Labor Market Institutions and Wage Inequality in the OECD

A Closer Look at Recent Trends in the Labor Market

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Summary:

This thesis studies the impact of labor market institutions on the development of the wage dispersion, using panel data on 20 OECD countries between 1973 and 2012. The thesis states that the results in Koeniger et al. (2007), where labor market institutions like; overall employment protection, unemployment benefit replacement and duration, tax wedge, union density and coordination and minimum wage, have an effect on wage dispersion both when the time series are revised and when the data set is extended. This thesis also investigates the effect of resent developments in the labor market; where most OECD countries have a higher share of workers on temporary contracts and high immigration rates, on wage dispersion. To this end, I have included a split measure of employment protection legislation (EPL) for temporary and permanent positions and a measure of immigration. When the overall measure of EPL is replaced by the EPL measures for temporary and permanent positions I find that the two measures have opposite effects on the wage dispersion. I find that stricter levels of EPL for permanent positions are associated with an increase in the wage dispersion; while stricter levels of EPL for temporary contracts have a compressing effect on the wage dispersion. I also find that higher levels of immigration are associated with an increase in the level of wage dispersion, and that this effect is most evident in the lower half of the wage distribution.

Keywords: Inequality, Labor economics, Labor Market Institutions, Employment Protection, Immigration,
Preface:

This thesis studies the relationship between labor market institutions and wage inequality and was written at Statistics Norway, spring 2013.

Writing the master thesis has been a long journey filled with ups and downs. I have learned a lot in the process, and gained a lot of insight in the field of labor economics and research methods. There were times when I did not think I would ever finish, but now that I have, all the hard work seems worth while.

There are many people I want to thank for helping me in the process of completing this thesis. First and foremost I want to thank Victoria Sparrman, my supervisor at Statistics Norway for academic guidance, inspiration, moral support and for setting high standards for me to reach.

I would also like to thank the people at the research department at Statistics Norway, in particular Ådne Cappelen for useful comments, but also for office space, office support and moral support. I would like to thank others that have taken the time to help me with programming, advice and by answering emails, along with family and friends for being who they are.

University of Oslo, May 2013
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1. Introduction

Income inequality started growing rapidly in most Anglo Saxon countries in the late 1970’s, but did not become widespread throughout the OECD until one decade later. Levels of income inequality have typically been lower in Continental Europe and the Nordic countries than in the Anglo-Saxon countries, but many of these countries have witnessed growing inequality in the past decades. The Anglo Saxon countries, along with Portugal, still have a substantially higher level of income inequality than continental Europe. France is the only OECD country that has seen an overall decline in inequality over the past decades, and two thirds of OECD countries have had growing inequality and poverty over the past 5 years (OECD 2011). Some of the most common explanations for the growing inequality in developed countries include: globalization, skill biased technological change, rent seeking and immigration.

The effects of globalization on income inequality are explained in the Stolper-Samuelson Theorem. A country with high-skill worker abundance will export high-skill intensive goods to countries with more low-skilled workers, increasing the output of high-skill intensive goods. This will increase the demand for high-skilled workers and increase their wages. The low-skill abundant countries, on the other hand, will export low-skill intensive goods, leading to an increase in the demand for low-skilled workers and their wages. This is thought to increase the wage differentials in developed countries, which export high-skill intensive goods and lower the wage differentials in countries exporting low-skill intensive goods. Since developed countries are relatively more high-skilled intensive than developing countries, globalization and increased international trade is thought to be a major cause of the increasing inequality in certain developing countries cf. Abrego and Edwards (2002).

There is also a broad agreement in the field of labor economics that skill-biased technological change is a significant cause of the widening of the wage gap. The theory is that technological development over the past two decades has been biased towards making high-skilled labor more productive. The relative wage of high-skilled compared to low-skilled workers has increased as a result of the demand for high-skilled labor increasing and the demand for low-skilled labor declining, cf. Berman et al. (1998).

All OECD countries have experienced these changes over the last four decades, but the evolution of wage inequality has varied greatly across countries. How can large differences in income inequality between seemingly similar economies and the differences in the
development when it comes to magnitude, timing and direction over the past decades be explained?

Between 1980 and 2000 most countries in the OECD underwent neo-liberal regulatory reforms that made labor markets more flexible. These reforms included easing of employment protection legislations, lowering of the relative minimum wage, weakening of union power, and some also cut down on unemployment benefits. Most of these regulatory changes were associated with lower unemployment rates, but also higher wage disparity. Krugman (1994) suggested a relationship between inequality, unemployment and labor market regulations known as the “Krugman Hypothesis”. While inequality in Anglo Saxon economies increased rapidly in the 1980s, so did the unemployment rates in continental Europe. According to the hypothesis, both the increase in inequality and unemployment, were due to a relative fall in the demand for low-skilled workers, giving different consequences in the two country-groups. The flexible wage structure caused by weak institutions in Anglo Saxon economies leads to an increase in the inequality, while the rigid labor market institutions in continental Europe lead to increased unemployment, indicating a strong compressing effect of labor market institutions on wage dispersion.

Blau and Kahn (1994) have looked at the effect of labor market institutions vs. market forces in explaining the large deviation in wage inequality in the USA in the middle to late 1980s. Their findings suggest that cross country differences in labor market institutions provided the most persuasive explanations for international differences. Their findings do not give any evidence of cross country differences in supply and demand that is consisted with the evolution of the wage gap. Leuven et al. (2004), on the other hand, use micro data from 15 countries and find that one third of the variation in relative wages between skill groups can be explained by differences in net supply of different skill-groups.

The paper “Labor market institutions and wage inequality“ by Koeniger et al. (2007) look at the role of labor market institutions in explaining differences in wage dispersion between countries over time for men in full time positions, between 1973 and 1998, controlling for technology, trade and supply and demand conditions. They find that changes in institutions can explain a substantial part of observed changes in male wage inequality. Their findings indicate that stricter Employment protection legislations (EPL), more generous unemployment benefits, longer duration of unemployment benefits, higher minimum wage and higher union density are associated with lower levels of inequality.
This thesis uses the empirical model from the paper by Koeniger et al. (2007) as a starting point, with extended data series and additional countries included to look at the effect of institutions in a longer time frame, using panel data for 20 OECD-countries, between 1973 and 2012. This thesis will also expand the analysis to investigate the effect of: The division of the labor force caused by the differences in EPL for permanent and temporary contracts, and the effect of immigration on income inequality.

The first topic is interesting in the context of the Temporary and Agency Work Directive, which has recently been implemented in the EU to give employees in temporary contracts and employees working through agencies equal treatment as employees in permanent contracts with similar work. One of the features of the neo-liberal labor market reforms that took place in the 80s and 90s were deregulations of EPL concerning temporary positions. This has lead to an increase in the share of fixed term contracts and the use of temporary work agencies. These types of contracts usually offer poor working conditions, both when it comes to wages, security and possibility for advancement. This in turn leads to a further division of the labor market. The thesis will assess the isolated effect of the regulation of temporary contracts on the wage inequality.

Along with an increase in wage inequality, most industrialized countries have seen a substantial increase in immigration over the past decades. This has lead to a huge empirical debate on the socioeconomic impact of immigration, and on the effect it has on native workers wages. This thesis will address this topic, and look at the explanatory power of different levels of immigration on the development of inequality across countries.

The thesis has the following structure: Chapter 2 consists of a summary of the results and methods from Koeniger et al. (2007). Chapter 3 contains a matching model to explain the dynamics between the different variables. Chapter 4 contains a brief explanation of the variables and details on the development of the data used in the analysis. Chapter 5 shows that the variables in Koeniger et al. (2007) still are important in explaining inequality, using extended and revised dataset. Chapter 6 presents the extended analysis which studies some recent trend in the labor market and includes the divided measure of EPL and immigration with extended dataset. Chapter 7 presents the quantitative implications of the estimated model, while Chapter 8 summarizes and concludes.
2. Measuring inequality and the findings in Koeniger et al. (2007)

2.1 Measuring Inequality:

There are many ways of measuring inequality that cover different aspects of a distribution. Income is one important factor that contributes to the distribution. An ideal measure of inequality should measure the relative welfare of a population and should include factors such as; wealth, lifetime income, opportunities, happiness, social mobility, poverty, health, etc. It is difficult to collect comparable data on many of these factors.

A common way of measuring inequality is by using the GINI-index, which measures the distribution of household income. The GINI index is measured on a scale from zero to one in which zero would represent a state where incomes are distributed equally to everyone, while a GINI-coefficient of one is a state of total inequality where one household gets all the income.

In addition to capturing effects of changes in income, the GINI-index can capture demographic changes that affect the distribution on a household level, such as: ageing populations, increasing numbers of people living in single households, changing gender composition in the labor market, a higher degree of assortative mating, etc. Other measures are, however, better suited when looking at the distribution of wages. This thesis uses income-deciles as a measure of inequality. The decile ratios compare the gross yearly income of men in full-time dependent positions at different deciles in the distribution. This is a homogenous group which makes the measure much more comparable over time.

It is a simple and rather efficient way to measure inequality that allows us to look at the pure wage effect in the labor market. The 9th- to 1st-, 9th- to 5th-, and 5th- to 1st- decile ratios compare relative income levels at different parts of the distribution. It allows us to look closer at where in the income distribution the changes have taken place.

2.2 Review of the empirical model from Koeniger et al. (2007)

Koeniger et al. (2007) investigates the relationship between labor market institutions and wage inequality. The following model is estimated:

$$\log\left(\frac{w_9}{w_1}\right)_{it} = \theta_0 + \theta_1 v_{it} + \gamma' z_{it} + \theta s_{it} + d_t + d_{it} + \varepsilon_{it}$$

Here \(\left(\frac{w_9}{w_1}\right)\) is the 9/1-decile ratio of the gross male wage distribution, which they claim is highly correlated with the wage differential by skill. \(z_{it}\) is a vector of the following labor
market institutions: Employment protection, benefit replacement ratio, a measure of benefit duration, union density, coordination in wage bargaining, the tax wedge and the minimum wage. \( v_{it} \) is a vector that controls for relative supply and demand conditions and consists of the following variables: the natural logarithm of the skill endowment, the unemployment rate, and the interaction between the two variables. This interaction is included as a proxy of the relative unemployment rate of high- and low-skilled workers, and implicitly assumes that this is proportional with the relative skill endowment. \( s_{it} \) - a vector of controls for trade and technology shocks and contains: Research and development (R&D) intensity, measured by gross expenditures on R&D over gross value added in the manufacturing sector, is used as a proxy for technology. Import intensity, imports over value added in manufacturing is a proxy for international trade. \( d_i \) is a fixed country effects, \( d_t \) is a year dummy and \( \epsilon_{it} \)-is the stochastic error term. The \( d_i \) and \( d_t \) control for country specific attributes and for year dummies that are common to al countries.

The results are based on a feasible GLS fixed effects estimator, with a variance-covariance matrix that assumes heteroskedasticity across countries. They do not account for the presence of autocorrelation in the error structure since the estimated coefficients are almost identical when it is, and when it is not accounted for. They find a compressing effect on the wage differential of stricter employment protection, higher unemployment benefits and duration, higher union density and higher minimum wage. The coordination of wage setting and the tax wedge also had a compressing effect, but are not statistically significant.

They find evidence that institutions are strongly associated with wage inequality, both when they use specifications in levels and in first difference. The first difference approach is included because the R&D intensity captures the effect of the stock of technology, and not the flow.

They find a decompressing relationship with the skill endowment in the population and the wage differential. The skill endowment alone does not, however, say anything about the relative supply and demand conditions for the different skill-types. The relative supply and demand conditions are approximated by the interaction variable between the logarithm of unemployment level and the skill endowment, but they find no significant effect of this variable or of the logarithm of the unemployment rate isolated. Moreover they find a decompressing association between the wage differential and import intensity, and a compressing association with R&D intensity. This contradicts the expected effect of
technological growth. They conclude that the R&D intensity is not a good proxy for the stock of technology, because it is both a stock and flow variable. They also suggest that much of the growth in the stock of technology will be captured in the time and country dummies in the model.

