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Parameters for convergence and divergence in wage distribution of professions 1970-2016 in Norway

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Abstract

Rising income inequality within countries is a concern that present a societal challenge. This thesis investigated whether wages between selected sectors in Norway in the time frame 1970-2016 has been subject for convergence or divergence. Thereafter the underlying factors causing this wage development was researched. We employed log-linear regression to test for beta convergence and sigma convergence in the wage data accounting for more than 20 sectors. Thereby convergence and divergence in the trend wages was identified, and the degree of convergence or divergence was extracted. Calculation of Gini coefficients was done for the nine sectors chosen to study in the thesis, in supplement to the discussion of wage development differences. Additionally, factors responsible for this development was examined by analyzing their relevance for the Norwegian wage formation. The Norwegian economy's steady development was beneficial for all sectors and average real wages increased by 127% between 1970 and 2016. Wages between different professions notably converged between 1970-1983 and diverged significantly the remaining period until 2016. The financial, manufacturing and the public administration and defense sectors have all been subject to a relatively steep increase in wages in addition to having had high level of wages from the start. Whereas the hotel and food service, health and the agriculture sectors, that were among the lower paid jobs initially, have lost terrain. The two most important explanations for wage divergence are differences in productivity and the strong development of financial sector wages. The rise in inequality was found to be considerably less when excluding the financial sector. The purpose of this thesis was to detect the direction wages in sectors move altogether, and expose factors influencing this movement. By doing so, the thesis provides relevant focus areas when interacting with the challenge of income inequality. We conclude that particularly productivity and wages in the financial sector is worth remarking as highly affecting the divergence observed in the time frame.

Contents

1. Introduction

Convergence and divergence of wages are closely related to the question of rising or falling inequality, an important focus in recent times. Income inequality dropped among most advanced economies during the 20th century until 1970, implying wage convergence in that time. Since then inequality is on the rise again in most industrialized countries, including Norway (Aaberge, Atkinson, & Modalsli, 2016). Yet, Norway is still seen as one of the most egalitarian countries in the world, being characterized as a homogenous society, having low income inequality compared to other countries, and a high level of trust in each other (You, 2012). There are several reasons for the narrow income distribution such as strong redistribution, a large public sector, and cultural factors (Fournier & Johansson, 2016).

The effects of rising inequality are debated. Some points out that it can decrease solidarity within a society and make people feel "left out". Research also indicates that inequality is associated with deteriorating health and overall happiness while others claim economic issues may be traced to inequality, for instance decreasing economic growth. On the other hand it has been argued that countries with higher inequality show higher economic growth due to economic incentives that enable entrepreneurs to "harvest their own fruits" (Fuest, Neumeier, & Stöhkler, 2018).

Extensive research has been conducted in the field of inequality over the last decades, for the most part concerned with the question of whether overall inequality in countries exists, and if so, what are the drivers of this development. When investigating inequality developments, it is inalienable to look at the wage development of certain professions. Some inequality drivers are profession specific, thereby omitting analyses about these drivers could end in a non-holistic way of fighting inequality in many countries. The same applies to Norway. Most of the research concentrates on overall inequality in Norway and tries to explain why inequality is low but rising.

This thesis aims to provide a comprehensive overview of the inequality developments between professions over the last 50 years, and the major drivers influencing this development. This analysis can furthermore partly explain overall inequality developments in Norway. Thus, it may assist when investigating if inequality has increased and in the analyses of the underlying factors, thereby support policy makers in deciding actions to impede inequality.

This thesis is structured as following: In chapter 2 we review existing literature regarding factors driving certain developments of wages. Chapter 3 provides insights into the Solow models of economic growth, convergence theory, globalization theory and productivity theory which will be the primary theoretical framework for our analysis. Chapter 4 presents the data we used in order to make our conclusions. In chapter 5 we investigate if there was convergence or divergence in wages by calculating sigma convergence, beta convergence, and the Gini coefficient. Chapter 6, 7 and 8 contain our analysis about factors driving convergence or divergence from the labor supply, demand, and policy side. In chapter 9 we compare our findings with developments in other countries, and the thesis is concluded in chapter 10.

2. Literature Review

Productivity is widely known as one of the major driving factors of economic development and wages. Anderson (2007) stresses the importance of developments in productivity when investigating the wage trends. He points out that recent gaps in the development between the average hourly earnings and productivity are attributable to the exclusion of variable payments that have been increasingly employed in recent times. Hagelund (2009) investigated the development of labor productivity since the 1950s in Norway and found low productivity growth in the 1970s and 1980s, while it picked up again after the 1990s due to increased usage of information and communication technology (ICT), predominantly in the service sector. Gartner (2014) shows that there is evidently a clear relationship between wages and productivity in the long run, whereas there can be both positive and negative correlations between the two variables in the short run. According to a policy paper of the OECD (2017), the divergence in productivity is the main contributing factor for an increase in wage dispersion between firms in the OECD.

Immigration as a diverging factor has long been debated in economics and a consensus is not yet to be found. One of the most influential papers from Foged and Peri (2015) investigates the impact of a large inflow of refugees between 1986 and 1998 in the Danish labor market. The findings indicate a positive effect of the refugee influx in Denmark on unskilled native wages, employment and occupational mobility due to a push effect that lifted natives in more complex work in order to avoid competition with immigrants. In contrast, Hoen, Markussen, and Røed (2018) found that immigration from low-income countries to Norway reduced social mobility among natives and reduced employment by 3.2% among them. High-skilled wage earners, however, benefited from low-skilled immigration, leading to widening inequality in Norway. Borjas (2003) finds similar results for the US where immigration depressed wages for US workers. Outside the USA findings are often different. Little or no effects of immigration on wages were found by Addison and Worswick (2002) for Australia, Pischke and Velling (1997) for Germany, Zorlu and Hartog (2005) for the Netherlands, United Kingdom and Norway, and Carrasco and Jimeno (2008) for Spain.

The financial sector as the cause for increasing between-profession inequality is brought up by the OECD (2015), which claims that financial sector payments are the main contributor to rising inequality in many countries. This is especially attributed to the use of variable payments in the sector. This argument is further developed by Boustanifar, Grant and Reshef (2014),

who examined underlying factors of the strong wage development within the financial sectors. Their findings show that skill intensity is the main explanatory variable when determining the wages developments in different sectors. The increasing demand for high-skilled workers is amplified due to increasing globalization, deregulations in the financial sector, and increasing investments in information and communication technologies. Philippon and Reshef (2007) add the risk of unemployment as a factor for higher compensation to the existing theories. Bell and Van Reenen (2010) investigate that the strong development in productivity is a major driver of financial sector wages. Furthermore, it can be noted that the special "moral hazard" situation and the "economic theory of superstars" can be used to explain the unique circumstances surrounding this sector.

There exists extensive literature that is dealing with trade effects on inequality of wages. Melitz (2003) used a dynamic industry model to estimate the impact of trade on intra-industries. Trade liberalization should generate wage divergence between firms in the same industry depending on export exposure. This is due to the fact that these firms outperform domestic operating firms in terms of productivity, wages and size. Hummels, Jørgensen, Munch and Xiang (2014) find a positive effect of offshoring on high-skilled worker wages, and vice versa on low-skilled workers. Exports, on the other hand, increase wages for all skill levels. Carluccio, Fougère and Gautier (2015) found in France that trade intensive firms in general pay higher wages notably with differences between worker subcategories. Blue-collar workers receive a much higher trade wage premium of 20% compared to white-collar workers receiving 5%. Goldberg and Pavcnik (2007) researched the parallel of inequality development and increased exposure to international markets in several developing countries. It was reviewed a lack of reallocation between sectors in developing countries suggesting a distributional challenge of resources within countries. According to empirical findings the less prosperous in developing countries did not benefit in relative terms when openness to trade increased.

