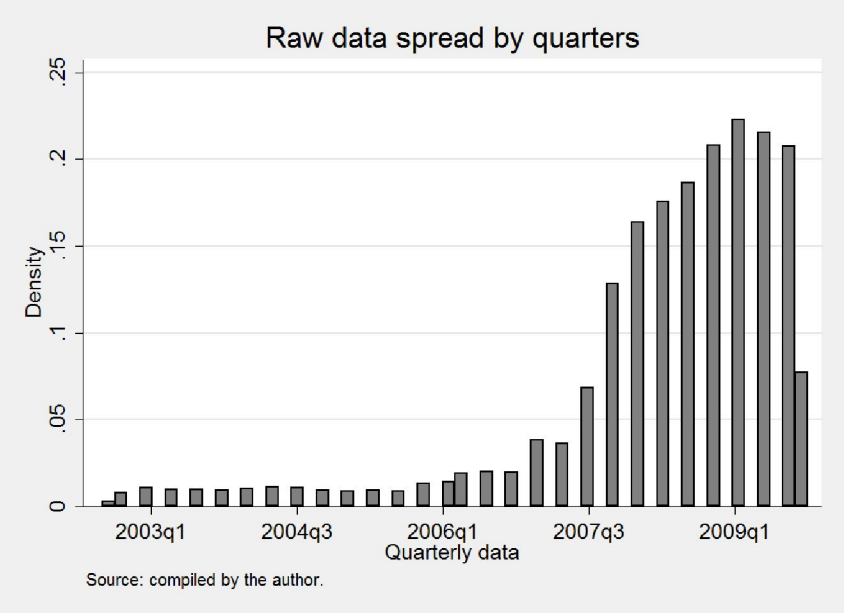

Figure 1. Frequencies in the raw dataset.

Moreover, the data is not evenly spread across public entities. The Figure 2 below illustrates the raw data spread across 6 broad types of public entities as described earlier:

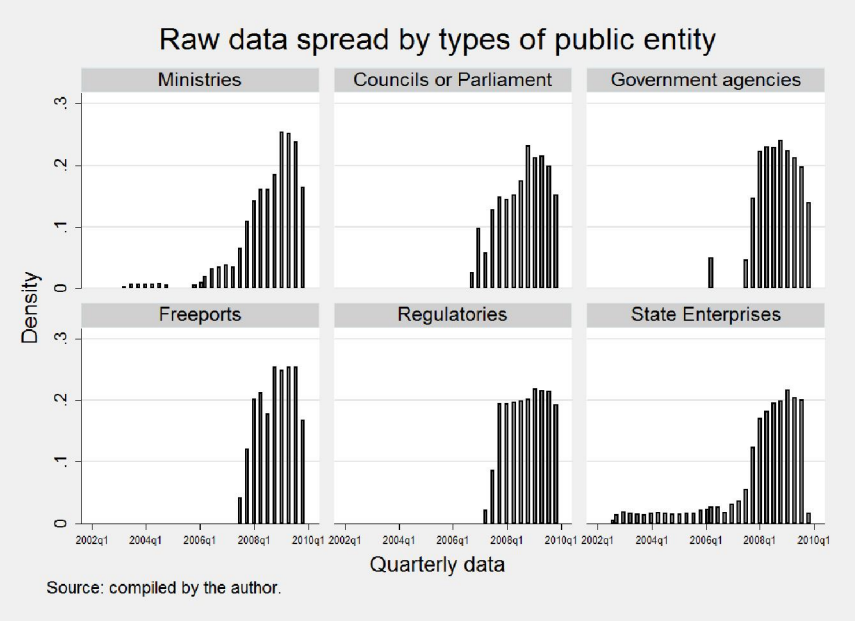

Figure 2. Frequencies in the raw dataset, by type of public entity.

Since most of the data covers the time period from late 2006 to late 2009, I homogenize the dataset and drop the data for the time periods preceding the third quarter of 2006. Noteworthy, the dataset lacks the coverage of fourth quarter of 2009 for most of the public enterprises. The reason for that is that the disclosure of the data started in September 2009, and the data for the public enterprises was disclosed first.

Additionally, to get reliable perception of dynamics in income distribution over time and across public entities, I filter out all part-time employees, defined as individuals with less than three months' employment history (2697 observations), and everyone earning less than the legally defined minimal wage (5734 observations). This allows me to focus only on full-time employees, clears the data from the seasonal employment distortions, and leaves 22748 unique individuals in the filtered dataset, or 82.59% of the raw dataset.

The levels of salaries are not evenly spread as well, but this is obviously the feature of the data and a subject of the current paper; the Figure 3 below gives a snapshot at average wages paid in the public entities, along with the legal minimal wage and the average salary in the public sector as provided by the Central Statistical Bureau of Latvia (CSB):

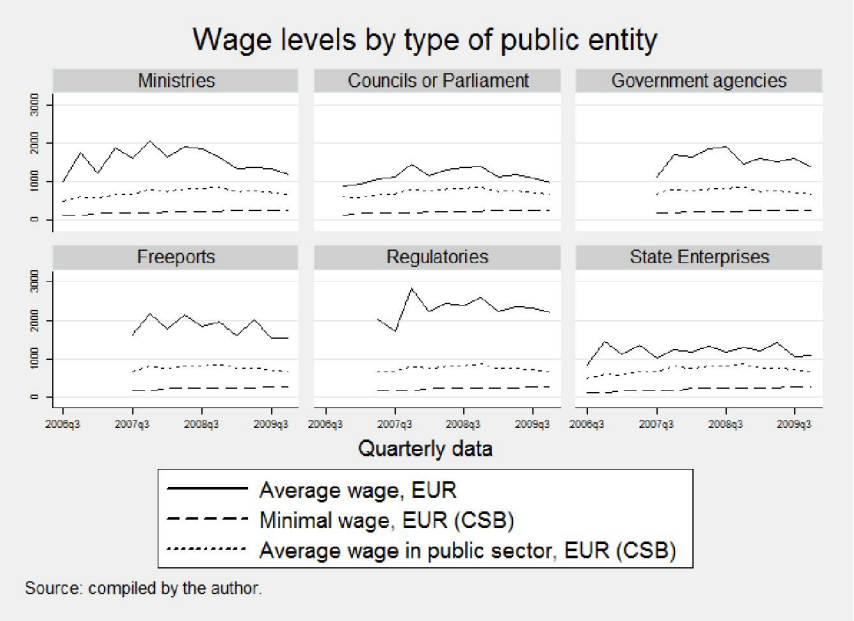

Figure 3. Wage levels over time.

This section would not be complete without discussion on the treatment of outliers. Truly, the raw data, even though originating from the State Revenue Service, can be subject to errors-in-variables typical for any kind of electronic income declaration system (misplaced decimal signs, wrong personal identification numbers, etc.). In turn, this could in principle give rise to several influential observations, but the amount of these errors in absolute terms is bound to be small. Moreover, comparing to the size of the dataset at hand, the number of outliers arising due to errors in variables is negligible and will not alter the general picture. Another type of outliers in the data is connected to extremely high quarterly average salaries paid to some individuals. Even though clearly a rare occurrence, the dataset contains several cases with average quarterly income of a public official exceeding 60 thousands Euro, whereas the average wage in the public sector at the same time stands below 1 thousand Euro. I manually cross-checked (whenever that was possible due to only partial anonymization of the raw data) these cases and in 5 out of 6 such cases the person ceased his/her employment immediately in the next period, implying that the extremely high income is actually a layoff benefit and thus should be treated exactly as the income received by employees.

As a concluding remark on the features of the dataset, I'd like to stress that even though at a first glance the use of that data would be problematic for academic purposes due to legal issues, it is not so due to (i) the decision of the Parliament to de-classify this data ex-post

(State Administration Structure Law, 2010) and (ii) full anonymization of the individuals in the dataset that I undertake prior to the analysis.