The fit of the model is tested by comparing the R² of the model above with a regression of the male wage differential on only the time and country dummies. They find that the fit is substantially improved when the institutional variables are included. The R² increased from 0.935 to 0.9702.

3. A theoretical model for labor market institutions, immigration and inequality

This section contains a matching model, based on the Mortensen-Pissarides matching model taken from Cahuc and Zylberberg (2004), to illustrate the dynamics between the institutions and wage dispersion. It is a two-sector model with high-skilled and low-skilled workers. The matching function explains the mutual existence of vacancies and unemployment, and describes the relationship between employer and employee when transaction costs exist and they baragin over wages. The model will generate a wage equation that illustrates the relationship between institutional variables and the wage level for the different skill groups.

The economy is endowed with Lₕ high-skilled and Lₙ low-skilled workers. The population growth of each type is denoted respectively by nₕ and nₙ, and they earn wages wₕ and wₙ. Uᵢ is number of unemployed of each type of worker, while Vᵢ is number of vacant jobs for each type of workers. A minimum wage w is expected to be set so that wₕ > w. For low-skilled workers the wage is max {wₙ, w}. sᵢ, i = h,l is the exogenous separation rate from employment into unemployment, it is potentially different for the two types. zᵢ<1 i=h, l is the unemployment replacement rate. The Poisson arrival rate of a match for a vacancy is q(θ_i) i = h, l. θᵢ = uᵢ/uᵢ is the unemployment rate over vacancy rate and represents the labor market tightness for the different skill groups. The Poisson arrival rate of a match for an unemployed is given by: θᵢq(θᵢ) i = h, l.

The flows in and out of unemployment are equal in steady state.

\begin{equation}
(1) \quad s_i (1 - u_i) = \theta_i q(\theta_i) u_i \quad , i = h, l
\end{equation}
This gives the relationship known as the Beveridge-Curve:

\[
(2) \quad u_i = \frac{s_i + n_i}{s_i + n_i + \theta_i q(\theta_i)} \quad i = h, l
\]

The separation rate, the labor market tightness and the population growth in the two groups are allowed to differ, and the Beveridge-Curve can therefore be different for high- and low-skilled.

There are three factors that can change the steady state unemployment rate for the two types of workers: change in separation rate, change in population growth and changes in job creation rates. For example, the effect of an increase in low-skilled immigration would give an unbalanced population growth where \( n_l \) increase more than \( n_h \). Following Equation (2), an increase in the low-skill population growth would increase the equilibrium unemployment rate, which would lead to a relative increase in the labor market tightness for the low-skilled.

In the following, we will see that the unemployment rates in the different skill-groups will affect the wages through the labor market tightness and the probability of a match.

**The worker:**

The present value of being employed \( j_i^E \) and unemployed \( j_i^U \) are given by the following equations:

\[
(3) \quad r j_i^E = \max(w_i, w) - s_i(j_i^E - j_i^U) \quad i = h, l
\]

\[
(3.1) \quad j_i^E = \frac{\max(w_i, w) + s_i j_i^U}{r + s_i} \quad i = h, l
\]

\[
(4) \quad r j_i^U = z_i + \theta_i q(\theta_i)(j_i^E - j_i^U) \quad i = h, l
\]

\[
(4.1) \quad j_i^U = \frac{z_i + \theta_i q(\theta_i) j_i^E}{r + \theta_i q(\theta_i)} \quad i = h, l
\]

We assume that \( j_i^U > j_i^E \), the unemployment benefits of high-skilled are higher than the wage for low-skilled. High-skilled will therefore not be interested in taking on low-skilled positions, and will not affect the supply of low-skilled workers. In the following the wage will be derived for situations where the minimum wage is not binding, but from Equation (3.1), it is obvious that the minimum wage would directly affect the wage of low-skilled if \( w \geq w_l \).
The firm:

The following equations give the discounted value of a filled position, $J^F_i$, of the firm for high-skilled and low-skilled workers.

\[
\begin{align*}
(5) & \quad rJ^F_h = \left[ A(f(k) - (r + \delta)k) - w_h(1 + \tau_h + s_h(\sigma_h)) - s_h(J^F_h - J^Y_h) \\ (6) & \quad rJ^F_l = A(f(k) - (r + \delta)k - w_l(1 + \tau_l + s_l(\sigma_l)) - s_l(J^F_l - J^Y_l)
\end{align*}
\]

Where $k$ is capital per effective unit of labor, $A(f(k)$ is the output given level of capital per effective unit of labor. $(r + \delta)$ are the cost and depreciation of capital. Low-skilled workers have one unit of effective labor each. High-skilled workers have $\eta > 1$ units of effective labor (cf. Acemoglu (2011)). Skill-biased technological change is equivalent to an increase in $\eta$.

There are costs associated with firing workers $\sigma_i$, $i=1,2$, that are given by the level of EPL for permanent positions. There is also a tax, $\tau_i$, $i = h, l$, on wages. $\tau_i$ will be relatively higher for high-skilled workers than for low-skilled workers if taxes are progressive.

For simplicity I denote $Y_h = [A(f(k) - (r + \delta)k)\eta_h$ and $Y_l = A(f(k) - (r + \delta)k$, the net production of one unit of high- and low-skilled labor.

$\gamma_i$, $i = h, l$ is the cost of posting a vacancy, $J^Y_i$, for the firm. The present value of posting a vacancy for the firm can be given by the following equation:

\[
(7) \quad rJ^Y_i = -\gamma_i + q_i(\theta_i)(J^F_i - J^Y_i) \quad i = h, l
\]

Equation (7) can be interpreted as the present value of a vacancy. It depends on the costs of posting a vacancy and the difference between the expected value and the expected cost of posting a vacancy multiplied by the Poisson arrival rate of finding a match for the position. The arrival rate of a match depends on the labor market tightness. The arrival rate increases when $v_i/u_i$, vacancy rate over unemployment rate, increases.

We assume that firms will keep posting jobs until their expected profit equals zero. Then the expected profit of a filled position will be equal to the average cost of posting a vacancy, and the expected value of a vacancy is equal to zero. This is known as the free entry condition:

\[
(8) \quad \frac{\gamma_i}{q_i(\theta_i)} = J^F_i
\]
Here the left hand side of Equation (8) represents the average cost of a vacant job, and the right hand side is the value of a filled job.

Equations (5) and (6) the free entry condition, \( J_i^V = 0 \) result in the following equation:

\[
J_i^F = \frac{Y_i - w_i[1 + r + s_i(\sigma_i)]}{(r + s_i)} \quad i = h, l
\]

which again is equal to the average cost of posting a vacancy.

\[
\frac{Y_i - w_i[1 + r + s_i(\sigma_i)]}{(r + s_i)} = \frac{y_i^1}{q_i(\theta_i)} \quad i = h, l
\]

Equation (10) shows that an increase in the separations rate, tax-level and firing cost will affect the value of a filled position negatively, and decrease the number of vacancies that are posted. Changes in each of these exogenous variables will give a downwards shift in the labor demand curve. This will in turn decrease the labor market tightness and increases the probability of finding a match for the firm, until the cost of recruiting a worker equals the profit of employing a worker again.

**Bargaining power:**

The potential employer and worker bargain over the wage when a worker and a vacancy come together through a match. This wage is thought to increase with the labor market tightness, because it determines the outside options of the participants (Cahuc and Zylberberg (2004) p. 526).

A filled position will create a surplus \( S \), the sum of the surplus connected to employment and a filled position, given by the equation:

\[
S = J_i^E - J_i^U + J_i^F - J_i^V
\]

This surplus will be shared between the worker and the firm according to their relative bargaining power. Let \( \beta \epsilon [0,1] \) be the relative bargaining power of the worker. Being member of a union increases the bargaining power of workers relative to the firm, leading \( \beta_i \) to
increase. If we maximize the general Nash criterion, the value of the wage negotiated at each date is the solution to the following problem (see Cahuc and Zylberberg (2004) p. 526):

\[
\max_{w_i} \left( j_i^F - j_i^U \right)^\beta \left( j_i^F - j_i^V \right)^{1-\beta} \quad i = h, l
\]

Nash showed that there exists a unique wage that maximizes the product of firm and the worker’s surplus. From equation (3.1) and (9) we can express the profit and utility from a filled position can be expressed in the following way:

\[
\begin{align*}
J_i^F - J_i^U &= \frac{w_i - r_l J_i^U}{r + s_i} \\
J_i^F - J_i^V &= \frac{y_i - w_l (1 + r + s_l (\sigma_l))}{(r + s_l)}
\end{align*}
\]

This can be inserted in equation (12) and solved for \(w_i\). This gives the wage equation:

\[
\begin{align*}
w_i &= r J_i^U + \beta_i \left[ \frac{y_i}{1 + r_i + s_i (\sigma_i)} - r J_i^U \right]
\end{align*}
\]

From this equation, we can see that the bargaining power affects the share of output that goes to wages. We can also see that the tax rate and layoff costs affect the wage negatively and that progressive taxes will affect the high-skilled wages more than low-skilled and have a compressing effect. The separation rate affects the impact of layoff costs on wages. If the bargaining power is equal to zero, we can see that the wage will be equal to the reservation wage which is the alternative income from being unemployed: \(r J_i^U\). The bargaining power of the low-skilled would have to be higher than the bargaining power of the high-skilled to have a compressing effect on the wage differential.

The solution of the wage curve can be found by inserting the term for the discounted value of unemployment from equation (4.1).

\[
\begin{align*}
r J_i^U &= z_i + \beta_i q(\theta_i) * S_i
\end{align*}
\]

Using the expressions in (13), (14) and (11), the total surplus, \(S_i\) can be expressed as:
The benefit replacement ratio and the duration of unemployment benefits are represented by $z_i$ in (16). This is the outside option to being employed. An increase in unemployment benefits would increase the reservation wage of workers and therefore also the wage. Also in this case the relative benefit replacement rate will have to be larger for the low-skilled for it to affect the wage dispersion. This is often the case, cf. Figure 17.

We insert for the expression of the surplus in (16) in (15) to get:

$$S_i = \frac{Y_i - \omega_i [\tau_i + s_i \nu_i] - r_i^U}{r + s_i}$$

From this expression we can see that values of being unemployed increases with the labor market tightness (vacancy rate over unemployment rate). The bargaining power shifts in favor of the employee when $\theta_i$ increases, and so does $r_i^U$, the discounted value of unemployment, and the reservation wage because the probability of unemployment decreases.

The effect on the wage differential between the different skill groups depends on the composition of high-skilled and low-skilled among the unemployed. A relatively higher share of low-skill will lead to a relatively larger drop in wages of the low-skilled, within the frames of the institutions. Taxes and layoff costs affect $r_i^U$ negatively.

EPL for permanent positions has an effect on the separation rate, $s_i$, and the cost of firing a worker, $\sigma_i$. From the wage equation in (15) we can see that these factors are both have a negative effect on the wage. The separation rate depends on the cost of firing a worker, when the cost of firing workers increase the separation rate decreases. Koeniger et al. (2007) suggest that the administrative burdens associated with layoffs are relatively more expensive for low-skilled workers. The effect of firing cost on the inflows to unemployment can therefore differ for the high- and low-skilled workers. Boeri et al. (2006) find that the unemployment inflows for low-skilled workers tend to be more responsive to the levels of EPL for low-skilled than for high-skilled. Increasing levels of EPL will, according to
Koeniger et al. (2007) have a compressing effect on the wage dispersion. Employment protection could also potentially increase the bargaining power of workers versus employers in markets where individual or collective negotiations take place.