In most countries a wage premium exists in the public sector, additionally to the inclusion of more extensive non-wage benefits, leading to higher compensated employees in this sector on average than in the private sector. Gindling, Hasnain, Newhouse and Becerra (2017) found that earnings premiums are negatively correlated with the share of employment and that premiums often either disappear or becomes insignificant when comparing to private formal earnings. Freeman (1985) studied wages in the public sector relative to the private sector in the U.S. and discovered that this relation varies considerably over time, which was evenly

caused by fluctuation in public pay. The employment in the public sector, however, was more stable than the private sector and rather countercyclical. Black people and women were among individuals that were highest paid compared to the private sector, implying less discrimination in the public sector. Gindling et al. (2017) found a trend of more female employees in this sector. It is also pointed out that lower-skilled and less educated workers is the most likely group to benefit from a wage premium. Johansen and Strøm (2001) state that there are reasons to believe that the wage setting process in public sector might not be equivalent to the process in the private sector and argues that wages in this sector might be treated independently. The sector differs with respect to demand for production, which is essentially decided by political institutions. Also, the "ability to pay", which is crucial in the private sector, is not as clear in the public sector.

Violante (2008) points out that skill-biased technological change is the main driver of recent inequality developments due to a shift in relative demand in favor of high-skilled workers. The reason behind this is that new information technologies are complimentary for high-skilled workers, while they are substitutes for low-skilled workers. Ábrahám (2008) finds similar results for the U.S. and explains that rising earnings inequality can be attributed to skills heterogeneity when controlling for productivity differences based on education, ability, and age. Berman and Machin (2000) investigate the same for developing countries where the skilled-biased technological change leads to increasing demand for high-skilled labor in middle-income countries.

Holden (2016) points out that the way wages are determined in Norway relies heavily on the wage-leadership model in which unions are crucial. This model leads to a moderate wage development in Norway overall. Helland, Bol, and Drange (2017) examined that three occupational characteristics - licensure, unionization, and credentialization - were drivers of an increase in between-occupation inequality. The rise in inequality was rather low and they found that the degree of unionization was negatively related to between occupational inequality. However, the rise in inequality was rather low and stable. Barth, Bryson and Dale-Olsen (2017) used a tax-induced exogenous variance in the price of union membership to find out the impact of higher union density in a workplace. The result revealed a significant positive effect on firm wages and productivity.

3. Theory

The Solow Model provides a theoretical foundation for economic growth based on capital accumulation and is a framework included in the thesis to assess productivity as a factor in the development of wages. We are interested in investigating in which way productivity is influencing the development of wages, and whether differences in productivity also presents a different wage development between sectors. The Solow model assumes diminishing return of productivity and predicts convergence between economies. It is considered to be applicable to sectors within the Norwegian economy. The idea is that wages will converge between sectors due to diminishing return of productivity. Our interest in this model is the explanatory power it might entail regarding a fairly convergent development or plausible temporary divergent movements due to differences of productivity between sectors.

In the analyzes productivity stands out as a particularly central term, which express the need for clarifying the way of measuring it. The following two measures of productivity, multi-factor productivity and labor productivity, is therefore explained and evaluated for the applicability in the thesis.

When comparing the wage development between sectors, it is analyzed whether the development is subject to convergence or divergence and underlying factors affecting this development. Recognizing the features of convergence and divergence thus becomes important in order to grasp the calculations and analysis of our thesis. Especially are our calculations conducted applying theory of beta convergence and sigma convergence which is weighted part of the convergence theory.

When discussing the development of wages in Norwegian sectors it is essential to include the perspective of how globalization affects this development. Norway is a small open economy relatively more dependent on exports and imports than many of its peers. Norwegian wages are particularly influenced by the international economy, as Norway forms wages following a model where the ability to compete internationally is an important goal. Globalization theory is complex and formulates many ways wages can be affected. The theory is explaining mechanisms of how wages are influenced when the market is expanded, and composition of resources differ. We present a description of globalization in our time frame 1970-2016 and some results of globalization provided by Richard Baldwin (2016). This gives the background suited to understand the impact of globalization. The background is further elaborated by a

theory about trade including David Ricardo's comparative advantage and the Heckscher-Ohlin model considering differences in factor endowments. The theoretical foundation for globalization is especially relevant when looking at migration, trade and skill-biased technological change as explanatory factors for development in wages in certain sectors.

3.1 Solow growth model

The Solow growth model, developed by Robert M. Solow in 1956, is one of the most renowned theoretical frameworks, in which long-run economic growth is explained through a neoclassical production function. The important factors that contribute to economic growth are namely capital accumulation, growth of labor force and an increase in productivity. Solow extended the already existing Harrod-Domar model, which included capital as a contributing factorbut did not include the factor labor nor the fact that capital-input ratios may vary over time.

The Solow model starts with a constant return to scale production function and the assumption of only one good. Production is represented by *Y* as a function of capital input *K* and labor input *L* meaning that the output is produced by these two input factors (Solow, 1956):

(1) $$Y = F(K, L)$$

The model assumes a closed economy with no government. Output *Y* may be seen as net output resulting in the production of a good minus depreciation (Whelan, 2015). The output is either consumed or saved. The savings ratio *s* is constant and leads to the rate of savings:

(2) $$sY(t)$$

Savings are equal to investments, hence the rate of increase for the capital stock *K* ($\mathrm{dK/dt} = \widehat{\mathrm{K}}$) is equal to the amount of savings:

(3) $$\widehat{K} = sY$$

Solow assumes here that the production function is homogenous of the first degree, meaning that the increase of the input factors by a certain factor leads to an increase of output by some power of this factor that is constant. Solow's production function shows constant returns to scale.

Inserting a production equation in the capital equation:

(4) $$\widehat{K} = sF(K,L)$$

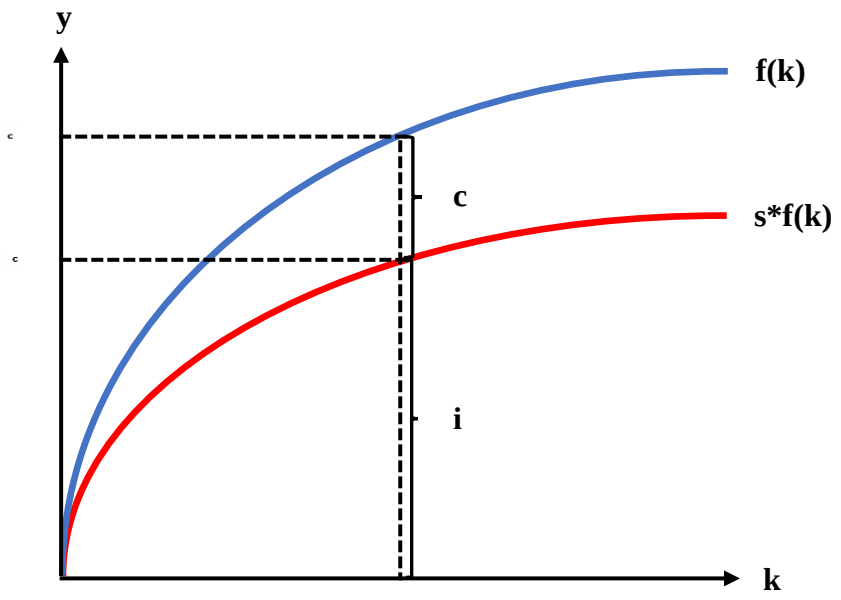
which shows the dependency of change in capital on the marginal savings rate as well as the input factors capital and labor. The equation is then divided by the labor force in order to obtain output per worker as well as the corresponding capital per worker. Per capita variables is written in small letters:

(5) $$Y/L = f(K/L, 1)$$

which leaves us with:

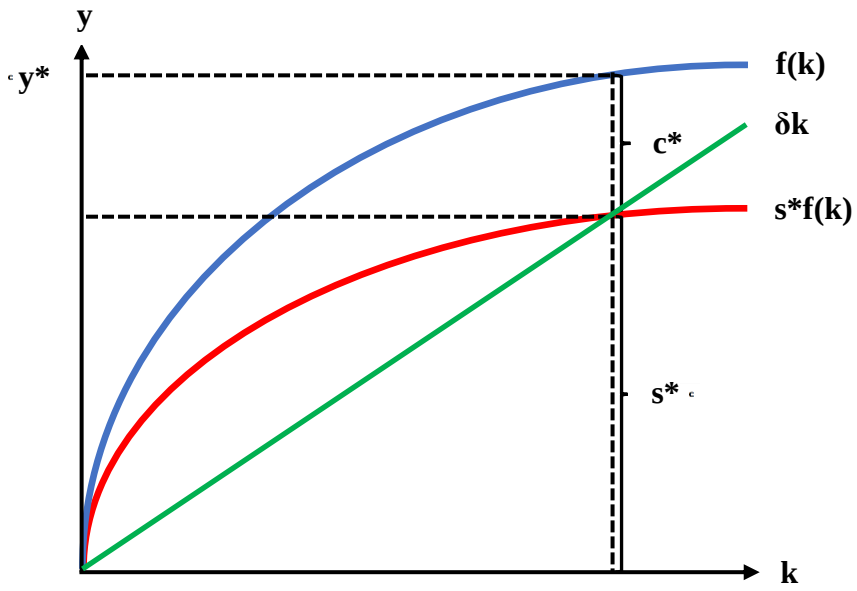
(6) $$y = f(k)$$

where *y* is the output per worker and *k* is the capital per worker.