3.2. Timing issues and external shocks

The time period covered by the dataset is of particular interest for the study of income inequality. Global financial crisis that started with the housing bubble burst in the U.S. in early 2007 affected Latvian economy in mid-2007. The Figure 4 below illustrates key economic indicators for the time period 2007-2009:

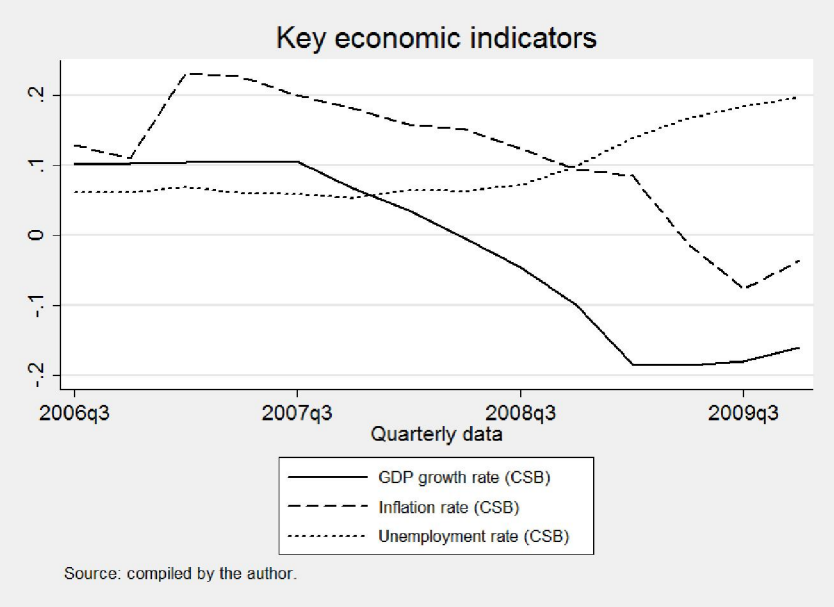

Figure 4. Key economic indicators, the data provided by CSB.

Sharp rise in inflation by the first quarter of 2007, and an equally sharp fall in GDP starting in the third quarter of 2007 that is evident from the graph allow to mark the 'crisis' event impacting the economy of Latvia as a midpoint in the second quarter of 2007. This point in time will be used for further analysis to document the effect of the crisis on inequality and income distribution in the public sector.

With about a quarter of GDP collapsing by the beginning of 2009 as compared to the beginning of 2007, double-digit inflation and rising unemployment rates, the government of Ivars Godmanis was forced to resign in March 2009, and a new coalition government led by Valdis Dombrovskis was formed. There were two main tasks for the new government: (i) to secure a 7.5bn Euro loan from the European Union, the World Bank and several other countries, and (ii) to design a package of measures to counter the effects of the crisis. Under

the pressure from potential lenders, the government decided to go for a path of fiscal austerity measures, labeled 'the fiscal consolidation plan'. The measures proposed and discussed during the Spring 2009 involved dramatic cuts in public spending, the retirement benefits and, most importantly for the purposes of the current paper, the wage cuts across the public sector. The target for the wage cuts was set at 25% of the total wage bill for most of the public entities, but the exact design of the measures (the mix of wage cuts and layoffs) was left at discretion of each particular public entity. Also, the plan was drafted by the end of the Spring 2009, but could only be accepted in July 2009 as an amendment to the State Budget 2009. This left sufficient time gap both for the open public discussion on the pros and cons of proposed measures, and for the public officials and top management of state enterprises to plan and prepare their actions based on information available about the forthcoming cuts.

3.3. Summary of the discussion of the data

Based on the details mentioned above, the dataset employed in the current paper has several distinctive features that make it particularly valuable for analysis of inequality and income distribution dynamics:

1. it provides a particular insight into income distribution and inequality in the public sector, the area largely untouched by previous studies,
2. the structure of the dataset allows to compute directly various types of inequality measures,
3. it covers time period that is sufficiently long for quantitative analysis,
4. it provides the data on the two broad types of public entities, the state enterprises and the public organizations; the former is more exposed to market forces in its operations, whereas the latter is much more affected by direct government actions. This provides an important dichotomy where state enterprises can be thought of a rough proxy of a public sector, and public organizations as a proxy for the whole sector of state administration.
5. it covers both the boom and the crisis periods, thus allowing to single out the effect of the financial crisis on income distribution,
6. it also allows to single out the effects of direct government intervention (the austerity measures) on income inequality and distribution,
7. it also relevant to ensure external validity of the results since Latvia is a typical small open service-based economy similar in structure to most of the developed countries.

With these ideas in mind, I proceed to the methodology employed to document inequality, as well as to the theoretical framework for the empirical analysis of determinants of inequality.

4. Methodology for empirical analysis

This chapter is structured as follows: Section 4.1 sets up the tools to trace developments in inequality over time using a variety of measures and subsamples; Section 4.2 proceeds with the framework for analysis of determinants of inequality and presents testable hypotheses.

4.1. Documenting inequality

Since to the best of my knowledge there are no empirical papers directly assessing income inequality in the public sector, I need to compile a panel of inequality measures sensitive to income changes in different parts of the distribution to ensure that important underlying dynamics (if any) is adequately captured. Building on the ideas presented in the first part of the literature review, I employ a set of measures that differ in their sensitivity to income inequality in different parts of the income distribution to document income inequality dynamics.

Following Cowell (2000), I compute a set of generalized entropy indices characterized by the form

$$\frac{1}{(\quad -1)} \quad = \quad -1 \ , \qquad = -1$$

$$(\ ) = \quad \frac{1}{} \quad = \ln \ = \ , \qquad = 1$$

$$\frac{1}{} \quad \ln \ = \ , \qquad = 0$$

where *N* is a number of individuals, is an individual income, ¯ is an average income and is a sensitivity parameter. Lower values of parameter thus make a resulting index more sensitive to income differences in the bottom of the income distribution; conversely, higher values result in index being more sensitive to differences in the top of the income distribution. One might also notice that with = 0 index becomes a mean logarithmic deviation and with = 1 index is just a Theil index, as special case of GE indices discussed earlier.

Following Atkinson (2004), I complement *GE*( ) calculations with Atkinson indices of the form

$$( ) = \begin{cases} 1 - \frac{1}{\bar{} } \sum \left(\frac{}{\bar{}} \right)^{1-} , & = 0.5, 2 \\ 1 - \frac{1}{\bar{}} \prod \left(\frac{}{\bar{}} \right)^{\frac{1}{}} , & = 1 \end{cases}$$

where *N* is a number of individuals, is an individual income, ¯ is an average income and is an inequality aversion parameter. Higher values of thus result in indices more sensitive to income differences in the bottom part of the income distribution.

I also provide calculations for the conventional Gini coefficient that is most sensitive to changes about the middle of the income distribution. The Gini coefficient without direct reference to the Lorenz curve is given by

$$= 1 + \frac{1}{} - \frac{2}{} \frac{\sum (+ 1 -)}{\sum }$$

where individuals are ranked by income in ascending order, *N* is a number of individuals, is an individual income and is a rank of an individual.

Finally, following Piketty (2003) and Roine, Vlachos and Waldenström (2009), I also provide calculations for income shares by income brackets. I use five income variables to document the key aspects of income distribution within my data limitations,

- 01 (99.9 − 100), the share of total income received by top 0.1% income earners
- 1 (99 − 100), the fraction of total income received by the top 1% income earners,
- 10 − 1 (90 − 99), the fraction of total income received by the next top 9%,
- 10(90 − 100), the share of total income received by top 10%,
- 90 (0 − 90), the remaining share received by the rest 90% of the sample.

To explore within the top inequality, I also calculate additional measures, *Top1/10*, defined as the share of top 1% in the income of the top decile, *Top10/90*, a share of income of top decile

in income of the bottom 90%, and *Top1/90* defined as a share of income top 1% in income of the bottom 90%. These measures are needed to assess inequality within the top of the distribution and are invariant to possible measurement errors as long as those are uniformly spread.

In order to get a disaggregated picture of development in inequality over time, I calculate the indices on the *UR*, the unrestricted sample; additionally, I split the sample by *Type* of public entity, dividing the sample on public organizations that are related to state administration (ministries, municipal councils and the Parliament, free ports administration, regulatory bodies and government agencies fall in this broad category) and public enterprises (fully or partially state-owned companies, utilities, etc.). For each slicing of the data, I calculate inequality measures on a quarterly basis, covering the time period slightly longer than three years, from the third quarter of 2006 to the fourth quarter of 2009. Additionally, I calculate a shortened version of the same panel of inequality measures splitting the dataset into six distinct categories (ministries, municipal councils and the Parliament, free ports administration, regulatory bodies, government agencies and state enterprises), and separately for each of the public entities.