When contracts are temporary the separation rate is high and the firing cost low and the workers in temporary contracts have very little bargaining power. TWA’s are known to increase the matching for a vacancy, but the effect this has on wages is small when the bargaining power of the workers is low.

The labor supply is given in Equation (15) and through equation Equation (18), we can see that there is a decreasing relationship between the wage and the labor market tightness.

The labor demand is given by the relationship in Equation (10). The free-entry-condition makes firm post vacancies until the expected profit of a vacancy equals the cost of posting a vacancy. There is a negative relation between the wage and the labor demand.

![Figure 1: The Negotiated Wage and the Labor Market Tighetness](image)

Figure 1 illustrates in which direction the different institutional variables affect the wage curve (WC) and the job creation curve (LD) in steady state equilibrium for the two skill-groups. Increases in unemployment benefits, bargaining power, production and matching, shifts the wage curve out, while the separation rate, interest rate, taxes and firing costs, shift the wage curve downwards. Increased production and matching rate gives the an upwards shift in the job creation curve, while increased cost of posting a vacancy, separation rate,
interest rate, taxes and firing costs shifts the job creation curve downwards in Figure 1 (see Cahuc and Zylberberg (2004) p.530).

Immigration does not lead to a shift in either of the curves, but leads to a shift in the Beveridge curve. If unemployment increases for the same amount of vacancies the probability of finding a job for each unemployed decreases. This effect is equivalent to a deterioration of the matching process (see Cahuc and Zylberberg (2004) p.532), and would shift the wage curve downwards.

Figure 2: The Relative Wages of High-Skilled and Low-Skilled and the Relative Labor Market Tightness of High-Skilled and Low-Skilled

Figure 2 illustrates the effect of the institutions on the relative wages of high-skilled and low-skilled. These effects are based on some assumptions about the scope of the effects of the institutions on the different skill groups; taxes are progressive, wages for high-skilled are higher than minimum wages, the exit rate into unemployment is more responsive of firing costs for low-skilled workers (cf. Boeri et al. (2006)), a disproportionately large share of immigration is low-skilled and that unemployment benefits are relatively more generous for low-skilled workers (see Figure 17). They therefore have compressing effects on the wage dispersion. A shift in production for high-skilled through skill-biased technological change will lead the wage dispersion to increase.
Within the framework of this model with the above assumptions about the institutions, EPL for permanent positions should have a compressing effect on the wage dispersion. The fact that permanent and temporary contracts coexist in the labor market adds a new dimension to the implications of the model on wage dispersion, since a disproportionately big share of low-skilled workers end up in temporary position (cf. Barbieri (2009)). When the workers in temporary positions have very low bargaining power and a very high separation rate, increasing bargaining power and lowered separation rate due to increased firing costs increases the within group wage dispersion in the two skill-groups, and especially in the low-skill group.

4. Data
This section will give an overview of the variables included in the analysis. The institutional variables that are included in this thesis are: Tax wedge, employment protection legislation, union density, coordination of wage setting, unemployment benefit replacement rate, unemployment benefit duration and minimum wage. The supply and demand variables are represented by the skill attainment and the unemployment rate, and the R&D intensity and import intensity are proxies for technological change and international trade. I also explain briefly how the variables are measured. The data is mostly taken from the same sources as in Koeniger et al. (2007), with exception of the coordination of wage setting and the skill attainment that are taken from Visser (2011) and Barro-Lee (2010). In addition to the variables in Koeniger et al. (2007) this section illustrates the development in the measures of EPL for temporary and permanent positions and immigration.

The series are mainly taken from OECD. For a more thorough explanation of sources and construction of variables see the data appendix.

Decile Ratios
The measure of inequality used in this thesis is, as previously mentioned, the decile ratio of yearly wages for men in full time positions. The relative incomes are measures of the ratio of the 9th to the 1st decile (9/1-decile ratio), the 9th to the 5th decile (9/5-decile ratio) and the 5th to the 1st decile (5/1-decile ratio). The three decile ratios reflect the wage dispersion in different parts of the wage distribution. The 9/1-decile ratio represents the wage dispersion between the upper and the lower part of the wage distribution. The 9/5-decile ratio represents the wage dispersion between the upper and middle part of the wage distribution, while the 5/1-decile
ratio represents the wage dispersion between the middle and the lower part of the wage distribution.

In Figure 3a and 3b below, we can see the development of the different decile ratios in the countries in the sample. The countries that have the highest levels of wage inequality today are the US with a 9/1-decile ratio over 5, Portugal comes in second with a 9/1-ratio of around 4. Australia, Canada and the UK also have wide dispersion, with a 9/1-decile ratio over 3.5. The countries in the sample with the lowest 9/1-decile ratios are the Nordic countries and Belgium.

The evolution of the decile ratios is quite similar in most countries, with some exceptions. The increase in the 9/1-decile ratio has mainly been driven by increasing wage dispersion in the upper half of the distribution in Austria, Switzerland and New Zealand, while the decline in the 9/1-decile ratio in France is driven by changes the decline in the wage dispersion in the lower half of the distribution.
Figure 3a: Development of Decile Ratios
Figure 3b: Development of Decile Ratios
**Tax Wedge**

The tax wedge measures the sum of the employment tax rate, the direct tax rate and the indirect tax rate. It represents the gap between the cost of labor for the employer and the purchasing power of the wage to the employee. The tax wedge has been increasing in most OECD countries since the 1970’s. It is especially high in Sweden, at almost 75 percent. The tax wedge is fairly high in countries like France, Finland, Denmark, and also Italy in the recent years, were it is above 60 percent. The tax wedge is especially low in the US and Switzerland, where it is below 30 percent.

**Figure 4: Development of the Tax Wedge**

**Employment protection legislation**

Employment protection legislations (EPL) are mandatory restrictions regulating the contractual relationship between employers and employees. Three different measure of EPL are used in this thesis; EPL for temporary contracts, EPL for permanent contracts and an overall measure which is an average of the two.

EPL on permanent positions include a measured of the price associated with firing workers and regulations on how easy it is to fire workers. The measure includes features such as: definition of when a dismissal is unfair, compensations following unfair dismissals, notification process when dismissing workers and severance pay.
The measure of EPL for temporary employment contracts cover the extent to which temporary contracts are allowed and regulated. It includes the maximum duration of fixed term contract and contracts through temporary agency work, and regulates the types of work where the use of temporary contracts is permitted. The restrictions of number of renewals of temporary contracts, and number of successive temporary contracts for the same position, and whether there are regulations that ensure equal treatment for employees in temporary and permanent positions.

The level of overall EPL were stable or increasing in all countries in the sample until around 1990 when the strictness dropped in many countries, mostly due to softening of the regulation of permanent contracts. The Anglo Saxon countries stand out with a low level of strictness also when it comes to EPL. On a scale of 0-3, all of the Anglo Saxon countries have had a level of EPL below 1 since the 1970’s. Today the countries with the strictest level of overall EPL are France, Spain, Portugal, Norway and the Netherlands. Germany, Belgium and Sweden were among the countries with strictest regulations in the 1980’s and early 1990’s, but have eased their regulations over the past decades.

Figure 5: Development of Overall EPL

We can see the separate developments in the measures of temporary and permanent positions in the Figure 6 below. The regulations of temporary contracts have become less strict in most countries with some exceptions. In the countries where they were very slack to begin with,
such as Australia, Canada, Finland, the United Kingdom and the United States, they have remained slack. They have only increased in strictness in France and Ireland, but only slightly.

Figure 6: Development of EPL for Regular Contracts

Figure 7: Development of EPL for Temporary Contracts
Union density and coordination of wage setting:

Union density equals the proportion of wage-earners who are unionized, while collective bargaining coverage is a measure of the proportion of wage earners that are covered by collective agreements. Collective agreements are agreements that are reached through bargaining between unions representing employees and organizations representing employers. The level of collective bargaining and union density varies a lot across OECD countries, and there is not necessarily a connection between the sizes of the two. There are other rules and regulations that help to determine the scope of the collective agreements. In France, for example, both unionized and non-unionized workers are covered by the collective agreements, leading the level of collective bargaining coverage to almost ten times as extensive as the unionization.

Figure 8: Development of the Union Density

Union density has also varied a lot within countries over time. It has increased in countries like Denmark, Finland and Belgium, but decreased in France, USA, Australia and United Kingdom. The collective bargaining coverage has been kept at a rather steady level in most countries, but has decreased in Japan, United States and United Kingdom and increased in France and the Netherlands. Union density has been declining in all the countries of interest since the late 1980’s/early 1990’s, where they peaked.
Figure 9: Development of the Coordination of Wage Setting

Unemployment benefit duration and benefit replacement rate

In this thesis, the benefit replacement rate is a measure of how much unemployed workers are compensated, by the government, the first year after losing their job. This measure also exists for, and can vary between countries and relative to the first year, in the year past the 1st year. The benefit duration is a measure of the duration of time unemployed are given unemployment benefits and how it develops relative to the benefit replacement in the first year.

The duration and size of benefit replacement vary a lot among the countries in the OECD, and the sizes of the two measures have little correlation. Some countries, like Australia, New Zealand and the United Kingdom have a low level of benefit replacement rate and a relatively high level of benefit duration, while it is the opposite in Canada. Benefit replacement rates are high in the Nordic countries, France, Netherlands, Portugal, Spain and Switzerland and relatively lower in Germany, Japan and the Anglo Saxon countries, with exception of Ireland. The duration of unemployment benefits are as low as one year in Canada and Japan. Australia and New Zealand give benefits at a constant level every year of unemployment, but at a relatively low rate.
Minimum wage

A minimum wage is the lowest rate it is legally possible for an employer to pay an employee. It is common to use the measure of minimum wage to median wage, which is also done in this
thesis, and only for countries with a minimum wage set at the national level are included. The minimum wage varies greatly in size and incidence in the OECD countries. Most countries have some form of minimum wage at some level or in some sectors.

From the Figure 12 below we can see that the size of the minimum wage relative to the median wage varies a bit across the countries of interest. The minimum has decreased in size relative to the median wage in most countries, except France and Japan, where it has increased. Figure 12 only contain countries that have set a minimum wage on a national level.

**Figure 12: Development of the Minimum Wage in Countries That Have Minimum Wage Set at a National Level**

The other variables in the regression:

**Skill endowment**

The skill ratio is the relative skill endowment, measured by the share of the population in each country with some tertiary education or higher, to the share of the population with a lower degree of education.

Relative skill endowment has had a prominent increase in all the countries in the sample over the past decades, especially in countries like Australia, Canada and the US, which have the
highest levels today. The skill endowment is still relatively low in countries like Italy and Portugal and fairly low in Austria and Switzerland.

Figure 13: Development of the Education Attainment

**Immigration**

The migration flows into OECD countries have been varying, but increasing in most OECD countries over the sample period, with a small decline in 2008 and the following years as a result of the recession. Migration flows are driven by work opportunities and migration policies tend to become more restrictive in countries where the unemployment rate is high.

The percentage of immigrant with tertiary education or higher has been growing over the past 15 years in most OECD countries, except Spain, Greece and Italy where they mostly receive low-skilled immigrants. The share of migrants from China and India into OECD countries is increasing, and that is where a large share of the high-skilled immigrants comes from. The OECD average percentage of immigrant population with at least tertiary education has increased from 25% in 2000 to 30% in 2011 (OECD 2012).
Figure 14: Development of Net Immigration

Figure 15: Development of the Unemployment Rate
Trade and Technology:
Changes in international trade and technology are approximated by the import intensity, the ratio of imports over value added, and the research and development intensity, the ratio of R&D expenditure over value added, both for the manufacturing sector.

The import intensity has been overall increasing in all of the countries in the sample over the past decades, except for Ireland, where it has decreased significantly. The R&D intensity has also seen an overall increase in most of the countries is the sample over the de past decades, except in the UK where it was very high to begin with.