Graph 1 / Source: (Terence, 2006)

In this graphical illustration, we see the production function together with the investment function, both in per capita terms (see graph 1). Both are characterized through diminishing returns to scale. Consumption is displayed by *c* and investments by *i* with *s*f(k)* being investments per capita leading to new capital per capita. Hence, an increase in output also increases the investment, i.e. causing an increase in the capital stock per capita. However, capital experiences a certain amount of depreciation each period that is decreasing the existing capital stock. Therefore, the model must be extended by a constant depreciation rate δ (see graph 2).



Graph 2 / Source: (Terence, 2006)

This leads to the final steady-state level of the capital stock *k**. In this point, the capital stock per capita is constant. A higher capital per capita would be absorbed by the depreciation rate, while a lower capital per capita stock would lead to higher investments than depreciation, thus increasing capital per capita stock. The steady state savings rate *s** and consumption *c** form together with the total steady-state income *y**.

The model is further extended by exogenous labor force growth by a constant rate *n*. Increasing the labor force decreases capital per capita as well as output per capita:

$$\Delta k = s * f(k) - (\delta + n) * k \tag{7}$$

which can be seen as the capital accumulation path as a differential of *K(t)* followed in a situation of full employment. The time path for capital accumulation and growth of the labor force can be used to compute the corresponding time path for the production function or real output. As noted, capital per capita is growing by investments per capita minus depreciation and labor force growth. The steady state conditions now change slightly due to the model extension where the depreciation curve is becoming steeper, leading to a lower capital per capita steady state. In contrast to the simpler model without population growth, the absolute terms of output and capital grow in the steady state by labor force growth *n*, while output and capital per capita are remaining constant (unchanged to the simple model).

We now extend the model one last time by a central factor in this thesis: Productivity. Due to exogenous technological processes (new ideas, inventions, etc.), labor is becoming more

efficient and therefore more productive. We can also say that *A* is a measurement of how well a given country is combining the two factors capital and labor. A higher *A* means both factors are combined more efficiently. This productivity measure is called the Solow residual or the Multifactor productivity. We include this factor by assuming that every given worker is producing more output for every new period:

(8) $$Y = F(K, L * A)$$

with *A* representing the multi-factor productivity which grows at a constant time g. Using a Cobb-Douglas production function as a geometric function for a more realistic approach we obtain:

(9) $$Y = A * K^{\alpha} * L^{\beta}$$

with alpha and beta being the output elasticities for capital and labor. Transforming this in per worker term leads us to:

(10) $$y = A * k^{\alpha}$$

When rearranging this formula, we can explain differences in countries through productivity:

(11) $$\frac{A_{FRA}}{A_{ZAF}} = \frac{(y_{FRA} / y_{ZAF})}{({k_{FRA}}^{\alpha} / {k_{ZAF}}^{\alpha})}$$

Let us assume that the output per worker of South Africa (denoted by "ZAF") is half of that of France ("FRA"). When we now assume that South Africa and France have the same levels of capital per worker, we can explain all the differences in output per worker through differences in productivity. In other words, South Africa is combining its capital in a less efficient way compared to France. Differences in productivity levels can empirically explain much of the differences in output per worker throughout the world (Hall & Jones, 1999). When we further assume diminishing marginal productivity the theory suggests that there should be seen a convergence of productivity over time (Slobodhikova, 2015).

From the above-derived model, we infer that one way for an economy to grow , i.e. to increase the steady state level, is to increase productivity. In order to further build the bridge to wage development we have to see the connections between the Solow model and real wages.

Real wages in the Solow model are determined as the marginal product of labor. Profit-maximizing firms in a framework of a Cobb-Douglas production function offer a real wage

that corresponds proportionally to labor productivity. Firms are hiring an additional input of labor as long as the marginal benefits exceed the marginal costs where the marginal costs are the costs of hiring, which is mostly the wage. If the marginal benefit is increasing due to rising productivity firms are willing to offer a higher compensation wage as the benefits are still exceeding the costs. Hence, growth in labor productivity is a driver of growth in real wages. As Solow is assuming diminishing returns of productivity, theory suggests a convergence of real wages, meaning in the long-run, poor countries should close the wage gap to rich countries due to their higher marginal productivity. The same should also hold for within country productivity between sectors. This leads to real wage convergence between the sectors, which builds the theoretical framework for this thesis. The premises for how productivity is measured and how it influences wages is examined in more details in the following subchapter.

3.2 Productivity

Mainly there are two different measures for productivity which are used in research: Multi-factor productivity and labor productivity:

Multi-factor productivity:

Multi-factor productivity (MFP) is the part of growth in economic output that cannot be explained by growth in the input factors labor and capital. It reflects the synergy of labor and capital inputs when the factors interact in the production process. Using a standard Cobb-Douglas function sheds light on the basic underlying mechanisms. This assumes a neoclassical production function and perfect competition in the factor markets. The MFP can be seen as the residual of this function:

$$Y = A * F(K, L) = A * K^{\alpha} * L^{\beta} \tag{12}$$

with *K* being the capital input (in constant prices), *L* being labor input (hours worked) and *A* being the multi-factor productivity as the residual of the function. *α (β)* is the capital's (labor's) share of the production. In order to understand the growth mechanisms, this Cobb-Douglas function must be log transformed and redefined in growth rates:

$$ln(Y) = ln(A) + \alpha * ln(K) + \beta * ln(L) \tag{13}$$

We define growth rates as:

$$\Delta y = dln(Y)/dt = (1/Y) * dY/dt \quad (14)$$

Combining (13) and (14) presents the following equation:

$$\Delta y = \Delta a + \alpha * \Delta k + \beta * \Delta l \quad (15)$$

The equations above show that the growth in aggregate output is coming from the growth in capital input, labor input (weighted by the labor's share of the product and capital's share of the product respectively) and growth in α, referred to as the multi-factor productivity growth. α captures all factors that affect economic output that are not included in the labor or capital inputs like network effects, economies of scale, spillover effects or changes in management practices (OECD, 2018).

MFP plays an important role when it comes to economic development. It is highly correlated with economic measures such as hours worked and output (GDP), and has strong pro-cyclical characteristics (Comin, 2006). It is seen as one of the main drivers of GDP growth and cross-country differences in development levels. However, MFP measures are also subject to criticism. Not only is MFP difficult to measure due to the complications of exactly measuring labor and capital input. It has also been criticized for claiming that the assumptions for a neoclassical production function are fulfilled. Neoclassical production functions assume linear homogeneity and convexity. In times of software developments and ICT, this assumption can be seen as implausible. Software is characterized through high costs in the developing process, while later it may be duplicated for close to zero costs, thereby contradicting the assumption of diminishing returns to scale. Furthermore, perfectly competitive markets should be seen as a model situation rather than reality. Most economies today are characterized through somewhat oligopolistic or monopolistic market structures, leading to market power that is not adequately reflected in the production function. Hence, the resulting MFP would be underestimated (Reati, 2001).