4.2. Empirical models

For the empirical analysis part of the paper, I largely follow methodology presented in Cornia (2012) and Roine, Vlachos and Waldenström (2009). With the main task to document the determinants of inequality in the public sector, I use 5 inequality measures for each public entity and for each quarter; the measures are the General Entropy coefficient *GE(1)* as a measure most sensitive to changes in the top part of the income distribution, Atkinson coefficient *A(2)* as a measure most sensitive to changes in the bottom part of the income distribution, and a standard *Gini* coefficient most sensitive to changes in the middle of the income distribution. This is complemented by *Top1*, the share of top 1% of income earners in the total income of the employees of each particular organization, and *Bot90*, the share of the bottom 90% of the income earners in the income of the employees of each particular organization.

Then, for each of the inequality measures, I run a pooled OLS regression to serve as a reference point. The regressions are of the following form:

$$= + + + + + + + \prime + , = 1,2 \ldots , = 1,2 \ldots ,$$

where *Ineq* is a respective inequality measure, *Wagegr* is average wage growth rate as compared to the previous period, *Crisis* and *Austerity* are indicator variables that denote, respectively, the beginning of the crisis and the start of the austerity measures, *GDPgr* is a fixed prices (base - 2000) GDP growth rate as compared to the GDP in the same quarter in the previous year, *X* is a set of controls that includes an indicator variable for the *type* of public entity (public organization or public enterprise) and *Starting* level of inequality within a particular public entity, *i* and *t* are respective public entity and quarter of the year identifiers. In the regression routine, observations are also weighted by the total wage bill of a respective public entity to account for the size differences across public entities.

The model specification is chosen based on the logics of cross-country regressions since to a large extent theoretical framework for determinants of income inequality in the public sector is missing in the literature, and since existing methodology can be applied directly for at least part of the sample (the state enterprises perceived as a broad proxy of public sector). Wage growth rate and GDP per capital growth are used to capture the effects of economic development (Roine, Vlachos and Waldenström, 2009). Crisis and austerity measures indicators are needed to single out the effects stemming from external shocks; they are included in the regression in the lagged form to account for slow speed of adjustments of wages that is especially pronounced in the public sector. Most importantly, the first own lag and the starting values of inequality measures are needed to reflect the autoregressive nature and intertemporal 'sticky' behaviour of inequality identified in previous studies (Cornia, 2012). Finally, controlling for the type of the public entity is necessary in order to account for heterogeneity in inequality arising across public entities due to different operational and labour market conditions that are faced by public administrative bodies and by public enterprises. Also, controlling for type of the public entity is needed due to the fact that the salaries paid in the public enterprises are at least in part dependent on financial performance of a said enterprise; this is clearly not an issue for employees in the public organizations and administrative bodies, and hence must be controlled for.

From the discussion provided in the literature review section, it is evident that for a simple OLS analysis of the effects of growth (in a form of wage growth in the current paper)

endogeneity and unobserved heterogeneity are two major issues. To deal with the former problem, I estimate an IV-GMM regression of exactly the same form as above, instrumenting the *Wagegr* variable with *Inflation* and *Unemployment rate* in the preceding period. These are the standard controls for the growth regression, at the same time not related in any way to inequality measures within public entities and thus are valid instruments (also see Appendix 2 for correlation statistics).

Finally, in cross-country studies unobserved heterogeneity between countries played an important role in shaping the final results (Roine, Vlachos and Waldenström, 2009). Based on this, I complement the pooled regression with a simple *public-entity* fixed effects IV model, estimating a version of the baseline model as before but also controlling for entity-specific heterogeneity and instrumenting for endogeneity in *Wagegr* with the same set of instruments as above. In fixed effect setting, the *crisis* and *austerity* indicators only mark the start of the crisis period and austerity measures, contrary to covering the whole interval in the pooled models. Moreover, the models cannot account for the *starting* values of inequality measures since they do not vary over time and thus are wiped out from the controls vector by the fixed effects estimator (Wooldridge, 2002).

The choice of the estimation method for the current paper is that of a lesser evil and greater caution. OLS performs poorly in almost every aspect, but is easily interpretable and serves as a clear reference point. However, the choice amongst more sophisticated models is not that simple. On the one hand, the IV model allows to partially clear endogeneity issues, but fails to account for entity-specific heterogeneity. In turn, this implies that on average the absolute value of the coefficients for continuous variables will be upward biased, but the coefficients for the indicator variables should not change much if correctly capturing the timing of the events (Wooldridge, 2002). On the other hand, the fixed effect IV model deal well with unobserved heterogeneity by differencing it out and also partially allows accounting for endogeneity. On the downside, that class of models by construction loses important time-invariant control variables, is sensitive to model specification, and relies heavily on a large amount of available data to produce reliable estimates; the latter is unfortunately not the strongest point of the dataset employed in the current analysis, so the results from panel fixed effect IV regressions should be interpreted with caution.

A natural extension and an even better way to model endogeneity and heterogeneity would be to use a variant of panel GMM estimation techniques (Arrellano and Bond, 1991; Arrellano

and Bover, 1995) specifically designed for large N, small T settings (Roodman, 2007). Unfortunately, these methods require both longer and broader panels for asymptotic conditions to work properly (Roodman, 2007), and the dataset employed in the current paper again is simply not big enough. Nevertheless, even if correct point-estimates are unlikely to be obtained in the current analysis, the *direction* of the effects and their statistical *significance* should still provide an interesting discussion material if interpreted with care.

4.3. Ex-ante expected effects of determinants of inequality

Concluding the theoretical section, for each of the variables included in the regression analysis, I provide a short discussion on the expected sign of the coefficients. Throughout this section, by the first four inequality measures (in order of listing) I mean *GE(1), A(2), Gini* and *Top1* since they all capture the concentration of wealth at the top of the income distribution, but do so from different standpoints. The fifth inequality measure is *Bottom90,* the share of the bottom 90% of the income distribution in overall income.

Lagged values of inequality measures are expected to be positively related to the current ones, reflecting the 'sticky' nature of inequality and slow speed of adjustments (Cornia, 2012).

In cross-country regressions growth of GDP per capita represented both an increase in individual well-being and a general development of economic situation in the country. Here, I can decompose and separately evaluate the effects stemming from these in two channels, the average wage growth for the former and country GDP growth for the latter. I expect the average *Wage growth* to be positively related to the first four inequality measures, but negatively related to *Bottom90*. This is motivated by the fact that a number of studies discussed earlier find within-entity growth disproportionally benefitting the top part of the income distribution (Roine, Vlachos and Waldenström, 2009). Along the same lines but from a different angle, *GDP growth* is expected to have a negative impact on the first four inequality measures, but a positive effect on *Bot90*; the rationale for that is the fact that for within the country analysis GDP growth rate is actually reflecting overall improvement in well-being and is thus equivalent to an expansion of the budget constraint. In turn, this should disproportionally more affect the poorest fractions of the income distribution and reduce inequality due to inability of public officials to fully internalize the gains (Bourguignon, 2002).

The effect of the crisis on income inequality is ambiguous. If growth was shown to be pro-rich, the crisis as an opposite of growth should have a negative effect on inequality (Roine,

Vlachos and Waldenström, 2009). At the same time, if the top income earners are able to shield themselves against the downside volatility of growth (insurance in the private sector, systems of checks-and—balances in the public sector), income inequality will rise due inability of low income earners to protect themselves.

As for austerity measures, the structure that was proposed by the government (i.e. the cuts in salaries), is expected to play an equalizing role. To a large extent, the cuts in the public sector wages can be thought of as an equivalent of an increase in marginal tax rate that has been shown to have a negative effect on inequality (Roine, Vlachos and Waldenström, 2009).

5. Results of empirical analysis

This chapter is structured as follows: Section 5.1 documents development of income inequality in time and across various types of public entities, and Section 5.2 presents the results of econometrics analysis. Also, Appendix 2 provides selected summary statistics for the variables used in this part of the paper.