5. Reassessment of the results in Koeniger et al. (2007)
In this section I will reassess the main findings from the paper by Koeniger et al. (2007). The reassessment is done in several steps; first I will replicate the baseline findings in the original paper with revised data. Secondly the dataset is extended with more recent data and more OECD countries are included in the analysis.

The OECD has revised some of the data series for the variables used (see Data appendix for a comprehensive review). The largest changes are seen in the measure of benefit replacement and benefit duration, especially for Canada. There are also level-differences in the measure of minimum wage for France and the Netherlands. The data on wage dispersion for Canada in 1973 is no longer available, and not included in the analysis. In addition the measure of coordination of wage setting, education attainment and the measure of employment protection used in Koeniger et al. (2007) do not exist for years after 1995. The data are therefore obtained from other sources in order to get comparable data for the estimation of the extended time period. The measure of EPL was found in OECD (2010), where they exist from 1985 and onwards. The data was extended backwards using the growth rate of the measure in the original paper. The measures of coordination and skill attainments were replaced by a new source for the whole series, respectively from Visser (2011) and Barro-Lee (2010).

5.1 Replication
The estimation results for the preferred model in Koeniger et al. (2007) on the revised data and the new data series for skill-attainment and coordination of wage setting, for the time period 1973-1998 are very similar to the findings in the original paper, cf. Koeniger et al (2007) Table 2 column 1, 3 and 4.
I find significant compressing effects on the wage differential associated with employment protection, the benefit replacement rate, the benefit duration, the tax wedge and the minimum wage on the 9/1-, 9/5- and 5/1-decile ratios.

The coefficients of the unemployment rate, the interaction between the unemployment rate and the skill-endowment, and the technology and trade proxies have effects in the same directions as in the original regression on all decile ratio measures.

The scope of the effect of some of the coefficients has changed somewhat in the replication. The employment protection legislation appears to have a smaller effect in the replication than in Koeniger et al. (2007). The unemployment benefit variables and the tax wedge appear to have a more compressing effect. The proxies for trade and technology have lost some explanatory power, while the coordination of wage setting has gained some. The minimum wage and the unemployment rate are at about the same level.

The coefficients that have seen a considerable change in the replication are those of the skill-attainment and the union density. The skill-attainment has gone from having an increasing effect to having a compressing effect on the wage dispersion at the 9/1- and 5/1-decile ratio level, and is significant. The union density now has an increasing effect on the wage dispersion.

I order to explain this I tested the robustness of the coefficient of the skill attainment in the dataset from the original paper. I found that the coefficient of skill-attainment in the original dataset turns negative if the US is left out after 1990. The authors had prolonged the series for skill-attainment for the years after 1990, and this prolongation turned out to reflect the development in the actual skill-attainment poorly. They explained the unequalizing effect of the skill-attainment on the wage dispersion with the theories of Skill-biased technological change. The skill attainment is a control for the relative supply and demand for skill, and reflects the composition of high-skill and low-skilled workers in an economy.
Table 1: Replication of the Preferred Model in Koeniger et al. (2007), Estimation Period 1973-1998

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Replication on 9/1-decile ratio Log(D9D1)</th>
<th>Replication on 9/5-decile ratio Log(D9D5)</th>
<th>Replication on 9/1-decile ratio Log(D5D1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPL overall</td>
<td>-0.0940** (0.0373)</td>
<td>-0.0426** (0.0169)</td>
<td>-0.0425* (0.0248)</td>
</tr>
<tr>
<td>Benefit Replacement rate</td>
<td>-0.317*** (0.0567)</td>
<td>-0.168*** (0.0301)</td>
<td>-0.169*** (0.0408)</td>
</tr>
<tr>
<td>Benefit Duration</td>
<td>-0.148** (0.0694)</td>
<td>-0.0810** (0.0352)</td>
<td>-0.0815* (0.048)</td>
</tr>
<tr>
<td>Tax Wedge</td>
<td>-0.676*** (0.163)</td>
<td>-0.301*** (0.0762)</td>
<td>-0.300*** (0.106)</td>
</tr>
<tr>
<td>Coordination of Wage Setting</td>
<td>-0.00548 (0.00352)</td>
<td>-0.00311* (0.00182)</td>
<td>-0.0025 (0.00245)</td>
</tr>
<tr>
<td>Union Density</td>
<td>0.214* (0.128)</td>
<td>-0.0596 (0.0587)</td>
<td>0.151* (0.0877)</td>
</tr>
<tr>
<td>Minimum Wage</td>
<td>-0.250*** (0.0516)</td>
<td>-0.158*** (0.0261)</td>
<td>-0.0863*** (0.0335)</td>
</tr>
<tr>
<td>Ln(Unemployment Rate)</td>
<td>-0.00103 (0.0258)</td>
<td>-0.0467*** (0.0142)</td>
<td>0.0559*** (0.0184)</td>
</tr>
<tr>
<td>Ln(Skill Ratio)</td>
<td>-0.134** (0.0574)</td>
<td>0.0106 (0.029)</td>
<td>-0.156*** (0.0407)</td>
</tr>
<tr>
<td>Ln(Skill)*Ln(Unemployment)</td>
<td>0.0399** (0.0155)</td>
<td>-0.0207** (0.00845)</td>
<td>0.0606*** (0.0109)</td>
</tr>
<tr>
<td>Import Intensity</td>
<td>0.764* (0.434)</td>
<td>0.543*** (0.21)</td>
<td>0.0287 (0.283)</td>
</tr>
<tr>
<td>R&amp;D Intensity</td>
<td>-0.674* (0.363)</td>
<td>-0.371** (0.187)</td>
<td>-0.239 (0.261)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.552*** (0.0914)</td>
<td>0.915*** (0.0478)</td>
<td>0.630*** (0.0647)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>174</td>
<td>174</td>
<td>174</td>
</tr>
<tr>
<td>Number of countries</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Standard errors in parentheses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>*** p&lt;0.01, ** p&lt;0.05, * p&lt;0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

On one hand it reflects the demand conditions that workers face, and in economies where it is profitable to get higher education; the skill attainment will go up. It is however reasonable to believe that the increase in relative supply of high-skilled workers lowers their wages. The development of the skill attainment was very similar and trending upwards in all the countries in the sample used in the original paper. The skill attainment in the data series used in the
extended sample has more variation across time and countries. The change in the sign of the coefficient of the union density could be explained by insider/outside-theory. I will come back to this in the discussion of the results of the extended analysis.

5.2 Results with extended data series
This section evaluates the results found in Koeniger et al. (2007) with an analysis using the revised and extended dataset and the preferred econometric model from the original paper. The extended dataset includes additional years from 1998-2012 and now covers the time period 1973-2012. It also includes 9 additional OECD countries; Austria, Belgium, Denmark, Norway, New Zealand, Switzerland, Ireland, Portugal and Spain, in addition to Australia, Canada, Finland, France Germany Italy, Japan, the Netherlands, Sweden, the UK and the US.

The results in Table 2, column 1 shows the results of the regression with the preferred econometric specification in Koeniger et al. (2007) and extended dataset.

As seen in Table 2 column (1), all institutional variables have compressing effects, as in the original regression, on the 9/1-decile ratio. With exception of the union density, they are all significant. The explanatory power of the measures of employment protection legislation, benefit duration and union density have become considerably smaller. The reduction in the effects of overall EPL is probably due to the changes in the relative changes of the measure of EPL for temporary and permanent positions, which I will come back to later. The explanatory power of the measure of the coordination of wage setting and the tax wedge have increased, while the benefit replacement rate and the minimum wage are close to the same level as in the original paper.

I test the results with the extended regression on the 9/1-decile ration in column 1, Table 2, and compared to a regression run only on the time and country dummies. While the regression run only on the time and country dummies had an $R^2$ of 0.72, the model in column 1 on the 9/1-decile ratio had an $R^2$ of 0.94, which indicates including the institutional variables substantially improve the fit.

The measure of overall EPL has a compressing effect on all decile ratio-levels, but is only significant on 9/1- and 5/1. Koeniger et al. (2007) suggest that the administrative burdens associated with layoffs are relatively more expensive for low-skilled workers, and that this in turn causes the unemployment inflows for low-skilled workers to be more responsive to the
levels of EPL for low-skilled than for high-skilled (see Boeri et al. 2006). This would support the findings that the effect is relatively larger in the lower half of the distribution.

Table 2: Results with Extended Date Series and the Preferred Model in Koeniger et al. (2007). Estimation Period 1973-2012

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Extended data on 9/1-decile ratio</th>
<th>Extended data on 9/5-decile ratio</th>
<th>Extended data on 5/1-decile ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log(D9D1)</td>
<td>Log(D9D5)</td>
<td>Log(D5D1)</td>
</tr>
<tr>
<td>EPL overall</td>
<td>-0.0778*** (0.0207)</td>
<td>-0.00821 (0.0112)</td>
<td>-0.0639*** (0.0115)</td>
</tr>
<tr>
<td>Benefit Replacement rate</td>
<td>-0.183*** (0.0476)</td>
<td>-0.0185 (0.0271)</td>
<td>-0.178*** (0.0292)</td>
</tr>
<tr>
<td>Benefit Duration</td>
<td>-0.0980*** (0.0248)</td>
<td>0.00338 (0.0117)</td>
<td>-0.0869*** (0.0162)</td>
</tr>
<tr>
<td>Tax Wedge</td>
<td>-0.391*** (0.098)</td>
<td>-0.209*** (0.0589)</td>
<td>-0.0501 (0.0588)</td>
</tr>
<tr>
<td>Coordination of Wage Setting</td>
<td>-0.0154*** (0.0033)</td>
<td>-0.00872*** (0.00211)</td>
<td>-0.00755*** (0.00228)</td>
</tr>
<tr>
<td>Union Density</td>
<td>-0.101 (0.0689)</td>
<td>-0.120*** (0.0397)</td>
<td>0.0169 (0.0397)</td>
</tr>
<tr>
<td>Minimum Wage</td>
<td>-0.0950*** (0.0227)</td>
<td>-0.0454*** (0.0135)</td>
<td>-0.0342** (0.0147)</td>
</tr>
<tr>
<td>Ln(Unemployment Rate)</td>
<td>-0.0122 (0.0235)</td>
<td>-0.0396*** (0.0134)</td>
<td>0.0307** (0.014)</td>
</tr>
<tr>
<td>Ln(Skill Ratio)</td>
<td>-0.133*** (0.0344)</td>
<td>0.000686 (0.0195)</td>
<td>-0.152*** (0.0202)</td>
</tr>
<tr>
<td>Ln(Skill)*Ln(Unemployment)</td>
<td>0.0425*** (0.0145)</td>
<td>-0.00541 (0.00821)</td>
<td>0.0536*** (0.00839)</td>
</tr>
<tr>
<td>Import Intensity</td>
<td>-0.423*** (0.136)</td>
<td>-0.208*** (0.0766)</td>
<td>-0.210*** (0.0647)</td>
</tr>
<tr>
<td>R&amp;D Intensity</td>
<td>-1.058*** (0.215)</td>
<td>-0.682*** (0.119)</td>
<td>-0.236* (0.136)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.566*** (0.0643)</td>
<td>0.861*** (0.0388)</td>
<td>0.647*** (0.0384)</td>
</tr>
</tbody>
</table>

Observations | 381 | 381 | 384
Number of countries | 20 | 20 | 20
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
The benefit duration and the benefit replacement rate both have compressing effects that are significant on the 9/1- and 5/1-decile ratios. They represent the outside option to being employed. An increase in unemployment benefits would increase the reservation wage of workers and therefore also the wage. Also in this case the relative benefit replacement rate would have to be relatively larger for the low-skilled for it to affect the wage dispersion.