Labor Productivity:

Labor productivity is an intuitive measure that is used to describe the standard of living, on the basis of the strong relationship between labor productivity and income per capita. In most settings labor productivity is measured as the value added per hours worked, hence using production output and labor input as relative measures. Value added is used in order to exclude

intermediate inputs to prevent an overestimation of the productivity measure. Average labor productivity is defined as:

$$ALP = Y/L \tag{16}$$

with *L* being labor input as hours worked. The Cobb-Douglas function (see equation 9) is used to show the decompositions. Note that: $\beta = (1 - \alpha)$. Growth rates are defined as:

$$\Delta y = \Delta a + (1 - \alpha) * \Delta k + \alpha \Delta l \tag{17}$$

The growth in average labor productivity (ALP) is a combined measure of growth in labor composition, capital per hours worked and adjustments in the growth of productivity of these inputs integrated as growth in MFP. Here, we use an arithmetic model:

$$\Delta ALP = \Delta y - \Delta l = \Delta a + (1 - \alpha) * (\Delta k - \Delta l) = \Delta MFP + (1 - \alpha) * (\Delta k - \Delta l) \tag{18}$$

With $(1 - \alpha) * (\Delta k - \Delta l)$ being the growth in capital per worker, the so-called capital deepening. Thus, growth in MFP and the capital deepening are determining the growth in average labor productivity. As we can measure labor productivity directly, we do not rely on information about the composition of labor and capital inputs or MFP. This makes the measure easy to apply and the likelihood of measurement errors decreases. Labor productivity automatically includes all technical enhancements and does not rely on assumptions about neoclassical production functions or market power. On this basis we evaluate labor productivity as an appropriate productivity measure for this thesis, especially when dealing with data on the macroeconomic level. We look specifically on labor productivity to find plausible relations between this measure and divergence in wages between different professions in Norway.

3.3 Convergence theory

3.3.1 The concept of convergence in neoclassical growth theory

With the background from the Solow models, we can dig deeper into convergence and divergence theory. Convergence as a macroeconomic theory has the purpose of studying factors influencing economic growth in countries and explaining differences in real output. It is thereby closely related to economic growth theory (Dvoroková, 2014). Neoclassical growth models for closed economies presents an inversely related per capital growth to the starting

level of output (or income) per person. If economies are similar in preferences and technology, and assuming a decreasing return to capital (output per worker), then poor economies grow faster than rich ones. Thus, there is a market force promoting convergence in levels of per capita product and income (Barro & Sala-i-Martin, 1992).

In the paper "Convergence" Barro and Sala-i-Martin (1992) quantified the transitional dynamics toward the steady state. This was done by using log-linearization of equations from neoclassical growth theory. Here, the positive convergence coefficient β dictate the speed of adjustment toward a steady state. A higher value of β means a more rapid convergence to the steady state. The model implies a conditional convergence as the growth rate is affected by initial output per unit effective labor, compared to the steady state level of output and the rate of exogenous labor-augmenting technological progress. The lower the initial level of output, the higher the growth rate. Differences between countries in their output produced is also appearing in their steady-state values. The Solow model predicts convergence toward each country's steady-state level, and this convergence is conditioned in specific values that determine this steady-state level (Mankiw, Romer, & Weil, 1992). Since these levels vary in different economies, it is necessary to hold these variations fixed in cross-country analysis to estimate β. A crucial part of the convergence in the neoclassical model is the diminishing returns to capital. This is reflected in the size of the capital share coefficient, α, which has a strong effect on β (Barro & Sala-i-Martin, 1992). To asses this relation quantitatively Barro and Sala-i-Martin (1992) use baseline parameters provided by Jorgenson and Yun (1986, 1990). An important finding is that an increased willingness to substitute intertemporally raises β. Also, it was found that parameter A, which amount to differences in the available technique, government policies or natural resources, does not affect β. Thus, the convergence coefficient can be similar across economies that differ much in other respects. Further, the analysis performed on baseline numbers resulted in a rapid speed of adjustment, which was estimated to be much slower empirically. Consequently, the speed of convergence can only be reconciled quantitively with the neoclassical theory if one assumes parameter values that differs substantially from the baseline case applied in the paper (Barro & Sala-i-Martin, 1992).

3.3.2 Definitions of terms

Real convergence and nominal convergence

One may differentiate convergence based on the variables employed in the analysis, i.e. nominal and real convergence. These types of convergence are interconnected and considered parallel processes. However, there does not seem to be a consensus understanding of nominal and real convergence. The measurement of real convergence uses a chosen real macroeconomic aggregate, where GDP in real terms in conversion per capita or per worker is most often used in empirical studies.

Nominal convergence is considered the case when economies are closing to each other in price characteristics and achieve the same level of nominal variables, e.g. inflation rate, interest rate, or exchange rate. It can be evaluated in broad terms as the degree to which the "Maastricht convergence criteria" is satisfied (Dvoroková, 2014). The Maastricht criteria are the rules for price and fiscal stability. The criteria are crucial to sustain the European Union in the future by providing premises for member states. The first three criteria are the convergence criteria which are designed to ensure monetary stability by supporting a fixed exchange rate regime (Afxentiou, 2000).

Absolute convergence and conditional convergence

Early studies of convergence were the study of the so-called absolute convergence, defined as "a process in which economies with lower capital per worker grow faster than economies with higher capital per worker" (Dvoroková, 2014, p. 89). Often when measuring convergence, it is set up a condition of homogeneity due to empirical observations where the economies with high capital per worker achieve faster growth per worker. It is called conditional convergence when a homogeneous sample is used with the same institutional parameters. A common sample in this context could be the OECD countries (Dvoroková, 2014). Barro and Sala-i-Martin (1992) presented that their findings of convergence in the U.S. states could be relevant for a broad cross-section of countries if allowed for the abovementioned conditional convergence in the underlying growth model.

3.3.3 Beta convergence

Beta convergence is when there is a negative partial correlation between growth in income per capita over time and the initial level of income (Young, Higgins, & Levy, 2008). This negative slope of the linear function illustrates the beta convergence (Dvoroková, 2014). Depending on the value of the convergence parameter β it is decided whether convergence or divergence occurs. That implies that if beta is negative (positive) the trend is converging (diverging). In other words, beta convergence occurs when countries with low initial output, has a higher growth rate compared to countries with higher levels of initial output, and thereby narrows the gap.

When testing for beta convergence, Baumol's "univariate growth regression" can be applied. This considers absolute convergence, holding all factors equal except for the level of wages the initial year, consequently not including sector-specific and time-variant effects (Eilertsen, 2016). Sectors within a country have the same institutional conditions and are presumably homogenous, thereby allowing for the validity of this method.

To calculate beta convergence, it is necessary to apply a two-stage operation. First, the growth rate of wages is found by using log differences between the years of interest (Eilertsen, 2016).

$$growth_{i,0\text{-}T} = ln(\frac{w_{i,T}}{w_{i,0}}) \tag{19}$$

The growth rate of wages in sector *i* in the period between the years *0* and *T* is computed and is further used when testing for beta convergence. Thereby leading to the second stage of the procedure, which is finding the convergence parameter β by using the simple univariate regression.

$$growth_{i,0-T} = \beta_{0_i} + \beta_1 lnw_{i,0} + \varepsilon_i \tag{20}$$

In this equation annual growth rate in wages between starting point *0* and end point *T* is analyzed where β_{0_i} is a constant, β_1 is the coefficient for the logarithm of wages for sector i in the initial year, and ε_i is the error term in the log-linear regression (Eilertsen, 2016). The equations of the two-stage operation can be combined into one equation for calculating beta convergence. The final mathematical equation for beta convergence is

(21) $$\frac{1}{T} ln(\frac{w_{i,T}}{w_{i,0}}) = \beta_{0_i} + \beta_1 lnw_{i,0} + \varepsilon_i$$

The independent variable is the logarithm of the initial wage level, and the dependent variable is the trend growth rate in wages for that period (Presstun, 2015).

3.3.4 Sigma convergence

Sigma convergence is when the distribution of real per capita income is falling over time across a group of economies (Young, Higgins, & Levy, 2008). It can be defined as "lowering of variance of real GDP per capita logarithm among economies in time" (Dvoroková, 2014, p. 89). The approach of sigma convergence is applied when answering whether the distribution of income across economies is becoming more equitable (Young, Higgins, & Levy, 2008).