5.1. Development of income inequality in time and across public entities

I start the discussion by providing a brief overview of the development in income inequality for the unrestricted sample, pooling together all the data at hand. Since ex-ante it was not clear in what part of the income distribution should I expect the most of the changes to occur, I calculate three General Entropy indices, the Gini coefficient, and three Atkinson indices with different sensitivity to changes across different parts of the income distribution. The Figure 5 below documents development of these indices over time, and also provides yearly growth of GDP to illustrate the state of the economy at each particular point in time, and vertical solid lines denoting the start of the crisis and the start of the austerity measures:

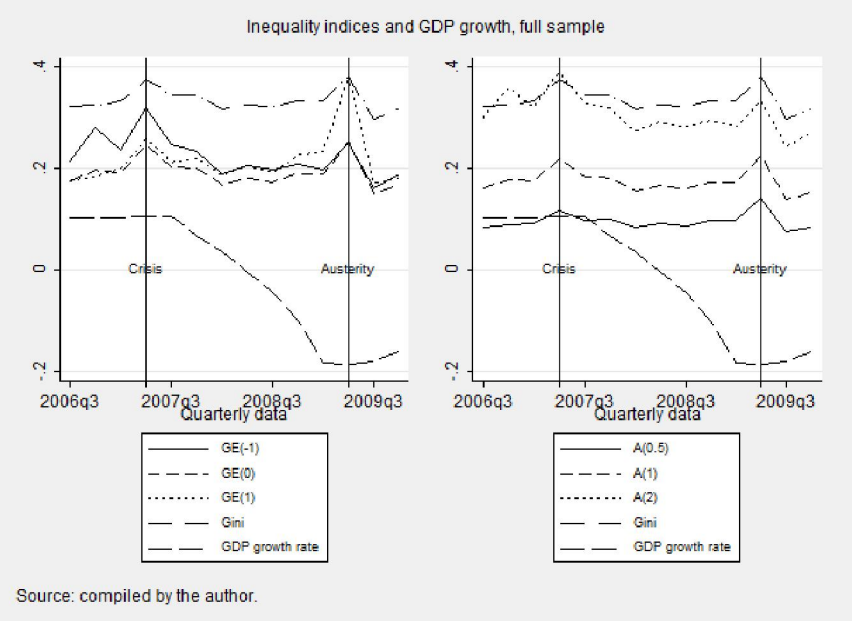

Figure 5. Selected inequality indices over time, unrestricted sample.

The graph illustrates several important points: (i) inequality was rising in the periods preceding the crisis (the boom years), culminating just before the crisis turning point, (ii) inequality measures fell during the first several quarters of the crisis period, but picked up rapidly in the following periods, (iii) the highest after-crisis point was reached by all inequality measures in the same quarter as the austerity measures were introduced, and, finally (iv) inequality fell in the periods following the introduction of austerity measures. As a reference point, according to the Central Statistical Bureau of Latvia estimates, the Gini coefficient for was equal to 0.354 in 2006, 0.361 in 2007, 0.374 in 2008, and 0.377 in 2009, thus also documenting an increase in inequality (Central Statistical Bureau of Latvia, 2012).

Overall, the development in inequality seems to be initially driven by changes in relative positions happening to the bottom part of the income distribution during the quarters around the crisis event; this is indicated by *A(2)* and *GE(-1)*, the coefficients that are most sensitive to changes in lower parts of the income distribution. However, most of the changes really come from the top income earners as the time approaches the introduction of the austerity measures; this, in turn, is indicated by the changes in *GE(1)* and *A(0.5)*, the measures most sensitive to the changes in the top of the income distribution.

To further expand the insights from the inequality indices, I provide a Figure 6 calculated for the shares of the overall income received by, respectively, top 0.1%, top 1%, top 10% and bottom 90% of the income distribution:

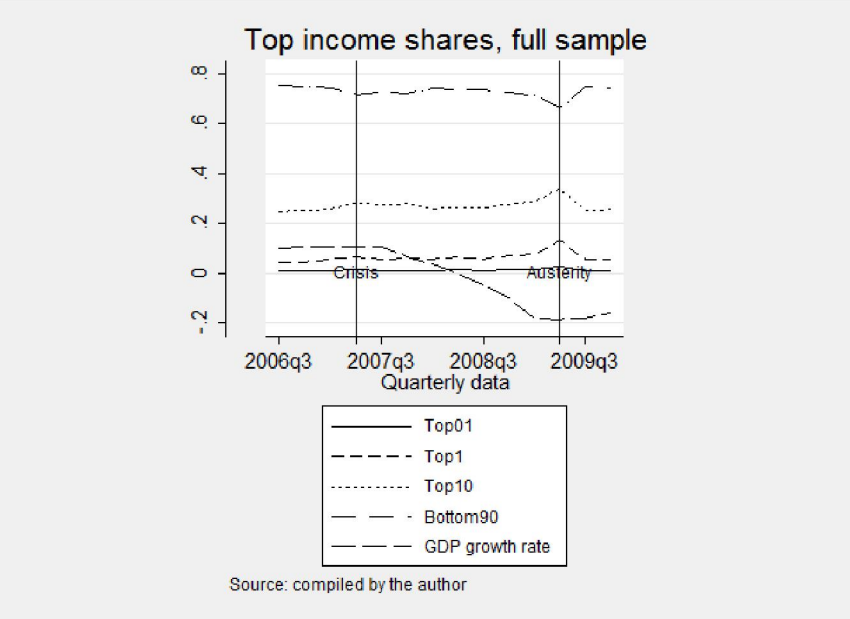

Figure 6. Income shares in the unrestricted sample.

This figure provides several important insights: (i) over time and during the crisis but before the austerity measures, the income shares are changing only marginally, (ii) there is a sharp rise in income of the top 10% just before the austerity measures were introduced, (iii) that rise in income share of the top 10% is mainly driven by the rise in the income share of top 1%, and, to a much lesser extent, by the income share of top 0.1% income earners, (iv) the share of top incomes falls down immediately after the austerity measures were undertaken.

Combined with the Figure 5, there are several important insights to be drawn:

1. Inequality seems to be falling in the aftermath of the crisis
2. Inequality seems to be rising before austerity measures were introduced, and falling just after them
3. The most significant changes happened to the bottom and to the top parts of the income distribution, whereas the impact on the middle part is fairly limited.
4. Changes in income shares are driven by the top 1% of income earners.

To expand the analysis and corroborate these findings, I compile similar graphs but with respect to the *type* of public entity, the public *organizations*, covering all types of public administrative bodies on the one hand (state ministries, municipal councils and the Parliament, regulatory bodies, government agencies and the free ports administration fall in this broad category), and the public *enterprises*, covering all state-owned companies in my sample on the other. The Figure 7 below illustrated development in inequality indices by type of the public entity:

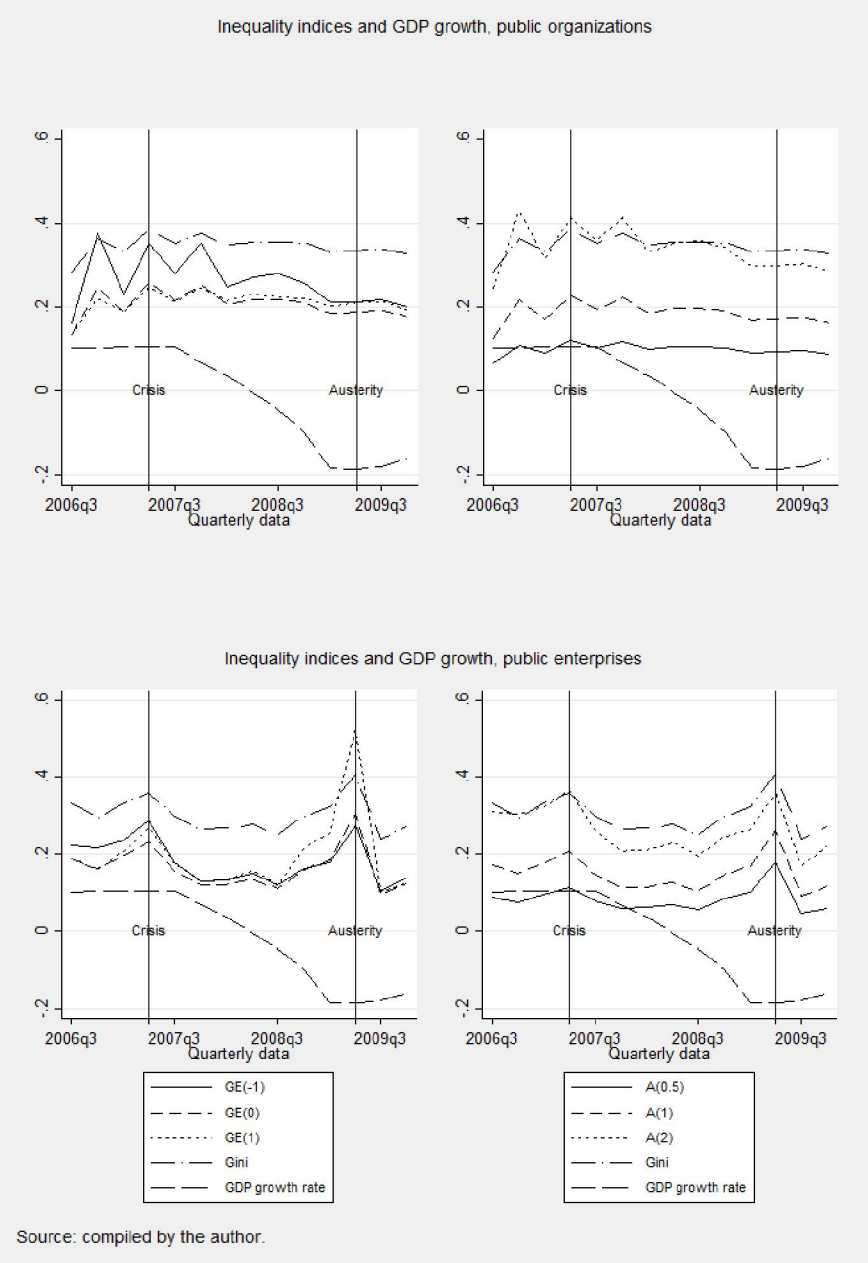

Figure 7. Inequality indices by type of public entity

Now, one can see that intertemporal development in inequality indices is fundamentally different in public enterprises, as compared to the public organizations. Those were the changes in inequality indices of the former type that produced the peak in mid-2009 that is described in Figure 5, since inequality (regardless of the measure employed) stayed reasonably constant across public organizations.

Furthermore, calculating the income shares by type of public organization, I also add Top90-99 that indicates the share of the top 90%-99% share of the income earners (that is, top 10% less top 1%) to better illustrate the extent to which top 1% is actually contributing to an increase in inequality. Figure 8 below reports the results:

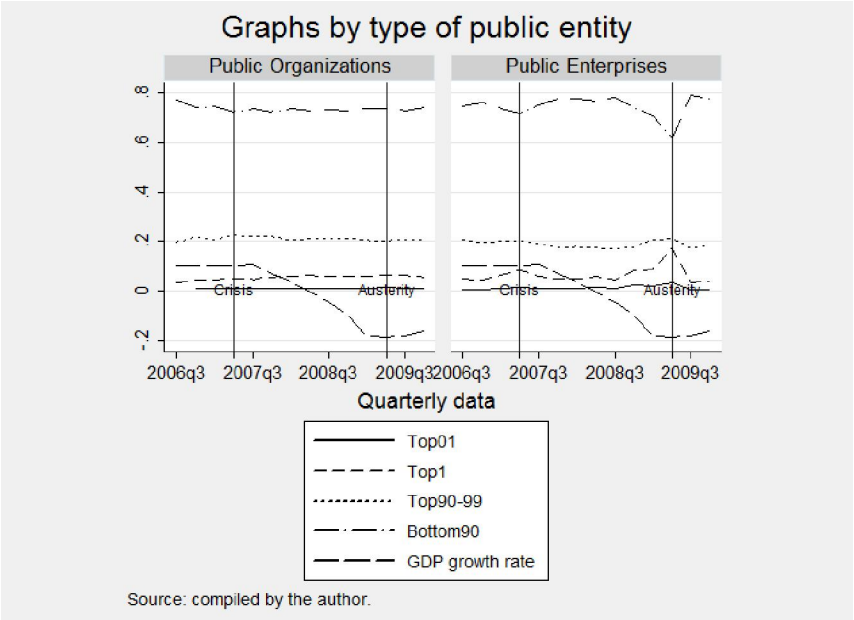

Figure 8. Income shares by type of public entity.

Again, one can note a remarkable difference in development of income shares over time and by type of public entity. While income shares stayed almost constant throughout the crisis across different public organizations, the drop of *Bottom90%* share just before the austerity measures and a corresponding gain of the *Top1%* are striking: over the course of less than one year, the top income earners in the public organizations more than doubled their share in the overall income pool.

To further explore within-the-top concentration of income, I provide calculation of relative share of income of top income earners in corresponding income of bottom income earners; the ratios are *Top1-10*, the share of income of top 1% in the total income of top 10% of income

earners, *Top1-90*, the share of income of top 1% in the total income of bottom 90% of income earners, and *Top10-90*, the share of income of top 10% in the total income of bottom 90% of income earners. The Figure 9 below provides an illustration, again by the type of public entity:

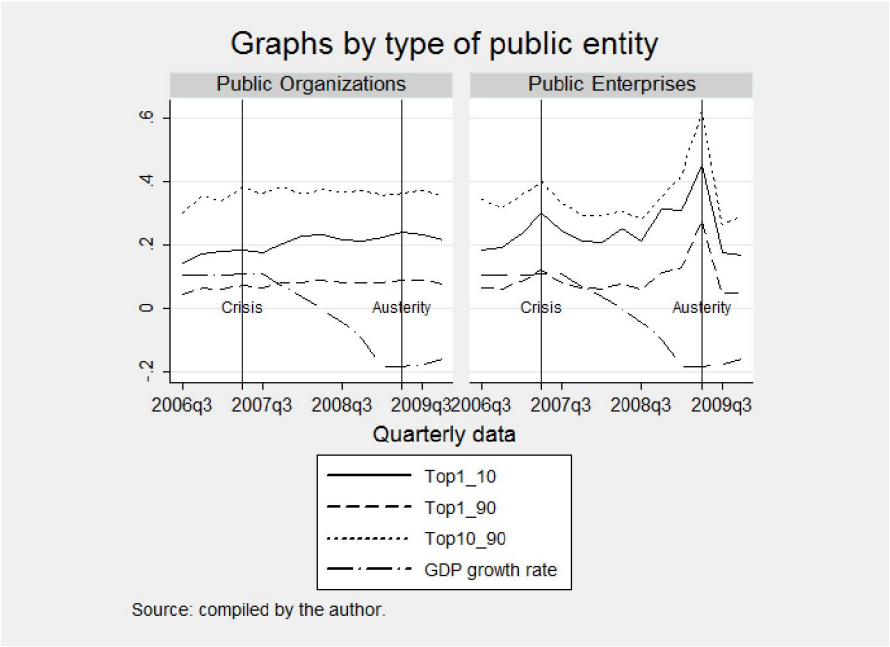

Figure 9. Income concentration within the top by types of public entities

As before, the picture provides additional evidence that while income concentration within the top stayed reasonably constant for the public organizations, it is not so for public enterprises. The driver of that dynamics was again the income of the top 1% that increased disproportionally during the crisis period, but fell to pre-crisis level just after the austerity measures were imposed by the government.

This brings me to the first important conclusion of the current paper, stemming directly from the observed facts. It is evident that the development in income inequality across two broad types of public entities is very different and thus might not only be driven by different factors, but also could be a reflection of fundamentally different processes of wage and compensation settings. In public organizations the wages are decided upon in a normative way and are not related to the financial performance of the organizations. Contrary, in public enterprises the pay rate of the employees is in part dependent on the market conditions and actual profit and loss earned by the company, especially so for the yearly bonus of the top employees. This implies that the public enterprises are more vulnerable to market conditions as compared to

public organizations, and, with ever worsening country's economic situation, inequality will rise as well. Adding to this effect, in public enterprises the top management has a much bigger control over the setting of salaries paid in their respective organization since the role of the unions in wage bargaining in Latvia is limited, as was the transparency of the public enterprises before the income data disclosure to the general public. Given overall deteriorating economic situation, this provides additional incentives *not to lose enough*, proportionally to the losses of employees in the bottom part of the income distribution. In other words, given control over wage setting, top management is actually able to transfer the costs of economic downturn to the bottom part of the income distribution, remaining at least as well off as before the crisis due to weak unions and insufficient transparency of public enterprises.

These observed differences have an important implication for the empirical analysis part of the current paper: estimations on the pooled data sample would produce spurious and shaky results because of the observed heterogeneity of dynamics across types of public entities. What is more important, simply controlling for the type of public organization is also insufficient. An indicator control variable in a regression equation would add to the intercept and thus would not change the slope of the regression line. In turn, this means that just adding an indicator variable to the regression would fail to account for fundamentally different processes happening within different types of public entities, and that regressions on the subsamples by two types are needed instead.

5.2. Estimation results

Based on the conclusions from the previous section, I estimate the models described in Chapter 4 on the two subsamples split by the type of public organization. I start with a simple OLS model, estimating the model on two different subsamples. Estimates are obtained using a standard OLS routine with heteroskedasticity-consistent standard errors. Table 1 below reports the results:

Table 1. Results from OLS regressions, by type of public entity.