Figure 16 illustrates the ratio of the benefit replacement rate for workers that have wages that are 67% of average wages to the benefit replacement rate of workers with average wages. The share of the initial wage that is compensated in the case of unemployment tends to be larger for workers earning 67% of average wage, than for workers earning average wage. This indicates that unemployment benefits replacement rates are relatively closer to wages for low-skilled workers compared to high-skilled workers.

Figure 16: The Ratio of Unemployment Benefit Replacement for Workers Earning 67% of Average Wage to Worker Earning Average Wage

The tax wedge has a compressing effect on the wage differential, but it is only significant on the 9/1- and 9/5-decile ratios. The tax wedge consists of different components that affect inequality in different ways. Income tax tends to be progressive and reduce income inequalities.

The coefficient of union density is not significant at the 9/1-decile ratio level. It is, however, significant in the regression run on the 9/5 in column (2), and it has opposite effects of the two.
ends of the distribution. In the paper by Koeniger et al. (2007) they explain the compressing effect of the union density by the fact that unions have more aggressive wage bargaining for low-skilled workers. Cahuc and Zylbeberg (2004) find that unions have contrasting effects on the wage dispersion. One effect is that workers that are covered by collective agreements tend to have higher wages. The other is that workplaces covered by collective agreements have more compressed wage structures than others. They find that the overall effect of unions increases the wage dispersion.

The regression result in column (2) and (3) show that the union density is positively associated with the 5/1-decile ratios, but has a compressing effect on the 9/5-decile ratio. This indicates that union density only has a more compressing effect on the wages in the upper half of the wage distribution. Because not all low-skilled workers are unionized, unionization can increase the within group wage gap in the low-skilled group.

Earlier work on minimum wage by Brown (1999), DiNardo et al. (1996) and Lee (1999) have concluded that minimum wage reduce wage inequality. If the minimum wage is above the competitive wage of workers, it will bring their wages to a higher level. A minimum wage will not have a direct effect on high skilled workers, and will therefore help to decrease the wage dispersion. Workers that see an increase in their wage as a result of minimum wages tend to be young workers below 24 and workers over 24 with few years of education (Addison and Blackburn, 1999).

A minimum wage could alternatively lead to the destruction of jobs, which could lead to a decrease in the labor market tightness, which would lead wages to fall. There is never the less no clear evidence of the relationship between labor market tightness and minimum wage in earlier literature, implying that wages that are increased by minimum wage laws tend to be below perfect competition equilibrium.

The controls for relative supply and demand conditions for labor; the unemployment rate, the skill attainment and the interaction term between the two have change somewhat in the extended data set. The interaction term between unemployment and skill attainment is still decompressing and now also significant.

The unemployment rate still has a compressing effect on the 9/1-decile ratio, but it is not significant. It does however, have significant effects on the 9/5 and 5/1-decile ratios in
column (2) and (3), but in opposite directions. It increases the wage gap in the lower part of the wage distribution, but has a compressing effect in the upper half of the distribution.

De Galdiano and Turunen (2005) find evidence that supports this result when looking at the elasticity of real wages with respect to local unemployment in the EU. They find that the wage elasticity is higher in the lower part of the distribution, and that wages in the public sector are especially rigid. Blachflower (1990) suggest that this is also the case for wages of unionized workers. This could cause the wages in the middle of the distribution to be less affected by unemployment than the upper and lower half of the distribution, leading to higher wage dispersion in the lower half and lower wage dispersion in the upper half.

As in the replication, the skill attainment has a compressing effect on the 9/1-decile ratio. In the original paper it had an increasing effect, but it turned negative when the US was omitted after 1990. The findings, with the extended data set, support the change in direction of the coefficient of the skill attainment in the replication. The level of skill attainment can affect the wage dispersion through different channels. One effect is the compositional effect. If wages are higher for high-skilled workers and the number of high-skilled workers increase, there will be more wage dispersion (to a certain degree), c.f. Blau and Kahn (2001) and Devroye and Freeman (2002). The skill attainment can also affect the wage dispersion through the price of skilled labor. An increase in the supply of skill will lower the price of skill.

The controls for trade and technology now both have negative coefficients. This fits poorly with the theories of the skill-biased technological change and the Stolper-Samueson theorem, where R&D is thought to affect the relative prices of skill-intensive and low-skill-intensive workers through relative factor productivity when technology change increases relative productivity in skill-intensive sector. In the original paper the authors also find a compressing effect of the R&D expenditure and conclude that it is not a good proxy for the stock of technology, being both stock and flow variable.

The coefficient of the trade proxy was positive in the original paper, but using the extended dataset it turned from positive to negative. The trade intensity is thought to increases with the relative price of skill-intensive goods.

Koeniger et al. (2007) were inspired by the methods used in Maschin and van Reenen (1998) when using these proxies of technology and trade. Maschin and van Reenen (1998) looked at the role of technology and trade in explaining the increasing returns to education in a number
of OECD countries. They found clear decompressing effects of the two variables on the wage differential. In the dataset used in that paper, the R&D intensity was increasing for all countries over time. This is not the case in the data series used in the paper by Koeniger et al. (2007), or the one used in the replication and the extended dataset.

It is unlikely that the technological development has declined any years between 1973 and today, and it can therefore not be viewed as a good proxy for technological progress or skill attainment. Koeniger et al. (2007) therefore suggested that the effect of the R&D intensity should be measured in first difference, since it has to be viewed as a stock variable if it is to reflect the technological development. The way the variable is used in the above analysis it could almost be seen as an investment in the productivity in the manufacturing sector, which could lead to higher wages.

The change in the direction of the coefficient of the import intensity could be due to the selection of new countries. 5 of the 7 countries where the import intensity is negatively correlated with the wage dispersion were added in the extended version, and the coefficient of the import intensity becomes positive, but not significant when France is left out of the analysis. The import of manufactured goods also depends on the demand of manufactures goods which can increase when wages are more equally spread.

5.3 Robustness

According to the Krugman Hypothesis, unemployment increases with the rigidity of labor market institutions. Many studies have found this to be true. Nickell et al. (2005) and Sparrman (2011) find that unemployment is increasing in EPL, unemployment benefit replacement ratio, while an interaction of the coordination and union density decrease unemployment. It is therefore likely that some of the effect of the institutional variables on the wage differential is taken up in the coefficient of the unemployment rate, because some of the effects of the institutional variables affect the wage dispersion indirectly through unemployment. I have tested for this in the baseline model with extended and revised data. Based on the estimated coefficients of the institutional variables on the unemployment rate in Sparrman (2011) (cf. Sparrman (2011) Table 12), I generated a new variable; the share of unemployment that is caused by institutional variables and subtracted this from the unemployment rate to generate the share of unemployment that is not affected by labor market institutions. I included both in the analysis and dropped out the overall unemployment rate. The compressing effect of the unemployment rate on the 9/1-decile ratio is much bigger.
for the share that is caused by unemployment rate, but it is not significant. On the 9/5-decile ratio, both variables are significant and compressing, but the effect of the share of unemployment caused by institutional variables is much bigger than the other. On the 5/1-decile ratio, the share caused by institutional variables is not significant, but the measure that is not caused by institutional variables is. This indicates that some of the compressing effect of the institutions on the 9/5-decile ratio is underestimated and given credit for by the unemployment rate.

I also tested the baseline model with different specifications. The results are displayed in Table 8 in the Data appendix B. A model with one-year lags gave bigger effects for some of the institutional variables. The coefficients of the tax wedge, the minimum wage and the coordination of wage setting gained some explanatory power.

6. A closer look at recent trends in the Labor Market

6.1 Impact on income inequality of dividing the measures of EPL into temporary and permanent positions

The previous analysis and the analysis in Koeniger et al. (2007), they used the measure of overall EPL, which is a combined measure of EPL for permanent and temporary positions. In this section we will extend the previous analysis by looking at the separate effect of EPL for permanent and temporary contacts.

Developments of the underlying measures have been different and the number of people in temporary positions has increased. There has been a common trend in the development of the EPL for the countries in the sample, where EPL for regular contracts has been more or less unchanged at a relatively high level, while EPL for permanent positions has been eased to stimulate job creation and gain flexibility in the labor market. The development in the share of persons in temporary positions has also increased as an effect of this (see Figure 17). This makes it interesting to study the separate effects of EPL on temporary and permanent positions are, and whether the two separate variables could actually affect the wage dispersion in opposite directions.
I have investigated the effects of EPL for permanent and temporary positions using the framework of Koeniger et al. (2007). The separate measures of EPL for temporary and permanent contracts only exist after 1985, causing the time series to become shorter. Table 3 shows the estimated results of this specification with separate measures of EPL for regular and permanent contracts. The results in Table 3 show that the effects of the employment protection for the two different types of contracts do have opposite effects on the wage distribution. Some of the other institutional variables coefficients have lost significance because the dataset has been shortened. Table 3, column 4 contains the results with overall EPL for the same time period. The $R^2$ of the results in the 1st and the 4th column are respectively 0.93 and 0.94, indicating that the fit of the model with overall EPL is marginally better.

![Graphs showing the evolution of the share of workers in temporary positions across different countries](image)

**Figure17: The Evolution of the Share of Workers in Temporary Positions**

The part of employment protection that concerns regular contracts contributes to increasing the differences between the 9th and the 1st decile, while the employment protection legislations concerning temporary contracts have a compressing effect on the wage distribution.

In the paper by Koeniger et al. (2007) they concluded that the overall EPL-level had a compressing effect on the wage dispersion. The results in Table 3 show that the effect of overall EPL is not unambiguous.
Table 3: Results with Extended Data Series and Separate Measures of EPL for Permanent and Temporary Positions. Estimation Period 1985-2012