Sigma convergence is a complementary theory to beta convergence (Bogdanova, 2010). Young, Higgins and Levy (2008) finds that beta convergence is a necessary but not adequate condition for sigma convergence. While beta convergence focuses solely on average growth in a specific time frame, sigma convergence provides a measure for the degree of convergence in specific years (Dvoroková, 2014). This by comparing the variance of the distribution. Sigma convergence occurs if the standard deviation of log wages in sectors σ in time t is reduced such as:

(22) $$\sigma_t > \sigma_{t+1}$$

Hence, a lower standard deviation in *t+1* than in *t* indicates sigma convergence.

3.4 Globalization and Integration

3.4.1 Globalization in 1970-2016 – a description of the "Great Convergence"

Globalization can be defined as "the international integration of goods, technology, labor, and capital*"* (Slaughter & Swagel, 1997, p. 1). Baldwin (2016) introduces a way to view globalization and the aspects of it dependent on the "3 cascading constraints". Prior to globalization, production was strictly bound to the consumption in the area one operated. This was because the costs of moving goods, communication and the costs of moving people

represented constraints that prevented integration of markets. Baldwin (2016) explains globalization through a perspective of unbundling these costs. In addition he separates the first and second "wave" of globalization as the periods prior to and the aftermath of the World Wars.

In contrast to the first wave of globalization, where the result was the "Great Divergence", the next development in the world economy is according to Baldwin the "Great Convergence". In our analysis we use data from 1970-2016.This period experienced globalization in two forms: the "second wave" of globalization and the "second unbundling". During this time frame, the wealth of industrialized countries in the "north" (Western Europe and the US) began to reverse compared to the other countries, with a strong decrease from the 1990s and forward (Baldwin, 2016).

3.4.2 Globalization and competition in the old paradigm

In the second wave of globalization countries in the "south" (East Asia) quickly became industrialized and the emergence of the Asian tigers occurred (Baldwin, 2006). In parallel with the industrialization of some of the Asian countries, the "north" started to get de industrialized. This was partly due to the access to cheap goods from the south, but also a result of changing consumer preferences towards services and employment in these sectors. Since these sectors provided domestically traded goods, prices and wages were possible to adjust up to the level of employment that met the domestic demand. The high productivity growth in the industry allowed a decrease in labor force while still obtaining the same level of output.

Competition in the first unbundling were between sectors where the prosperity of sectors relied on the productivity of factors most employed. This resulted in "winning" sectors and "losing" sectors depending on how the sector's productivity was relative to the rest of the world. The superior labor productivity in the winning sectors was offsetting the lower wages in competing sectors, causing a growing productivity-adjusted wage gap. The impact of the first unbundling in globalization favored the skill intensive sectors and disfavored the unskilled labor-intensive sectors (Baldwin, 2006). In addition to globalization, the northern unskilled labor force was challenged by a shift in technology. Between the years 1979-1988, the wage gap between a college graduate and a high school graduate rose by 20 % in the U.S. Countries with less wage inequality experienced higher rates of unemployment in the lower-skilled group. The trend among the less-skilled workforce therefore appeared in either income and/or employment. The

outcome is much decided from the labor market structure in each nation, where some have flexible wages and others have rigid wages resulting in changes of employment rate (Slaughter & Swagel, 1997).

3.4.3 Globalization and competition in the new paradigm

The second unbundling of costs was evident through the reduced costs of moving ideas combined with the continuing decreasing costs of moving goods. Baldwin (2006) refers to this as a shift of paradigm and elaborates how this is different from prior globalization by competing in trade in tasks rather than trade in goods. The second unbundling is due to the revolution in Information and Communication Technologies (ICT). Low communication costs made it possible to coordinate business in other parts of the world, enabling the profitability of the offshore industry profitable. An industry that has been booming since the late 1980s and influencing terms of competition. The period is defined by a "global value chain revolution", in which the knowledge flow differs from the previous form of globalization. Earlier, knowledge was to a large extent retained within national borders, where industrial clusters fostered innovation in technology. The new international production networks provided new knowledge flows by reducing the costs of moving ideas, outweighing the need for close physical proximities in order to stimulate innovation (Baldwin, 2016).

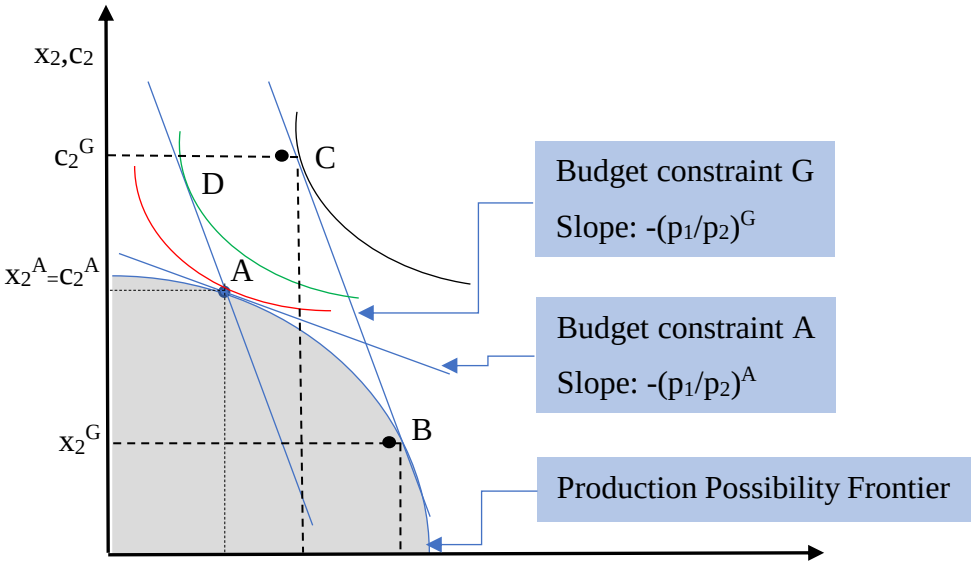
The basis of competition changed as the production processes were fragmented, meaning "competition from low-wage workers in developing nations came directly into Northern factories and offices" (Baldwin, 2016, p. 168). Consequently, competition shifted from affecting sectors to affecting at the stage level. Workers in the same sector could either find themselves benefiting or hurting from globalization depending on whether the stage the worker operated in was boosted in competitiveness from offshore, or if that stage itself was offshored.

Unlike the beginning of first unbundling, where the industrialization of the north was increasing wealth and wages within these nations, the second unbundling, in which low communication costs emerged, combines technology developed in one country with cheap labor force from another country. Thus, the former wage equilibrium process, where international wage gaps adjusted to international differences in technology, is partly disrupted since new technology no longer exclusively benefits the nation inventing it. The results of the second unbundling are a more polarized workforce where the high-skilled are benefiting, while

the middle-skilled face challenges from offshoring, and the low-skilled are surviving (Baldwin, 2016).

3.4.4 Effect of International trade

Since the trade theory introduced the comparative advantage developed by David Ricardo, most economists agree that trade leads to rising standards of living in countries involved in trade. According to this trade theory, every country has a certain comparative advantage arising through natural resources or differences in technology. Comparative advantage is measured in the alternative cost to the production of a good compared to this relative cost in other countries (Norman & Orvedal, 2010). The alternative cost is how many units of a good one must forego in order to produce other goods. This price relation is affected by variables in both the supply and demand sides of the economy. Countries should concentrate on the production of goods they are relatively better equipped to produce compared to other countries. Trying to produce every good needed within a country would waste input factors, as other countries are more efficient in producing certain goods. Trade leads to improved allocation of resources as well as higher competition. As a consequence, the overall welfare of a state is increasing and with that the standard of living.