			Public Organizations		
	(1) GE1	(2) A2	(3) Gini	(4) T1	(5) B90
Wage_growth	0.05**	0.14***	0.04***	0.01	-0.02*
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Lag1.Austerity	0.01	0.01	0.01	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Lag1.Crisis	0.02	0.02	0.02	0.01	-0.01
	(0.02)	(0.04)	(0.02)	(0.00)	(0.01)
GDP_growth	-0.00	-0.02	0.01	-0.02	0.01
	(0.04)	(0.03)	(0.02)	(0.01)	(0.02)
Lag1_GE(1)	0.43***				
	(0.09)				
Lag1_A(2)		0.79***			
		(0.05)			
Lag1_Gini			0.62***		
			(0.06)		
Lag1_T1				0.38***	
				(0.09)	
Lag1_B90					0.46***
					(0.08)
Constant	-0.02	-0.11***	0.01	0.00	0.17**
	(0.02)	(0.03	(0.02	(0.01)	(0.05)
Controls	Yes	Yes)	Yes)	Yes	Yes
N	*196*	*196*	*196*	*196*	*196*
adj. R-sq	*0.546*	*0.744*	*0.652*	*0.304*	*0.550*
			Public Enterprises		
Wage_growth	0.45**	0.23***	0.19***	0.09**	-0.19***
	(0.16)	(0.06)	(0.05)	(0.03)	(0.05)
Lag1.Austerity	-0.22***	-0.12***	-0.11***	-0.05***	0.11***
	(0.06)	(0.03)	(0.02)	(0.01)	(0.03)
Lag1.Crisis	0.28	0.14*	0.14*	0.06*	-0.13*
	(0.14)	(0.06)	(0.06)	(0.03)	(0.05)
GDP_growth	-0.88***	-0.38***	-0.38***	-0.19***	0.42***
	(0.25)	(0.09)	(0.09)	(0.05)	(0.09)
Lag1_GE(1)	0.53*				
	(0.24)				
Lag1_A(2)		0.60***			
		(0.17)			
Lag1_Gini			0.56**		
			(0.18)		
Lag1_T1				0.50**	
				(0.16)	
Lag1_B90					0.56**
					(0.20)
	-0.36*	-0.21**	-0.12	-0.07	0.64**
	(0.16)	(0.06)	(0.07)	(0.03)	(0.21)
Controls	Yes	Yes	Yes	Yes	Yes
N	*71*	*71*	*71*	*71*	*71*
adj. R-sq	*0.615*	*0.723*	*0.668*	*0.601*	*0.678*

Standard errors in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001

Source: Compiled by the author.

Across both subsamples, the growth in average wage rate has a positive effect on inequality indices, positive effect on the share of income of the top 1% of income earners in the total

income, and a negative coefficient on the share of bottom 90% of income earners in the total income, thus being consistent with the theory presented in the Chapter 4 regarding GDP per capital growth in cross-country regressions. For state enterprises, however, this effect is much stronger, both in magnitude and in terms of statistical significance, also in line with the reasoning presented earlier in this chapter. Uniformly for the two subsamples, inequality is also found to be 'sticky', or depending on own past values; these effects have expected positive signs, are similar in magnitude and strongly statistically significant. The GDP growth is found to have no effect on inequality within public organizations, but is negatively related to inequality in the public enterprises, thus being consistent with reasoning concerning lifting the budget constraint. Similarly, results also indicate that in public enterprises the bottom 90% of income earners disproportionally benefit from GDP growth, as compared to the top 1% income earners.

Furthermore, while public organizations seem to be invariant to the crisis and austerity measures effects, it is not so for public enterprises. Again, consistently with reasoning presented in the Chapter 4, austerity measures have a strongly significant negative effect on inequality indices and on the income share of the top 1%, and a positive strongly significant effect on the income share of the bottom 90%; this is also consistent with a marginal tax effect having a negative impact on inequality found in previous studies. The crisis effect on inequality index is positive and weakly statistically significant for the public enterprises, also in line with conclusions from theoretical discussion presented earlier.

Even though reported results are already considerably improved over the OLS model proposed in the Chapter 4 by (at least in part) accounting for unobserved heterogeneity across different types of public entities, the endogeneity problem is still an issue, casting a shadow of doubt on the validity of the obtained results. To account for this, I estimate an IV-GMM regression, instrumenting the wage growth in the period *t* with the unemployment and inflation in the preceding period *t-1*. The Table 2 below presents the results from the IV regression for the public organizations:

Table 2. IV-GMM regression results for public organizations

	Public Organizations				
	(1) GE(1)	(2) A(2)	(3) Gini	(4) T1	(5) B90
Wage_growth	0.02	0.06**	0.02	0.01	-0.01
	(0.03)	(0.02)	(0.01)	(0.01)	(0.01)
Lag1.Austerity	0.00	0.01	0.00	0.00	-0.00
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Lag1.Crisis	0.01	-0.02	0.01	0.01	0.00
	(0.02)	(0.03)	(0.02)	(0.01)	(0.01)
GDP_growth	0.03	0.09**	0.05	-0.02	-0.01
	(0.04)	(0.03)	(0.03)	(0.01)	(0.02)
Lag1_GE(1)	0.37***				
	(0.10)				
Lag1_A(2)		0.68***			
		(0.07)			
Lag1_Gini			0.55***		
			(0.07)		
Lag1_T1				0.36***	
				(0.08)	
Lag1_B90					0.42***
					(0.10)
Constant	0.02	-0.00	0.04	0.00	0.17***
	(0.03)	(0.03)	(0.02)	(0.01)	(0.05)
Controls	Yes	Yes	Yes	Yes	Yes
N	196	196	196	196	196
adj. R-sq	0.534	0.690	0.637	0.302	0.541
Chi-sq(2) P-val for underID test	0.0050	0.0036	0.0089	0.0074	0.0075
Hansen J-Statistic	0.4020	0.3295	0.3444	0.2836	0.2617

Standard errors in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001

Source: Compiled by the author.

Model is estimated using GMM routine for IV models and standard errors clustered on public organizations. The underidentification test based on Kleibergen-Paap rank LM statistic for all models clearly rejects the null hypothesis of not relevant instruments (i.e. the matrix resulting from the first stage regressions always has a full rank, and hence the model is identified). Overidentification test with the null hypothesis of jointly valid instruments based on Sargan-Hansen J-statistic is never rejected. In sum, this allows concluding that the instruments used in the estimation are relevant for the current analysis and jointly valid; hence I proceed to the discussion of the results.

Compared to the OLS results, the wage growth, despite retaining the expected positive signs, is significant in only one specification for the Atkinson *A(2)* coefficient as the dependent variable, the coefficient most sensitive to changes in the lower part of the income distribution. A likely reason for that is that correlation identified in the OLS estimations was largely taken away during the instrumentation stage. The only variable that remains uniformly statistically significant and even retains the order of magnitude for all the coefficients is the own lag of

inequality-measuring variable. This is a very strong result showing that income inequality within public organizations is mostly related to its own past values and can only be affected with directed external shocks specifically targeting the income distribution within the public organizations.

Proceeding to the IV estimations on the subsample of public enterprises, the Table 3 below reports the results:

Table 3. IV-GMM estimation results for public enterprises.

	Public Enterprises				
	(1) GE(1)	(2) A(2)	(3) Gini	(4) T1	(5) B90
Wage_growth	0.26	0.15*	0.10	0.04	-0.10
	(0.22)	(0.07)	(0.07)	(0.04)	(0.07)
Lag1.Austerity	-0.16***	-0.09***	-0.09***	-0.05***	0.09***
	(0.03)	(0.02)	(0.02)	(0.01)	(0.02)
Lag1.Crisis	0.16	0.09*	0.09*	0.04*	-0.08*
	(0.09)	(0.04)	(0.03)	(0.02)	(0.03)
GDP_growth	-0.57***	-0.24*	-0.24*	-0.15***	0.27**
	(0.17)	(0.10)	(0.10)	(0.04)	(0.09)
Lag1_GE(1)	0.46***				
	(0.06)				
Lag1_A(2)		0.55***			
		(0.04)			
Lag1_Gini			0.52***		
			(0.04)		
Lag1_T1				0.42***	
				(0.06)	
Lag1_B90					0.51***
					(0.03)
Constant	-0.14	-0.11	-0.01	-0.01	0.54***
	(0.25)	(0.08)	(0.09)	(0.04)	(0.06)
Controls	Yes	Yes	Yes	Yes	Yes
N	71	71	71	71	71
adj. R-sq	0.525	0.659	0.575	0.509	0.577
Chi-sq(2) P-val for underID test	0.2181	0.2037	0.2472	0.1802	0.2074
Hansen J-Statistic	0.1817	0.1747	0.3437	0.1010	0.1885

Standard errors in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001

Source: Compiled by the author.