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Model with two measure of EPL on 9/1-decile ratio</th>
<th>Model with two measure of EPL on 9/5-decile ratio</th>
<th>Model with two measure of EPL on 5/1-decile ratio</th>
<th>Overall EPL for same estimation period on 9/1-decile ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Log(D9D1)</td>
<td>Log(D9D5)</td>
<td>Log(D5D1)</td>
<td>Log(D9D1)</td>
</tr>
<tr>
<td>EPL for Regular Contracts</td>
<td>0.0767***</td>
<td>0.0537***</td>
<td>0.0274**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0251)</td>
<td>(0.0141)</td>
<td>(0.0131)</td>
<td></td>
</tr>
<tr>
<td>EPL for Temporary Contracts</td>
<td>-0.0204****</td>
<td>-0.0016</td>
<td>-0.0198***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00634)</td>
<td>(0.00347)</td>
<td>(0.00382)</td>
<td></td>
</tr>
<tr>
<td>Benefit Replacement rate</td>
<td>-0.0761</td>
<td>0.0105</td>
<td>-0.107***</td>
<td>-0.0295</td>
</tr>
<tr>
<td></td>
<td>(0.0605)</td>
<td>(0.0324)</td>
<td>(0.0375)</td>
<td>(0.0586)</td>
</tr>
<tr>
<td>Benefit Duration</td>
<td>-0.0664**</td>
<td>-0.000941</td>
<td>-0.0510***</td>
<td>-0.0711**</td>
</tr>
<tr>
<td></td>
<td>(0.0291)</td>
<td>(0.0114)</td>
<td>(0.0195)</td>
<td>(0.0288)</td>
</tr>
<tr>
<td>Tax Wedge</td>
<td>-0.214*</td>
<td>-0.198***</td>
<td>0.0566</td>
<td>-0.204*</td>
</tr>
<tr>
<td></td>
<td>(0.112)</td>
<td>(0.0639)</td>
<td>(0.0736)</td>
<td>(0.111)</td>
</tr>
<tr>
<td>Coordination of Wage Setting</td>
<td>-0.00507</td>
<td>-0.00141</td>
<td>0.000942</td>
<td>-0.00872**</td>
</tr>
<tr>
<td></td>
<td>(0.00496)</td>
<td>(0.00208)</td>
<td>(0.0038)</td>
<td>(0.00411)</td>
</tr>
<tr>
<td>Union Density</td>
<td>0.0641</td>
<td>-0.0247</td>
<td>0.0522</td>
<td>-0.132</td>
</tr>
<tr>
<td></td>
<td>(0.101)</td>
<td>(0.0524)</td>
<td>(0.0542)</td>
<td>(0.0905)</td>
</tr>
<tr>
<td>Minimum Wage</td>
<td>-0.0318</td>
<td>0.0205</td>
<td>-0.0453**</td>
<td>-0.0121</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.0199)</td>
<td>(0.023)</td>
<td>(0.0382)</td>
</tr>
<tr>
<td>Ln(Unemployment Rate)</td>
<td>-0.0449*</td>
<td>-0.0552***</td>
<td>0.0114</td>
<td>-0.0548**</td>
</tr>
<tr>
<td></td>
<td>(0.0268)</td>
<td>(0.0147)</td>
<td>(0.0175)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>Ln(Skill Ratio)</td>
<td>-0.0676</td>
<td>0.0353</td>
<td>-0.111***</td>
<td>-0.0476</td>
</tr>
<tr>
<td></td>
<td>(0.0441)</td>
<td>(0.0241)</td>
<td>(0.0273)</td>
<td>(0.0405)</td>
</tr>
<tr>
<td>Ln(Skill)*Ln(Unemployment)</td>
<td>0.0061</td>
<td>-0.0252**</td>
<td>0.0361***</td>
<td>-0.00413</td>
</tr>
<tr>
<td></td>
<td>(0.0176)</td>
<td>(0.00982)</td>
<td>(0.011)</td>
<td>(0.0168)</td>
</tr>
<tr>
<td>Import Intensity</td>
<td>-0.438***</td>
<td>-0.202***</td>
<td>-0.230***</td>
<td>-0.347**</td>
</tr>
<tr>
<td></td>
<td>(0.141)</td>
<td>(0.0753)</td>
<td>(0.064)</td>
<td>(0.141)</td>
</tr>
<tr>
<td>R&amp;D Intensity</td>
<td>-0.619**</td>
<td>-0.390***</td>
<td>-0.0287</td>
<td>-1.078***</td>
</tr>
<tr>
<td></td>
<td>(0.265)</td>
<td>(0.148)</td>
<td>(0.168)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>EPL overall</td>
<td>-0.0560***</td>
<td>-0.0560***</td>
<td>-0.0560***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0215)</td>
<td>(0.0215)</td>
<td>(0.0215)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.645***</td>
<td>0.882***</td>
<td>0.740***</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>(0.0694)</td>
<td>(0.0375)</td>
<td>(0.0427)</td>
<td>0</td>
</tr>
</tbody>
</table>

Observations 302 302 305 302
Number of countries 20 20 20 20
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The EPL reforms mentioned earlier, where EPL for regular contracts were held more or less unchanged, while EPL for permanent positions was eased were implemented to stimulate job creation. Cahuc and Postel-Vinay (2001), Khan (2000) and Blanchard and Landier (2001)
found that these reforms increased the share of employees in temporary positions, but did not find any clear long term effects of these reforms on unemployment. Blanchard and Landier (2001) also suggest that the types of positions that were offered in the labor marked were altered to adjust to these reforms, and that firms now create routine, lower productivity jobs where workers can easily be replaced with temporary contracts.

Autor (2003) finds that EPL for regular contracts increases the incentives to invest more in training of employees in permanent positions, leading to accumulation of firm-specific human capital which can increase both productivity and wages. The two different aspects of the overall measure of EPL have opposite effects on the wage dispersion and contribute to creating a dual labor market. It this way, it can increase the within group wage dispersion in both groups. It can also increase the between group wage dispersion between high and low-skilled workers because a disproportionate share of low-skilled workers end up in the permanent positions (cf. Barbieri 2009).

It indicates that the reforms have contributed to a division of the labor market, which my estimated results with separate measures for EPL support. Some workers have stable permanent positions with a high degree of employment protection, while others have low-paid temporary jobs with little possibility for advancement. The easing of EPL for temporary positions has lead in an increase in the share of workers in temporary positions, both through temporary work agencies and fixed-term contracts, and has also contributed to increasing the wage dispersion.

6.2 Robustness

One way to test the results in Table 3 is to explore how the estimated coefficients change to each of the included countries. This is particularly interesting since the reassessment of Koeniger et al. (2007) showed that the prolonging of skill in United States changed sign when new data where available. The main results in Table 3 are tested by excluding one and one country at the time.

The regressions showed that all coefficients of institutional variables remained negative, except when France was excluded and the coefficient of the overall EPL changed sign, cf. Table 2. This implies that stricter overall employment protection does increases inequality. This can probably be explained by the fact that the overall EPL and the wage differential have

---

1 The robustness test of the overall EPL is based on the full extended sample length
developed in clearly different direction in France over the sample period with a correlation of -0.9. France is also one of few countries that have seen a simultaneous change where EPL for temporary positions has increased while the wage differential has decreased. France is one of few countries that have seen increases in overall EPL only as an effect of an increase in EPL for temporary positions. When the overall employment protection measure is divided into temporary and regular contracts, the results remained constant for all of the countries in the sample. Excluding the US from the sample gave a loss of significance for the coefficient of the tax wedge.

6.3 Impact on income inequality of changes in immigration

I will now look at the impact of immigration on the wage dispersion. Along with an increase in inequality in most countries, there has been an increase in the degree of immigration. Immigration has therefore become a popular explanation for the growth in wage dispersion, and it is also interesting to include this variable in the analysis.

Immigration could affect the wage dispersion in different ways. It depends on the skill-level of the immigrant and the natives, and the substitutability at different skill-levels of the two groups. It could be through compositional effects, either if immigrants on average have a lower skill-level and lower wages than the average native population, the between group inequality of the immigrant- and the native population increases the overall inequality, or because immigrants tend to be concentrated at the bottom and the top of the skill and income distribution. If the within group inequality in the immigrant population is larger than the level of inequality in the native population, the relative growth of the immigrant population will lead to a more unequal overall wage dispersion. Immigration can also affect the wages of the native at the same skill-level through substitution.

The results from the analysis are presented in Table 4. The analysis is conducted within the framework of Koeniger et al. (2007), on the full extended dataset. From the estimated result we can see that immigration has a significant, diverging effect on the 9/1- and 5/1-decile ratio when included in the regression. The diverging effect could be caused either by compositional effect or by the increase in supply of labor at the skill-levels where the immigrant groups are substitutable for native workers.

The effect on the 9/5-decile ratio is also decompressing, but not significant, and much smaller than the effect on the 9/1- and 5/1-decile ratios. This indicates that immigration contributes most to increasing the wage dispersion in the lower half of the wage distribution. This could
be either because immigrant workers on average have lower wages than native workers, causing the between group inequality between native and immigrant workers to increase, or because immigrant workers are relatively better substitutes for low-skilled workers and hence causes the wages for all low-skilled workers to decrease. The inclusion of immigration has little effect on coefficients of the other variables in the regression.

Earlier studies done on the effect of immigration on the wage dispersion also find that the effect is mostly found in the lower half of the distribution. And many find that other immigrant workers usually are the ones who suffer the most from increases in immigration. Jahn and Brüker (2011) look at the wage and employment effects of immigration in Germany, a country with a rigid labor market and relatively strong institutions. They find evidence that native and immigrant workers are imperfect substitutes at the same skill-level. They find that native workers tend to benefit from immigration in terms of higher wages and lower risk of unemployment, but foreign workers experience a major impact from immigration at their given skill and experience level.

Card (2009) looks at the connection between immigration and inequality in the US, where low-skilled immigrant from Mexico and Central-America are thought to have contributed to an increase in the skill-differential and lower the wages for low-skilled native born through substitution. The immigrant population in the US is concentrated in the upper and lower tails of the skill-distribution. Similarly to Brüker and Elke (2011), Card (2009) finds that immigration had little impact on the wages of the native born, but that the overall impact is clearly contributing to increasing the level of inequality. This indicates that the compositional effects of immigration were present. He estimates that about five percent of the rise in overall wage inequality in the US between 1980 and 2000 can be explained by immigration.

Native and immigrant workers could be imperfect substitutes for several reasons. It could be caused by language or cultural barriers or discrimination. In many cases immigrant workers can have lower reservation wages because they do not have the same unemployment benefit rights and in some cases they do not have equally strong employment protection. The unemployment rates of foreign born citizens tend to be higher for immigrants. In 2010, foreign born citizens had higher rates of unemployment in all countries in the sample with exception of the US. Immigrants are often the first to loose their jobs during recessions.
Table 4: Results with Extended Data Series Including the Measure of Immigration. Estimation Period: 1973-2012

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Model with immigration on 9/1-decile ratio Log(D9D1)</th>
<th>Model with immigration on 9/5-decile ratio Log(D9D5)</th>
<th>Model with immigration on 5/1-decile ratio Log(D5D1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPL overall</td>
<td>-0.0859*** (0.0205)</td>
<td>-0.011 (0.0116)</td>
<td>-0.0679*** (0.0116)</td>
</tr>
<tr>
<td>Benefit Replacement rate</td>
<td>-0.179*** (0.0478)</td>
<td>-0.0214 (0.0271)</td>
<td>-0.175*** (0.0293)</td>
</tr>
<tr>
<td>Benefit Duration</td>
<td>-0.119*** (0.0254)</td>
<td>0.000951 (0.0122)</td>
<td>-0.0978*** (0.0167)</td>
</tr>
<tr>
<td>Tax Wedge</td>
<td>-0.445*** (0.0997)</td>
<td>-0.210*** (0.0597)</td>
<td>-0.0884 (0.0613)</td>
</tr>
<tr>
<td>Coordination of Wage Setting</td>
<td>-0.0152*** (0.00328)</td>
<td>-0.00876*** (0.00212)</td>
<td>-0.00749*** (0.00228)</td>
</tr>
<tr>
<td>Union Density</td>
<td>-0.126* (0.0678)</td>
<td>-0.128*** (0.0409)</td>
<td>0.0197 (0.0392)</td>
</tr>
<tr>
<td>Minimum Wage</td>
<td>-0.102*** (0.0223)</td>
<td>-0.0457*** (0.0137)</td>
<td>-0.0353** (0.0145)</td>
</tr>
<tr>
<td>Ln(Unemployment Rate)</td>
<td>-0.0127 (0.0234)</td>
<td>-0.0394*** (0.0135)</td>
<td>0.0282** (0.0139)</td>
</tr>
<tr>
<td>Ln(Skill Ratio)</td>
<td>-0.133*** (0.034)</td>
<td>0.000699 (0.0196)</td>
<td>-0.147*** (0.0202)</td>
</tr>
<tr>
<td>Ln(Skill)*Ln(Unemployment)</td>
<td>0.0386*** (0.0145)</td>
<td>-0.00588 (0.00824)</td>
<td>0.0506*** (0.00839)</td>
</tr>
<tr>
<td>Import Intensity</td>
<td>-0.445*** (0.134)</td>
<td>-0.211*** (0.0772)</td>
<td>-0.230*** (0.0676)</td>
</tr>
<tr>
<td>R&amp;D Intensity</td>
<td>-0.954*** (0.22)</td>
<td>-0.662*** (0.124)</td>
<td>-0.209 (0.138)</td>
</tr>
<tr>
<td>Net Immigration</td>
<td>0.00570** (0.00226)</td>
<td>0.000692 (0.00117)</td>
<td>0.00318** (0.00144)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.559*** (0.0642)</td>
<td>0.861*** (0.0392)</td>
<td>0.649*** (0.038)</td>
</tr>
</tbody>
</table>

Observations: 381 | 381 | 384
Number of countries: 20 | 20 | 20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

7. Quantitative implications of all the empirical models

I will now study at the quantitative implications of the results in table 2 to 4. Table 6, Panel A presents the change in the 9/1-decile ratio as an effect of a one standard deviation increase in
the rigidity of the measures of the institutional variables and the net immigration from the model. The quantitative implication must also be interpreted in light of the difficulties in measuring institutions as previously discussed.