Graph 3 / Source: (Norman & Orvedal, 2010)

The gains of trade are illustrated graphically in the figure above (see graph 3). Here the production is separated from consumption and the competitive advantages are exploited. An economy moves from being an autarky *A* producing two goods x_1,x_2 that consumes the

equivalent to these c_1,c_2, to participate in the world trade *G*. When joining the world trade the economy is facing a different budget constraint $(p_1,p_2)^G$ versus $(p_1,p_2)^A$. When optimizing utility, the economy will restructure the production of goods to the point where the new budget constraint line is tangent to the curve of possible production. The economy will adapt production of goods according to their competitive advantage, thereby moving production from point A to point B. Possible consumption is expanded from the original point A to C. The higher level of utility achieved in point C compared to point D, which denotes the benefit of a production mix exploiting the economies' comparative advantages.

However, it should be mentioned that it is empirically shown that to a large extent international trade is not exchanging as many different types of goods as expected following Ricardo's presentation of trade. Often the same types of goods are traded, although representing different brands. Thus, product differentiation, imperfect competition, and economies of scale are relevant in theory of trade in addition to the comparative advantage theory (Norman & Orvedal, 2010).

Since its arrival in the 20th century, the Heckscher-Ohlin model became a leading model within trade implying that countries should always export products that are heavily dependent on a factor that the country is abundantly supplied with. While Ricardo focuses on the gains of trade due to different production possibilities in countries, Heckscher-Ohlin attributes this theory by including the context of a country's initial endowments (hereafter factors) and international trade (Norman & Orvedal, 2010).

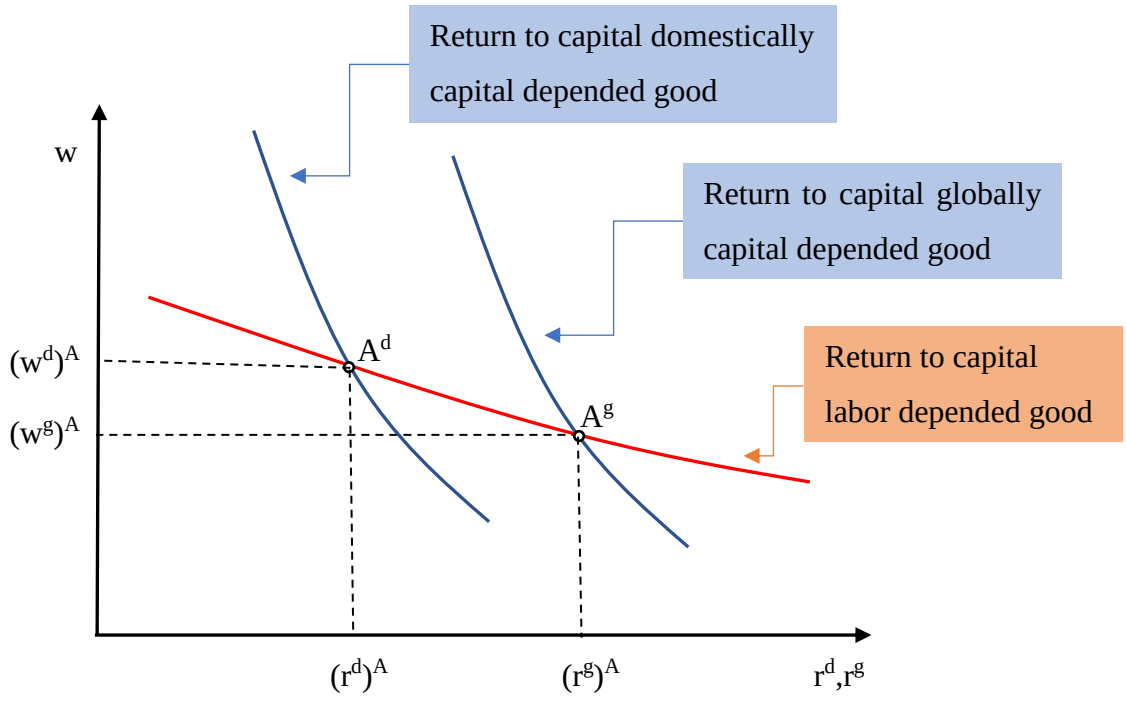
The simplest form of this theory looks at two countries (domestic=*d,* global=*g*) trading two goods (capital depended=*1*, labor depended=*2*) with international given prices p_i^f and without transaction costs. The goods are produced by two factors, capital *K* and labor *L*, which are not available to purchase on the international market but are transferable among sectors within the country. The prices of the factors are w^d, r^d and w^g, r^g. Additionally, the model assumes an equal production technology in the countries, as well as identical demand curves, constant return to scale and perfect competition. What essentially differs between the countries is the access to these production factors, hence the impact of accessibility to factors of production is the fundament of the theory.

The questions intended to answer is first; the impact of relative accessibility to factors of production and trade, and second; the impact of trade on prices among the factors. The theory

and its result are presented illustratively. First in a figure that reveals different autarky prices (autarky price=*A*) in factors and consequently the countries' comparative advantages. Second, the factor equalization theorem is shown, where long-term equilibrium is given by equal prices in factors between the countries, assuming free trade.

The simple form of the Heckscher-Ohlin model (the 2*2 edition) is not applicable for all countries, though for Norway it is. Norway is richly abundant in real capital per workplace. Following the reasoning of the model, the expected outcome for Norway is exports of goods dependent on capital and imports of goods dependent on labor, which is exactly the case.

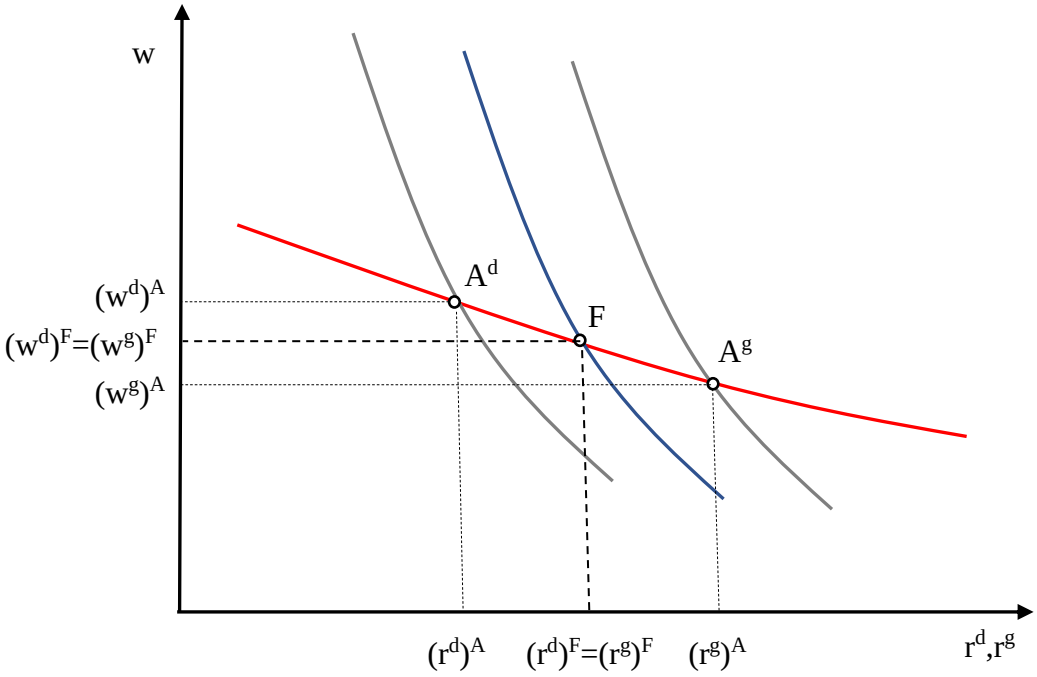
When comparing countries that have different relative prices for the factors the price of capital is set equal to 1 in both countries in order to identify the relative prices of the factors. The country with the lower autarky price of the capital dependent good (Norway), has a comparative advantage in the production of this good. This means lower return to capital and higher wages in Norway compared to other countries globally. This is illustrated in the figure below that identifies factor prices and thereby the countries competitive advantage (see graph 4).