The results for public enterprises are considerably weaker in terms of underindentification test; the null hypothesis of Sargan-Hansen is never rejected at conventional levels. An obvious interpretation of these results is that the variables used for instrumentation provide insufficient correlation with the instrumented variable, but at the same time are still valid due to absence of correlation with the error term in the second stage regressions. This is a likely consequence of a much smaller sample size, and thus even despite weak identification we can move on to the discussion of IV estimation results.

As in the previous IV regression on the sample of public organizations, the instrumented variable loses significance in all but one regressions, but retains the expected direction of the effects nevertheless (i.e. an increase in average wage levels is associated with an increase in inequality measures). There are two takeaways from these results: (i) better instruments and more data are needed, and (ii) the statistically significant effect identified on OLS stage is likely a consequence of endogeneity problem. Still, a stable direction of effects points out that the effect might be there, and only a limited sample size does not allow to reliably identify the effect of average wage growth on inequality. Adding to the latter, GDP growth is also strongly and statistically significantly associated with the decrease in inequality measures. Again, this suggests a causal interpretation that leveling up a budget constraint disproportionally benefits the people at the bottom of income distribution within public enterprises.

Similarly to the previous results, inequality is still 'sticky', heavily depending on owns' past values.

As in the OLS results, austerity measures and the crisis effects are statistically significant and work in the same direction as discussed in Chapter 4. The magnitude of the effects, however, is smaller than in OLS case. Still, it is important to note that both the austerity measure and the crisis had a statistically significant result on inequality in almost all specifications regardless of the estimation method used. In turn, this suggests a clear causal interpretation: (i) austerity measures in a form of wage cuts decreases inequality in the sample of public enterprises, skewing income distribution in favor of the employees at the bottom part of the income distribution, and (ii) the crisis effect increases inequality in the sample of public enterprises, skewing the income distribution in favor of the employees at the top part of the income distribution.

Finally, moving on to fixed effects IV estimations, the Table 4 below summarizes the results for the regression on a subsample of public organizations:

Table 4. Fixed effect IV estimation results for public organizations

	Public Organizations				
	(1) GE1	(2) A2	(3) Gini	(4) T1	(5) B90
Wage_growth	0.21	0.35	0.16	0.08	-0.10
	(0.23)	(0.84)	(0.47)	(0.06)	(0.13)
Lag1.Austerity	-0.03	-0.04	-0.02	-0.01	0.02
	(0.03)	(0.07)	(0.05)	(0.01)	(0.02)
Lag1.Crisis	-0.16	-0.21	-0.11	-0.06	0.07
	(0.17)	(0.54)	(0.33)	(0.05)	(0.10)
GDP_growth	-0.09	-0.18	-0.04	-0.08	0.06
	(0.22)	(1.06)	(0.54)	(0.05)	(0.11)
Lag1_GE(1)	0.24				
	(0.43)				
Lag1_A(2)		0.82			
		(1.90)			
Lag1_Gini			0.45		
			(1.43)		
Lag1_T1				0.16	
				(0.17)	
Lag1_B90					0.18
					(0.42)
Constant	-0.08	-0.32	0.00	-0.05	0.72***
	(0.32)	(1.46)	(0.95)	(0.07)	(0.19)
Fixed effects	Yes	Yes	Yes	Yes	Yes
N	196	196	196	196	196
Between-R-sq	0.2203	0.6561	0.4716	0.0466	0.1693

Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Compiled by the author.

The model is estimated using conventional variance-covariance matrix and small sample corrections.

Similarly to the initial OLS estimates, the results indicate that inequality is positively associated with an increase in average wage, but coefficients are never significant. Neither the crisis, nor the austerity measures succeeded in affecting income distribution. Recall that in IV specification the main traceable statistically significant result was coming from own lags of inequality measures. Clearly, once the unobserved heterogeneity effect was differenced out, even the lags of inequality measure lost any significance. This, along with low R^2 values suggests that any effect of explanatory variables identified in previous regressions on income inequality in public organizations was due to unobserved heterogeneity amongst these public organizations, and really not due to the effect of explanatory variables.

I can conclude discussion on the subsample of public organizations by saying that econometric analysis indicates clearly that it is particular organization's specificity that matters for income inequality, not a conventional set of determinants borrowed from cross-

country comparisons. It is also safe to extrapolate that conclusion for the whole category of public administrations not interacting directly with markets other than the labor market.

Moving on, the Table 5 below summarizes results from fixed effects IV estimations on a subsample of public enterprises:

Table 5. Fixed effect IV estimation results for public enterprises

	Public Enterprises				
	(1) GE1	(2) A2	(3) Gini	(4) T1	(5) B90
Wage_growth	0.41	0.18	0.15	0.04	-0.17
	(0.22)	(0.10)	(0.09)	(0.05)	(0.10)
Lag1.Austerity	-0.11*	-0.07***	-0.07**	-0.03**	0.06**
	(0.04)	(0.02)	(0.02)	(0.01)	(0.02)
Lag1.Crisis	0.19*	0.09*	0.10*	0.04	-0.10*
	(0.09)	(0.04)	(0.04)	(0.02)	(0.04)
GDP_growth	-0.54**	-0.22**	-0.22**	-0.10**	0.26***
	(0.16)	(0.08)	(0.07)	(0.04)	(0.07)
Lag1_GE(1)	0.40*				
	(0.17)				
Lag1_A(2)		0.47**			
		(0.15)			
Lag1_Gini			0.43**		
			(0.14)		
Lag1_T1				0.27	
				(0.15)	
Lag1_B90					0.42**
					(0.14)
Constant	-0.35	-0.07	-0.01	-0.01	0.63***
	(0.25)	(0.13)	(0.13)	(0.06)	(0.10)
Fixed effects	Yes	Yes	Yes	Yes	Yes
N	71	71	71	71	71
R-sq	0.4129	0.6557	0.5594	0.3942	0.4835

Standard errors in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001

Source: Compiled by the author.

Using the same model as described in Table 4, but estimating it on a different subsample, I get vastly different results. As in the previous IV setup for public enterprises, *wage growth* retains expected direction of effects, but loses statistical significance; this is a clear consequence of weak instruments, so further studies might improve on that. *Austerity* measure has a clear and statistically significant negative effect on income inequality; *crisis* retains statistical significance and the order of magnitude of coefficients as compared to the previous estimation results. The *GDP growth* retains the direction of effects, the magnitude and statistical significance as compared to the previous IV estimation results, and inequality is still positively and strongly related to own past values.

There are several important messages stemming from this empirical analysis:

1. The results from last two panels IV regressions present a challenge to build a model identifying driving factors behind changes in inequality in the public organizations in a notion employed for the current paper (a broad class of state administrative units, regulating agencies, etc.). The determinants of these changes differ a lot from those in the private sector and, similarly, from the determinants of inequality in the public enterprises.
2. The two broad types of public entities should not be mixed in the same data pool, as the driving forces behind income inequality developments are fundamentally different, and little can be said about determinants of inequality in public administrative bodies as of yet.
3. Across public enterprises, austerity measures and the crisis are confirmed to have an effect as discussed in Chapter 4 of the current paper; crisis fosters inequality in a sample of public enterprises, and austerity measures decrease inequality just like an increase in the marginal tax rate would.
4. GDP growth is shown to have a negative effect on income inequality in the public enterprises, broadly confirming the 'budget constraint' reasoning discussed earlier.
5. Inequality in public enterprises is shown to be dependent of own past values, implying that to make any changes in the income distribution of public enterprises one must overcome a very strong inertia.
6. Generally, the results from the subsample of public organizations can be extrapolated to a sector of public administration. Public enterprises in the context of the current paper serve as a rough proxy for private sector, and ability to extrapolate the results from the latter subsample depends on the goodness of that proxy.