Table 5: Summary of the Extended Dataset Used in the Analysis. Time Period 1973-2012

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage Differential D9/D1</td>
<td>3.003</td>
<td>0.657</td>
<td>2.030</td>
<td>5.140</td>
<td>N = 381</td>
</tr>
<tr>
<td>Wage Differential D5/D1</td>
<td>1.656</td>
<td>0.229</td>
<td>1.310</td>
<td>2.400</td>
<td>N = 381</td>
</tr>
<tr>
<td>Wage Differential D9/D5</td>
<td>1.800</td>
<td>0.196</td>
<td>1.430</td>
<td>2.650</td>
<td>N = 381</td>
</tr>
<tr>
<td>EPL Overall</td>
<td>1.037</td>
<td>0.586</td>
<td>0.126</td>
<td>2.142</td>
<td>N = 381</td>
</tr>
<tr>
<td>EPL Temporary</td>
<td>1.685</td>
<td>1.264</td>
<td>0.250</td>
<td>5.380</td>
<td>N = 302</td>
</tr>
<tr>
<td>EPL Regular</td>
<td>1.855</td>
<td>0.822</td>
<td>0.170</td>
<td>4.170</td>
<td>N = 302</td>
</tr>
<tr>
<td>Benefit Replacement Ratio</td>
<td>0.435</td>
<td>0.191</td>
<td>0.012</td>
<td>0.885</td>
<td>N = 381</td>
</tr>
<tr>
<td>Benefit Duration</td>
<td>0.486</td>
<td>0.340</td>
<td>0.000</td>
<td>1.045</td>
<td>N = 381</td>
</tr>
<tr>
<td>Tax Wedge</td>
<td>0.467</td>
<td>0.139</td>
<td>0.208</td>
<td>0.747</td>
<td>N = 381</td>
</tr>
<tr>
<td>Coordination of Wage Setting</td>
<td>2.853</td>
<td>1.334</td>
<td>1.000</td>
<td>5.000</td>
<td>N = 381</td>
</tr>
<tr>
<td>Union Density</td>
<td>0.372</td>
<td>0.208</td>
<td>0.076</td>
<td>0.839</td>
<td>N = 381</td>
</tr>
<tr>
<td>Minimum Wage</td>
<td>0.248</td>
<td>0.238</td>
<td>0.000</td>
<td>0.675</td>
<td>N = 381</td>
</tr>
<tr>
<td>Unemployment Rate</td>
<td>6.772</td>
<td>2.728</td>
<td>1.880</td>
<td>17.874</td>
<td>N = 381</td>
</tr>
<tr>
<td>Skill Attainment</td>
<td>0.296</td>
<td>0.199</td>
<td>0.034</td>
<td>1.036</td>
<td>N = 381</td>
</tr>
<tr>
<td>Net Immigration</td>
<td>2.916</td>
<td>2.381</td>
<td>-1.512</td>
<td>12.137</td>
<td>N = 381</td>
</tr>
</tbody>
</table>

The results from the baseline model do however imply that the largest effect of a standard deviation (see Table 5) change comes from the tax wedge which is associated with a 5.4 decline in the 9/1-decile ratio from a change of a standard deviation of 13.9 percentage points in the tax wedge. A one standard deviation in the strictness of the overall EPL measure of 0.6 on a scale from 1-3, is associated with a 4.6% decline in the 9/1-decile ratio. A standard deviation change in the measures of unemployment protection is associated with around 3% decline in the 9/1-decile ratio, while the a standard deviation change in the minimum wage, the coordination of wage setting and the union density are associated with decline in the 9/1-decile ratio of around 2%.

The quantitative implications of the effect of the different aspects of EPL are quite large. According to the results from Table 6 a one standard deviation change in the measure of EPL for regular contracts leads to a change in the 9/1-decile ratio of over 6 %, while the effect of a one standard deviation increase in the rigidity of the measure of EPL for temporary contracts reduces it by 2.57%. A standard deviation change in immigration of 2.4% is associated with an increase in the 9/1-decile ratio of 1.36%.
Table 6: Quantitative Predictions of the Baseline Analysis, Analysis with Separate Measures of EPL and Analysis with Immigration. Percentage change in 9/1-Decile Ratio

Panel A: One Standard-Deviation Increase in Rigidity/Level

<table>
<thead>
<tr>
<th></th>
<th>EPL Overall</th>
<th>Benefit Replacement Rate</th>
<th>Benefit Duration</th>
<th>Union Density</th>
<th>Tax Wedge</th>
<th>Min Wage</th>
<th>Coordination of Wage setting</th>
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<tr>
<td>Baseline</td>
<td>-4.56</td>
<td>-3.50</td>
<td>-3.33</td>
<td>-2.10</td>
<td>-5.43</td>
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<tr>
<td></td>
<td>EPL Regular</td>
<td>EPL Temporary</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>6.30</td>
<td>-2.57</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Immigration</td>
<td></td>
<td></td>
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<td></td>
<td>1.36</td>
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</table>

Panel B: An Increase from Minimum to Maximum Rigidity/Level.

<table>
<thead>
<tr>
<th></th>
<th>EPL Overall</th>
<th>Benefit Replacement Rate</th>
<th>Benefit Duration</th>
<th>Union Density</th>
<th>Tax Wedge</th>
<th>Min Wage</th>
<th>Coordination of Wage setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>-15.70</td>
<td>-15.98</td>
<td>-10.24</td>
<td>-7.710</td>
<td>-21.07</td>
<td>-6.16</td>
<td>-6.41</td>
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<tr>
<td>Divided measure of employment protection</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EPL Regular</td>
<td>EPL Temporary</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>30.68</td>
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<td>Immigration</td>
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<td></td>
<td>Immigration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6 Panel B presents the change in the 9/1-decile ratio associated with an increase in institutions from the minimum levels of rigidity to the maximum levels of rigidity.

A change from minimum rigidity to maximum rigidity is associated with a change in the 9/1-decile ratio of around 6% for the coordination of wage setting and an increase in the minimum wage from non-existing to 67% of the median wage, 7.7% of a change of the union density from 7% to 84%, 21% decrease for a rise in the tax wedge from 20% to 75%. An increase in the measure of overall EPL is associated with a decrease in the 9/1-decile ratio of 15.7%. If we look at the quantitative implications of the measures of EPL for temporary and permanent positions they clearly show that the two variables have opposite effects on the wage differential. An increase in the rigidity of EPL for permanent positions from .17 like in the US
since the mid 1980’s to 4.17 like Portugal in the 2000s, on a scale from 1-6, is associated with an increase in the size of the 9/1-decile ratio of 30.7%, while an increase in the rigidity of EPL for temporary positions from .25 which is common in Anglo Saxon countries to 5.38, the level in Italy until 1996, is associated with an decline in the 9/1-decile ratio of 10.46%. Few countries have seen a change in institutions of the magnitudes described here, so the content of Panel B should be interpreted with even more care than Panel A.

8. Conclusion
This thesis has reassessed the main findings in Koeniger et al. (2007), with revised and extended dataset. It looks at the role of labor market institutions in explaining the differences in development of wage inequality for 20 OECD countries from 1973 to 2012, with controls for technology and trade and supply and demand conditions for labor. The analysis was expanded to also study the effect of a separate measure of EPL for temporary and permanent positions, and immigration.

I find that the institutional variables: employment protection legislation, the benefit replacement rate, the unemployment benefit duration, the tax wedge, the minimum wage and the coordination of wage setting all have a significant compressing effect on the 9/1-decile ratio. Union density also has a compressing effect, but it is only significant on the 9/5-decile ratio. The findings indicate that the level of strictness of labor market institutions can explain some of the differences in the development of wage inequality across countries. The estimated effects of the labor market institutions in the reassessment are very similar to the results in Koeniger et al. (2007) qualitatively, but vary somewhat in magnitude. I also found that the estimated coefficient of the skill attainment, the ratio of people with some tertiary education to people with no tertiary education, have a compressing effect on the wage differential. This is the case in both the replication on the revised and extended dataset. The estimated results presented in the original paper indicated that the effect was in the opposite direction, but I found that when the US was left out after 1990 for which the data was just extended with the growth rate in the original paper, the effect is actually compressing there too. Interestingly, my findings indicate that the unemployment rate has opposite effects on the wage dispersion in the upper and lower parts of the wage distribution. The effect on the 9/5-decile ratio is compressing, while the effect on the 5/1-decile ratio is decompressing. This could be due to the rigidity of wages of public and unionized employees that have less elastic wages with respect to unemployment and are typically located in the middle of the wage distribution.
A separate measure of EPL for temporary and for permanent positions and a measure of immigration are also included in the analysis. While the overall measure of EPL has a compressing effect of the wage dispersion, the measures of EPL for temporary and permanent positions have opposite effects that are both significant. I find that EPL for temporary contracts has a compressing effect on the wage differential, while EPL for permanent contracts has contributed to increasing the wage differential. The measure of immigration has a significant compressing effect on the wage differential. This effect appears to be dominant in the lower half of the wage distribution.

For future research, it would be interesting to investigate the effects of changes in EPL for temporary positions on other aspects of the labor market. Easing the restrictions on EPL for temporary positions in order to stimulate job creation did not give a long term effect on employment, but as my results show, it has lead to an increase in wage dispersion. It would be interesting for future research to study the effect of the implementation of the TWA directive on the wage dispersion and employment in the EU.

It would also be interesting to look more closely at the effect of immigration on the wage distribution. While labor market institutions have a compressing effect on the wages of employed workers, many of the institutional variables have an increasing effect on unemployment for immigrants. It would therefore be interesting to study the contrasting effect on the integration of immigrants. Labor market institutions can give immigrants better conditions in the labor market, but at the same time make it harder for immigrants to enter the labor market.
Bibliography


Blanchflower, David G (1990) “Fear, Unemployment and Fear” Dartmouth College, NBER and Centre for Economic Performance, LSE


Sparrman, Victoria (2011), “Unemployment in OECD Countries”, Series of dissertations submitted to the Faculty of Social Sciences, University of Oslo, No. 266

Data appendix:

Appendix A
The data appendix describes where the data used in this thesis is found and how the variables are build up.

Wage differentials:
The measure of wage inequality used in this thesis is the ratio of 9th to 1st, 9th to 5th (median), and 5th to 1st decile, where 9th, 5th (or median) and 1st-deciles are upper-earnings decile limits of gross earnings of full-time dependent employees.

Most of the numbers are from the “Decile ratios of gross earnings database OECD, Labor statistics, Earnings” in OECD iLibrary (doi: 10.1787/data-00302-en)


Unemployment Rate (UNR):
The standardized unemployment rate (UNR) from “Economic Outlook No 91 - OECD Annual Projections”

The data are prolonged backward for some countries, using the growth rate of numbers found in older versions of OECD’s Economic Outlook: Germany before 1992 using numbers from Economic Outlook 90 for Former Federal Republic of Germany, Ireland before 1990 using Economic Outlook 88 and Spain before 1967 using Economic Outlook 77.

Employment Protection Legislation Indicator (EPL):
The OECD indicators of EPL are synthetic indicators of the strictness of regulation on dismissals of individuals or groups, and the procedures involved in hiring workers on fixed-term or temporary work agency contracts. They are compiled of 21 items, and divided into three areas: Individual dismissal of workers with regular contracts, additional cost for collective dismissals, regulations of temporary contracts, and an overall measure of EPL which is an average of the indicators for regulations for temporary and regular contracts.


The series is prolonged backwards by the growth rate of the measure of employment protection “ep” in the CEP OECD database. These numbers are based on Blanchard and Wolfers (2000).