Graph 4 / Source: (Norman & Orvedal, 2010)

Trade between countries encourages the transfer of resources to the production of the good in which the country has a comparative advantage. In Norway resources will be transferred to the production of good 1, leading to a shortage in capital, thus making capital relatively more

expensive. This outcome is described in the Stolper-Samuelsom theorem, which predicts that increasing price of a good leads to increasing price of the most dependent factor in production, which in turn exceeds the percentage increase in the price of the good and thus reduces the price of other factors in production. Trade is in this way smoothening the differences in factor prices between countries.



Graph 5 / Source: (Norman & Orvedal, 2010)

When considering all the assumptions in the Heckscher-Ohlin theory, the prices of the production factors will become equal (see point F), and the comparative advantages are then fully exploited. In the illustration the price of good 2 is held constant and is equal for the countries in autarky and free trade (see graph 5). Thus, for the given price, the return on capital curve for good 2 is constant. What varies is following the return on capital on good 1, that differs in the country's autarky price and the free trade price. This price is lower in Norway, which is a capital abundant country. Trade will continue until the prices on good 1 are equal in the countries, and the countries have equal prices of factors, meaning equal return on capital. The factor price equalization theorem implies that reducing differences in wages between countries can be achieved through outsourcing, transfer of technology and trade or alternatively through migration from developing to industrialized countries.

The expected result of an industry becoming more worldwide competitive is lower wages and smaller wage differences across countries. Thus, free trade may trigger redistributive effects

within countries and equalizing effects across countries as presented in the Heckscher-Ohlin model. The subsequent result would be a relative decrease (increase) in the supply of an abundant (scarce) labor force, which would result in an increase (decrease) in wages. “This leads to a convergence in labor costs across countries” (Slaughter & Swagel, 1997, p. 9). However, the theoretical concept of wage convergence is under constrictive assumptions limiting this outcome in practice.

There is a discussion of whether international trade actually incite income inequality, as opposed to previously discussed findings. Approaches to evaluate this question are to either look at the price of imports and evaluate if this is reducing the price of products and therefore lowering wages or using the number of imports to measure the degree of competition. The findings from research on the topic indicate that the impact of international trade on wages and inequality is actually modest. A plausible reason for this could be that due to non-tariff barriers, such as voluntary export restraints for steel and cars, the international markets are not especially more open to trade although tariffs otherwise have been reduced. Also, the combination of produced goods/services in advanced economies might have been evolved to higher value-added goods. In this way, the effect of prices on imports may present less of a competition. Globalization seems to increase overall welfare in nations across the world. Still, there are some “winners” and “losers” in which some groups of workers are displaced and face adjustment cost in reallocation and loss of industry/firm-specific knowledge (Slaughter & Swagel, 1997).

4. Data

To proceed with our analysis, we used wage data from the databases of Statistics Norway (SSB). To work with comparable wages, we used nominal wages per man-hour which are calculated by dividing the total sum of wages through full-time equivalent employment. Wages are here defined as gross cash payments from the employer to the employee for work that is rendered excluding insurance and non-taxable expense allowances. This also includes extra payments such as bonuses, variable payments etc. Both needed data series were obtained through the wage database of the national accounts of Norway. SSB should be the most reliable source of aggregate data for the whole economy. We extracted annual data for the years between 1970 and 2016. This time period was chosen due to data availability. The following sectors were analyzed: Agriculture and forestry (referred to as agriculture); fishing and aquaculture (fishing); manufacturing; construction; transport activities excluding ocean transport (transport); accommodation and food service activities (hotel and food services); financial and insurance activities (financial services); public administration and defense; health and social work (health services). We concentrate on these sectors due to their size and relevance for the Norwegian economy, as these cover more than 50% of the total employment (Statistics Norway, 2019).

We work with real wage data to get an indicator for the standard of living resulting from workers' earnings. Therefore, we deflated the time series with the annual average of the consumer price index (CPI) from 1970 until 2016 and analyzed real wages in 2015 prices. Prices are defined as retail prices of goods and services including indirect taxes, fees, and subsidies. The consumer prices index displays the price of a consumer basket that is formed by the weighted combination of a large variety of goods and services. The CPI is published by SSB on a monthly basis and is normalized to 100 for the base year 2015.

Additional, detailed wage data was retrieved specifically for the financial sector from the wage database of SSB. We use average monthly earnings for full-time employees in financial intermediation divided into basic monthly salary, variable additional allowances, bonuses and overtime payment, starting in 2000. Full-time employees are all employees working in a 100% position. The basic salary is defined as the regular basic wage paid to the employee on a regular basis. Variable allowances cover certain extra payments for working evenings and nights, call-outs, shifts, offshore or other irregular allowances. Overtime work is compensation for working beyond contractual working hours. Bonuses are payments that are not connected with

specific duties and occur irregularly. One example of bonuses is profit sharing with the employee.

Labor productivity was also collected from the Norwegian national accounts as value added at basic values per hour worked in fixed prices from 1970 until 2016. Here labor productivity is displayed as the ratio between the volume of produced output as value added and an input measure such as hours worked. Value added is the value increase of an article at each stage of production excluding the initial costs.

Data on immigration was obtained from the SSB migration database as net migration (immigration – emigration) from 1998 until 2012 from all countries that became new members of the EU in 2014 (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia) plus Turkey. An immigrant is here defined as persons who were born abroad by two foreign-born parents and four-foreign born grandparents and have chosen to come to Norway with the purpose of living there permanently.

Trade data was used from the SSB trade database including total exports and imports from and to Norway from 1970 to 2016 in NOK millions. Imports are all foreign-manufactured goods that are entering Norway, including re-importation of Norwegian produced and processed goods. Exports, on the other hand, are all domestically produced goods that are leaving the Norwegian statistical territory. Included are also re-exports of foreign-produced and processed goods.

Data for skill levels was handled by applying the educational attainment database from SSB, which is breaking down the population's education from 1980 to 2017 by four different categories defined by the Norwegian Standard Classification of Education. Basic school level education is achieved after completing the compulsory education of 10 years in Norway. Upper secondary education is reached after fulfilling a total of 12 years of education, while tertiary education is including education through college or university. Within tertiary education, we distinguished between tertiary education short (less than 4 years) and long (equal or more than 4 years).

To compare our findings internationally, we used wage data for the UK as not seasonally adjusted average weekly earnings in pounds from 2000 to 2018 retrieved from the Office for National Statistics (ONS). The ONS obtains the data from the Annual Survey of Hours and Earnings (ASHE) as well as the Labour Force Survey. We deflated the wage series with the

UK consumer price index also retrieved from ONS with the base year 2015. Additionally, we compared our findings to developments in the USA by using average hourly earnings of production and nonsupervisory employees provided by the Bureau for Labor Statistics (BLS). The data is on a monthly basis from 1990 to 2018. The wage data was deflated by the U.S. consumer price index for all urban consumers with the base year 2015.

5. Convergence testing

The economic development in Norway since 1970 was outstanding in the international context. Up until 2016 real GDP per capita increased continuously by more than 280%, only interrupted by economic downturns in 1987 and 2007 due to financial crises. The positive progress was also to the advantage of the Norwegian workers that enjoyed substantial real wage increase. In general, the real wages in Norway had a positive long-run development, as did the GDP per capita growth. As a consequence, the improvement of standard of living have been substantial over the last 50 years. Only the occasional recessions led to temporary downward movements of wages. This development was relevant for all sectors, with an average real wage that increased by 127% between 1970 and 2016. However, the wage increases have differed in magnitude. Not all sectors profited equally from the strong economic development in Norway over the last decades.