Noteworthy, empirical analysis in the current paper could benefit greatly from broader dataset that would allow employing better econometric techniques. Also, I believe that in line with reasoning from cross-country regression, there should be an effect from the growth of average wages on income inequality, and stable direction of effects in various specifications weakly supports this reasoning. Thus, a paper could also benefit from better choice of instruments.

6. Conclusions and discussion of results

This paper has reached several important objectives. First and foremost, it is a unique contribution documenting developments in income inequality across public sector entities during the (last) periods of rapid economic growth, during the financial and economic

downfall, and during the fiscal austerity measures involving severe cuts in public spending that were imposed by the government as a reaction to the financial crisis. I document that inequality as measured by a panel of different indices was first falling during the initial stages of the crisis, and then rising again in anticipation of austerity measures as the economic situation continued to deteriorate. A sharp immediate reaction to austerity measures being imposed was a fall in inequality measures.

This dynamics, however, was not uniform across all the entities in the public sector. Rather, despite the crisis and austerity measures, income inequality stayed reasonably constant for a broad class of organizations related to public administration (state ministries, regulators, government agencies, etc.). Contrary to this, income inequality in the public enterprises reacted vividly to external shocks. Extrapolating these results further, one can argue that income inequality in public administration as a whole is pre-determined at a design stage and not affected by a set of conventional inequality determinants; income inequality in state enterprises (and, broader, in the private sector) is affected just as suggested by results from cross-country analysis. This is an extremely important finding, implying that any study concerned with analysis of income inequality determinants and operating with country-level aggregate data might *underestimate* the effects of factors influencing income inequality in the private sector, and *overestimate* the factors influencing income inequality in the public sector. Fundamentally different nature of processes determining income inequality in the two sectors thus bias the results from aggregated data regressions towards zero, and this has to be accounted for by proper weighting of the respective sectors if the results of the current paper do possess some external validity.

Unfortunately, the dataset does not allow tracing down the developments in income inequality for sufficiently long period of time after the austerity measures were imposed, and thus the long-term effects (i.e. whether the fall after austerity measures was permanent, or was it only a temporary step down to be recovered rather fast?) of that direct and drastic government intervention remain unclear.

Second, concerning the panel of different measures of inequality employed in the current paper, it is evident that most of the changes in income inequality happened due to the changes at the very top of the income distribution, specifically the top 1% of income earners. Contrary to some of the previous studies, the effect from 0.1% of income earners appears to be rather limited. Based on the currently available data, developments in *GE(1)* and *Top1* income share

measures provided the most illustrative picture; these important changes would be at large neglected if the standard measures such as the Gini coefficient and *80/20* income shares coefficient were used instead. With a certain stretch, based on the results from the current study it is possible to argue that whenever the top 1% of income earners in the public sector gains share, they gain at expense of the bottom 90% of the income distribution as opposed to the top 90%-99% or, in other words, the *very top* gain at expense of the *bottom*, not *just top* part of income earners. Concluding the discussion on the measures, it is also evident that measures more sensitive to the changes happening at the top of the distribution should be given priority over others for any subsequent empirical analysis in the field, but whenever possible a full panel of inequality indices should be used instead to examine the changes in different parts of the income distribution. Also, a further decomposition of income shares could be employed to see in more detail what part of the income distribution is actually losing, aside from the bottom 90%.

Third, the econometric analysis part of the paper (even though not without purity issues) provided important evidence on the driving forces behind the changes in income inequality. Little can be said about inequality determinants in public organizations and state administrative bodies apart from the fact that inequality appears to be very entity-specific, and thus depends a lot on own the starting values. This is, in fact, an important implication for designing new public organizations with specific properties of the income distribution in mind.

Across all specifications and for any inequality measure used, for public enterprises inequality is shown to be ‘sticky’, depending heavily on own state in the past. Growth in average wages is weakly confirmed as a determinant of inequality that disproportionally benefits the top part of the income distribution. Linking this back to theory, it is important noting that it is the within-entity growth that matters, be it GDP per capita for country-level analysis, or the growth in average wage for the public sector as shown in this paper. Interestingly enough, current analysis actually provides some evidence that the strong positive effect of growth on inequality identified in the previous cross-country regressions actually comes mainly from the private, not the public sector. The effect of GDP growth on the public sector income inequality is negative, if anything. A likely explanation for that is the essence of the impact of GDP growth on the public sector that boils down to simply lifting the budget constraint. This is thus disproportionally benefitting those in the bottom of the income distribution since

public officials and top management of the state enterprises are not able to fully internalize the benefits stemming from that expansion, contrary to case of the public sector.

The effects of financial crisis and the effect of austerity measures are found to work in the opposite directions, with crisis increasing income inequality and austerity measures lowering it, at least in the majority of specifications. Additionally, the austerity measures implementation resulted in roughly everybody receiving proportional wage cuts; this shrunk the spread in income levels and resulted in decrease of income inequality measures in a manner similar to a uniform increase in the marginal tax rate as discussed earlier.

Finally, this paper utilizes a unique dataset on income in the Latvian public sector. The nature of the dataset allows for an extremely valuable extension to the current study, namely evaluation of the effect on income inequality stemming from disclosure of information about income levels in public entities. This requires an update of the dataset to include the data covering the time period after the information was unexpectedly made available to the public. Getting this additional data is contingent on consent from the State Revenue Service of Latvia, something on which I am working constantly but with limited results as of yet.

The paper could benefit greatly from more sophisticated econometric techniques to be employed for the empirical analysis, since each of the estimation methods used in this paper has its own flaws. In turn, the methods that are exempt from these flaws again require an expansion of the dataset (i.e. a broader and longer panel and better instruments), something that is again contingent on the State Revenue Service of Latvia. Thus the most significant area for improvement of the current paper is in fostering cooperation with the said institution.

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Appendix 1. Full list of public entities included in the data base.

#	Name		#	Name	
1	Mnistry of	Agriculture	22	City council of	Ventspils
2	Mnistry of	Culture	23	Parliament	
3	Mnistry of	Defence	24	Free port of Riga	
4	Mnistry of	Economics	25	Free port of Ventspils	
5	Mnistry of	Education	26	State Chancellery	
6	Mnistry of	Environment	27	Presidential Chancellery	
7	Mnistry of	Family Affairs	28	Presidential Security	
8	Mnistry of	Finance	29	Bank of Latvia	
9	Mnistry of	Foreign Affairs	30	LGD/AIP Latvia	
10	Mnistry of	Healthcare	31	Financial Markets Commission	
11	Mnistry of	Internal Affairs	32	Riga	Airport
12	Mnistry of	Judicial	33	Augstprieduma	tikli
13	Mnistry of	Reg. Developm.	34	Celu	uzturs
14	Mnistry of	Transport	35	Latvenergo	
15	Mnistry of	Welfare	36	Rigas	siltums
16	City council of	Daugavpils	37	Rigas	udens
17	City council of	Jelgava	38	Sadales	tikls
18	City council of	Jurmala	39	Saeimas	autobaze
19	City council of	Liepaja	40	Valsts	celi
20	City council of	Rezekne	41	Valsts	mezi
21	City council of	Riga			

Appendix 2. Summary statistics for selected variables

Table 6. Summary statistics for selected variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Wage_gr	354	1.028858	.2522965	.3182244	2.097133
GE1	355	.1664976	.0866073	.0319931	.860962
A2	355	.2573874	.0874845	.0534281	.5423436
Gini	355	.2909356	.0624019	.1096171	.519916
Top1	355	.0467031	.0216942	.0180663	.1958701
Bot90	355	.193446	.031319	.1348347	.3347762
GDP_gr	355	.7598509	.0458465	.4693538	.8433706
Infl	344	-.0751749	.1066363	-.1855782	.1058111
Unempl	355	8.29831	9.361935	-7.6	23.2

Table 7. Correlations for the key variables

	Wage	GE1	A2	Gini	Top1	Bott90	GDP_gr	Infl	Unempl
Wage_gr	1								
GE1	0.1857	1							
A2	0.3067	0.762	1						
Gini	0.2131	0.8971	0.9281	1					
Top1	0.0739	0.8111	0.3726	0.5812	1				
Bot90	-0.1529	-0.9615	-0.6948	-0.8705	-0.8056	1			
GDP_gr	0.2805	0.0568	0.3007	0.2053	-0.0907	-0.0384	1		
Infl	0.2015	0.0906	0.2935	0.2205	-0.0304	-0.0797	0.8523	1	
Unempl	-0.2803	-0.0988	-0.3219	-0.236	0.0339	0.0848	-0.8879	-0.9482	1