This was done for all countries before 1985, except New Zealand that was prolonged backwards before 1990.

Trade Union Density:
Trade union density corresponds to the ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners (OECD Labor Force Statistics). Density is calculated using survey data, wherever possible, and administrative data adjusted for non-active and self-employed members otherwise.


**Benefit Replacement Rates:**

The benefit replacement rate is a measure of how much each unemployed worker receives in benefit from the government. The OECD gives information about the unemployment benefits for year 1, the average of year two and three, and the average of year four and five for unemployed person in different family situations and with different initial income level.

The three different family types are: Single, with a dependent spouse and with a working spouse.

The different income levels are: 67 percent and 100 percent of average earnings.

The measures used in this thesis are:

Brr67a1: First year benefit replacement rate for workers with, 67 percent of average earnings and the average over family types.

Brr67a2: Benefit replacement for the second and third year, with 67 percent of average earnings and the average over family types.

Brr67a4: Benefit replacement for the fourth and fifth year, with 67 percent of average earnings and the average over family types.

Brr100a1: First year benefit replacement rate for workers with, 100 percent of average earnings and the average over family types.

Brr100a2: Benefit replacement for the second and third year, with 100 percent of average earnings and the average over family types.

Brr100a4: Benefit replacement for the fourth and fifth year, with 100 percent of average earnings and the average over family types.

The benefit replacement rate is calculated by taking the average of brr67a1 and brr100a1.

BRR= (brr67a1 + brr100a1)/2

**Benefit Duration:**

The benefit duration is a measure of how long benefits last when you are unemployed and how the amount given changes over the duration. Benefit duration is given by the equation:

\[
BD_{jt} = \alpha \frac{brrja2_{it}}{brrja1_{it}} + (1 - \alpha) \frac{brrja4_{it}}{brrja1_{it}}
\]

Where \( \alpha = 0.6 \), \( j = \{67,100\} \), \( i=1,2...20 \) and \( t = 1960, 1961...2011 \). brrja1it is the benefit replacement rate in year 1, brrja2it is the benefit replacement rate in year 2 and 3, and finally brrja4it is the benefit replacement rate in year 4 and 5. \( \alpha = 0.6 \) gives more weight to the second
and third year as compared to the fourth and fifth year. The index is calculated for both employment situations, i.e. j=67 percent and j=100 percent of average earnings.

If benefit replacement stops after one year, then \( \text{brr67a2} = \text{brr67a4} = 0 \), and \( \text{BD67} = 0 \). If benefit provision is constant over the years, then \( \text{brr67a1} = \text{brr67a2} = \text{brr67a4} \), and \( \text{BD67} = 1 \). Some countries have increasing benefit replacement over the duration of unemployment, which gives a \( \text{BD}>1 \).

Source: OECD Data-base on Benefit Entitlements and Gross Replacement Rates

**Tax Wedge:**

Tax wedge is equal to the sum of the employment tax rate, the direct tax rate and the indirect tax rate. It measures the total amount the government receives as an effect of taxing the labor force. It can also be seen as the difference between the employees’ take-home earnings and the total cost of employing them.

\[ TW = t1 + t2 + t3 \]

\( t1 \) is equal to employers actual wage cost calculated by the sum of wages received by employees and taxes paid by the employer to the government

\[ t1 = \frac{\text{EC}}{\text{IE} - \text{EC}} \]

**EC-Employers Social Security contributions**

Social contributions are the actual or imputed payments to social insurance schemes to make provision for social insurance benefits. They may be made by employers on behalf of their employees or by employees, self-employed or non-employed persons on their own behalf. The contributions may be compulsory or voluntary and the schemes may be funded or unfunded.

**IE- Compensation of employees**

Compensation of employees is made up of two components: Wages and salaries payable in cash or in kind: These include the values of any social contributions, income taxes, etc., payable by the employee even if they are actually withheld by the employer and paid on behalf of the employee.

**t2 Direct Tax Rate**

\[ t2 = \frac{\text{IT + WC}}{\text{HCR}} \]

**WC- Employees social security contributions**

Social contributions are the actual or imputed payments to social insurance schemes to make provision for social insurance benefits. They may be made by employers on behalf of their employees or by employees, self-employed or non-employed persons on their own behalf. The contributions may be compulsory or voluntary and the schemes may be funded or unfunded.

**IT- Income tax**
Current taxes on income, wealth, etc.  
**HCR- Current receipts of households**

Current receipts of households consist of all income to a household, whether monetary or in kind received by the household or by individual members of the household. It includes income from employment, investments, current transfers, etc.

\[ t3 = \frac{TX - SB}{CC} \]

**TX-Indirect taxes**

Taxes on consumption goods.

**SB- The value of subsidies**

Value of subsidies paid by government.

**CC- Final consumption**

Final consumtion epediture for entire economy.

All variables were found in National Accounts. EC (NFD12R), IE (NFD1R), WC (NFD61P-NFD12R), IT (NFD5P), HCR (NFB5GR) and SB (NFD3P) were found in Table 14.A (Non-Financial accounts by sector) in household sector for all except SB which was found in general government sector. TX(D2) was found in Table 10 , general government sector. CC(P3) was found in Table 1.

This series is extended backwards with the growth rate of the series for tax wedge used in Sparrman (2011) before 1995 for: Austria, Belgium, Denmark, France, Germany, Netherlands, Norway, Portugal and Sweden. It is extended backwards before the 1990 for UK and Italy, before 1975 for Finland, before 2002 for Ireland, Before 2000 for Spain and before 1998 for US. Australia, Canada, New Zealand and Switzerland are replaced for the entire time series.

**Education attainment:**

This is the ratio of the overall population over 15 with some level of tertiary education. The data are taken from the Barro-Lee database on educational attainment, where levels are given every fifth year. I have filled in in the missing years with linear approximation.


**Value added in manufacturing industry:**

Gross value added is the value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry or sector; gross value added is the source from which the primary incomes of the SNA are generated and is therefore carried forward into the primary distribution of income account.

The numbers are taken from OECD’s “STAN database” for structural analysis ISIC rev.3.

Import of goods for manufacturing:

The numbers are taken from OECD’s “STAN database” for structural analysis ISIC rev. 3.

R&D costs in manufacturing industry:

The numbers are taken from The OECD's ANBERD database. It presents annual data on industrial R&D expenditures. Series are published from 1987 to 2010.


Most countries are prolonged backwards by the growth rate before 1987, with data from this database. Data for Austria was missing 1999 to 2001 and was interpolated for this period. New Zealand was missing data every other year from 1994 to 2008 and interpolation was used there as well. Data for Sweden was missing before 1995, but the data was supplemented with data from the BERD database. Data is for Former Federal Republic of Germany for Germany prior to 1991.

Immigration:

The measure of immigration is found in United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2010 Revision, New York, 2011 (comprehensive Excel tables). The data were given every fifth year, and is interpolated.

Minimum Wage:

The minimum wage is measures as the minimum wage relative to median wage and is taken from the OECD iLibraryOECD (2010), "Earnings: Minimum wages relative to median wages", OECD Employment and Labour Market Statistics database (doi: 10.1787/data-00313-en)

Coordination of Wage bargaining:

The coordination of wage bargaining is based on Kenworthy’s 5-point classification of wage-setting coordination scores (Kenworthy, 2001a,b) and is on a scale of 1 to 5. It was found in :Data Base on Institutional Characteristics of Trade Unions, Wage Setting, State Intervention and Social Pacts, 1960-2010 (ICTWSS), Jelle Visser (2011)

Appendix B

Table 7: Results with Extended Date Series and the Preferred Model in Koeniger et al. (2007) with a measure of unemployment that is controlled for the part of unemployment that is caused by institutions. Based on Findings in Sparrman (2011). Estimation Period 1973-2012

<table>
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<th>VARIABLES</th>
<th>Extended data on 9/1-decile ratio</th>
<th>Extended data on 9/5-decile ratio</th>
<th>Extended data on 5/1-decile ratio</th>
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</thead>
<tbody>
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<td>-0.0627***</td>
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<td>(0.0207)</td>
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<td>(0.0116)</td>
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<td>-0.0140</td>
<td>-0.175***</td>
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<td>-0.00803***</td>
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<td>-0.140***</td>
<td>0.0191</td>
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<tr>
<td>Ln(Share of Unemployment rate caused by institutions)</td>
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<td>-0.119***</td>
<td>0.0250</td>
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<td>(0.0673)</td>
<td>(0.0393)</td>
<td>(0.0411)</td>
</tr>
<tr>
<td>Ln(Unemployment Rate Controlled for Effects of Institutions)</td>
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<td>-0.0393***</td>
<td>0.0299**</td>
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<td>(0.0132)</td>
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<td>Ln(Skill Ratio)</td>
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<td>0.0128</td>
<td>-0.154***</td>
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<td>(0.0209)</td>
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<tr>
<td>Ln(Skill)*Ln(Unemployment)</td>
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<td>-0.00947</td>
<td>0.0547***</td>
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<tr>
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<td>(0.0150)</td>
<td>(0.00840)</td>
<td>(0.00865)</td>
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<td>Import Intensity</td>
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<td>-0.201***</td>
<td>-0.208***</td>
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<td>(0.0659)</td>
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<td>R&amp;D Intensity</td>
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<td>-0.642***</td>
<td>-0.244*</td>
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<td>(0.119)</td>
<td>(0.137)</td>
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<td>(0.147)</td>
<td>(0.0862)</td>
<td>(0.0950)</td>
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</table>

Observations | 381 | 381 | 384
Number of code | 20 | 20 | 20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

55
Table 8: Results with Extended Date Series and the Preferred Model in Koeniger et al. (2007) with different specifications. One-year Lag and Two-Year Lag. Estimation Period 1973-2012.

<table>
<thead>
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<th>Variables</th>
<th>Ln D9D1</th>
<th>Variables</th>
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<td>(0.0206)</td>
<td>L2.Benefit Replacement Rate</td>
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<td>L.Benefit Duration</td>
<td>-0.163***</td>
<td>L2.Benefit Duration</td>
<td>-0.132***</td>
</tr>
<tr>
<td>L.Tax Wedge</td>
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<td>L2.Tax Wedge</td>
<td>(0.0291)</td>
</tr>
<tr>
<td>L.Coordination of Wage Setting</td>
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<td>L2.Coordination of Wage Setting</td>
<td>-0.0156***</td>
</tr>
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<td>L.Union Density</td>
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<td>(0.00351)</td>
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<td>L.Minimum Wage</td>
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<td>L2.Minimum Wage</td>
<td>-0.109*</td>
</tr>
<tr>
<td>L.Ln(Unemployment Rate)</td>
<td>(0.0234)</td>
<td>L2.Ln(Unemployment Rate)</td>
<td>(0.0235)</td>
</tr>
<tr>
<td>L.Ln(Skill Ratio)</td>
<td>-0.141***</td>
<td>L2.Ln(Skill Ratio)</td>
<td>-0.145***</td>
</tr>
<tr>
<td>L.Ln(Skill)* Ln(Unemployment)</td>
<td>0.0175</td>
<td>L2.Ln(Skill)* Ln(Unemployment)</td>
<td>0.0405*</td>
</tr>
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<td>L.Import Intensity</td>
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<td>L2.Import Intensity</td>
<td>0.0130</td>
</tr>
<tr>
<td>L.R&amp;D Intensity</td>
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<td>L2.R&amp;D Intensity</td>
<td>-0.401***</td>
</tr>
<tr>
<td>Constant</td>
<td>1.523***</td>
<td>Constant</td>
<td>1.461***</td>
</tr>
<tr>
<td></td>
<td>(0.0664)</td>
<td></td>
<td>(0.0614)</td>
</tr>
</tbody>
</table>

Observations 387 391
Number of countries 20 20
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1