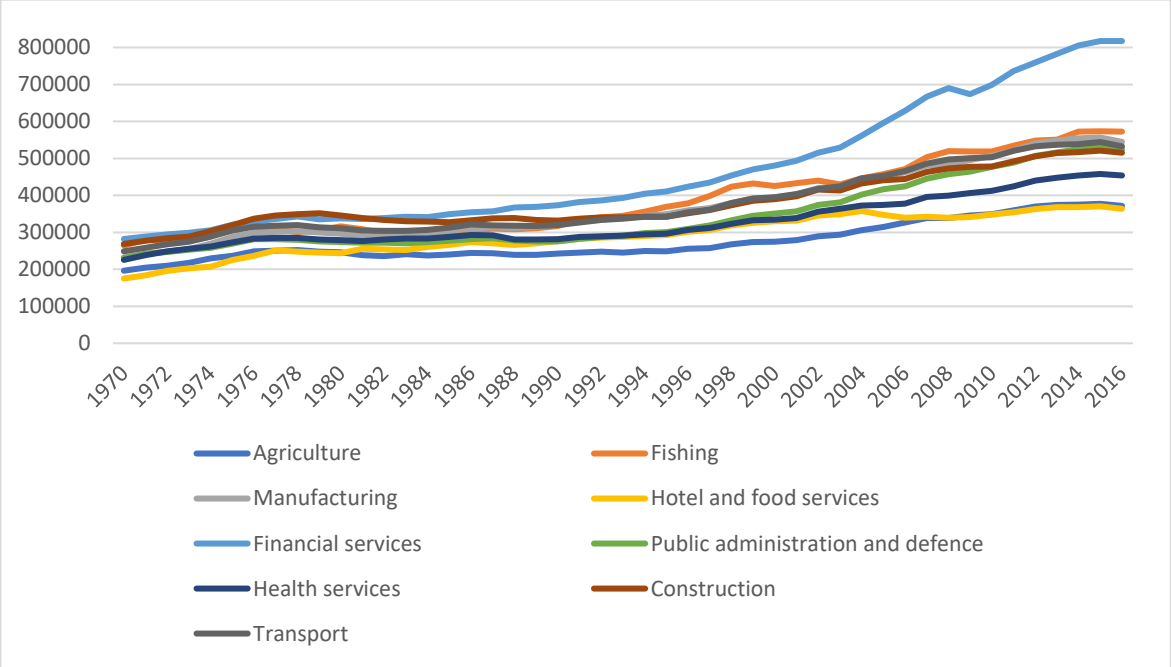


Figure 1: Real wage per man-hour development in Norway, by industry (2015 prices). Source: SSB, own calculations

By far the strongest real wage development can be seen in the financial sector. Wages in this sector accelerated especially in the 2000s, with only a small interruption stemming from the financial crisis in 2007/2008.Thus, this sector have been the clear winner in wage developments over the last decades (see Figure 1). Not only did the financial sector already

have the highest wages at the beginning of our time frame in 1970, but it has also experienced the highest increase of wages since then (see Table 1).

Sector	**Real wage growth 1970-2016**
Financial services	189%
Manufacturing	134%
Public administration and defense	127%
Fishing	116%
Construction	113%
Hotel and food services	107%
Health services	101%
Agriculture	97%
Transport	91%

Table 1: Real wage growth 1970-2016, by sector. Source: SSB, own calculations

Other sectors that have been subject to a high increase of real wages include the manufacturing sector, public administration and defense. These sectors also had relatively high initial wage levels in 1970, in contrast to for example the hotel and food service sector. From the beginning of our time frame these sectors started with the lowest initial wage levels and since then they have also had one of the weakest wage developments. The same is true for the other two "losers" of our wage development ranking: the health sector and the agriculture sector. Both were placed among the lowest initial wage levels in 1970 and have also seen the lowest real wage growth.

From these results we can hypothesize that there have been considerable divergences in the wage formations between different sectors. Initially already high paid jobs could further increase their wages in a strong manner, while low paid jobs struggled to keep up and

experienced the lowest of all real wage growths. To help the analysis of divergence and convergence we look at beta and sigma convergence of wages between the discussed sectors.

5.1 Convergence

5.1.1 Sigma convergence

We are starting our examination of wage convergence by looking at the sigma convergence. While this concept is often used to investigate the convergence of real GDP per capita between countries, we can apply this to our research question of convergence between sector wages within a country. Sigma convergence is, as explained in chapter 3.3.4, looking at the wage dispersion, assuming convergence in wages when the standard deviation of wages is decreasing over time.

(23) $$\sigma_{year} > \sigma_{year+1}$$

Visa versa is a divergence assumed when the standard deviation is increasing over time. We apply the relative standard deviation due to our concern of wages being higher at the endpoint in absolute terms. The standard deviation is thus divided by the mean and multiplied by 100. When the standard deviation decreases the sigma decreases accordingly, meaning a narrowing of wage differences between sectors over time. We also extended our dataset by more sectors[1] such that we analyze the sigma and beta convergence since 1970 in over 20 sectors in Norway. The extension is based on the need for more observations in our statistical analysis and a desire to get a more comprehensive overview of the various sectors relevant for Norway.

In our analysis, we include a Hodrick-Prescott-Filter (HP-filter) to obtain the smoothed trend of the standard deviation. The HP-filter is minimizing the distance to the raw series as well as fluctuations around itself with the following formula:

(24) $$\sum_{t=1}^{T}(s_t - g_t)^2 + \lambda \sum_{t=1}^{T}((g_{t+1} - g_t) - (g_t - g_{t-1}))^2$$

[1] Newly added sectors are mining and quarrying; electricity; gas and steam; water supply; sewerage; waste, wholesale and retail trade; repair of motor vehicles; postal and courier activities; information and communication; real estate activities; professional, scientific and technical activities; administrative and support service activities; education; arts; entertainment and other service activities

with **s** being the standard deviation of wages and g being the trend. For our analysis, we use $\lambda = 100$, a filter commonly applied when handling annual data.

When looking at the development of the standard deviation of sector wages in Norway we find a clear two-sided development of wage convergence since 1970 (see Figure 2).

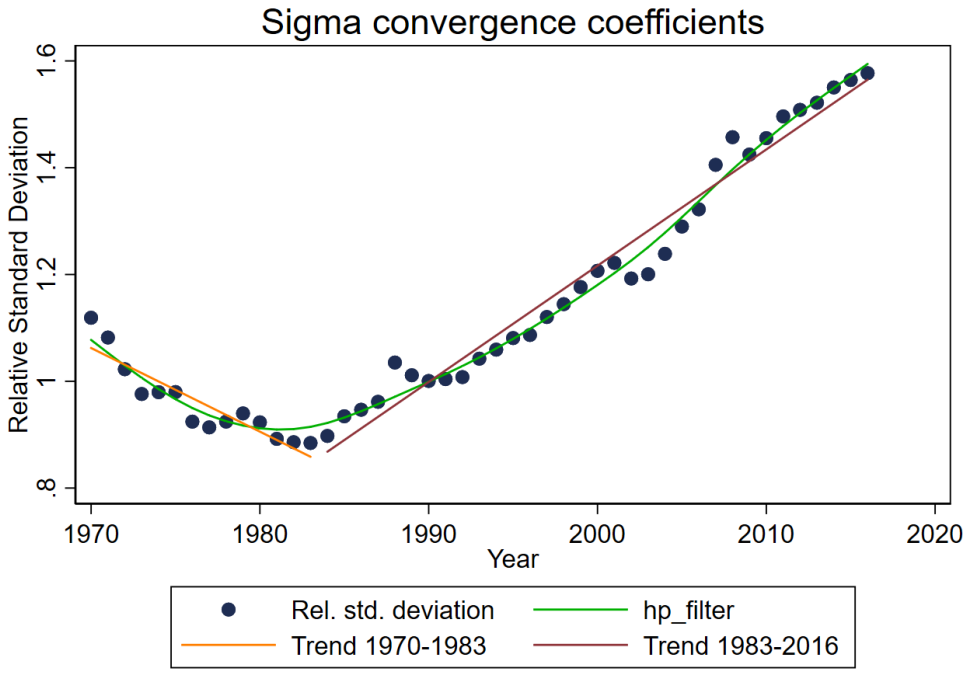


Figure 2: Sigma convergence between sectors in Norway 1970-2016. Source: SSB, own calculations

Form 1970 until 1983 we see a clear negative development of the relative standard deviation displayed by the negative trend line. The decrease seen in Figure 2 is indicating a convergence between sector wages within these years. After 1983 however, there was a steep increase in the wage standard deviation, and we note a curious hike in standard deviation in 1987. This trend was only interrupted by a slight decrease at the beginning of the 2000s and in the aftermath of the financial crisis. Today we can observe a record high standard deviation, amounting to almost double the level of its trough in 1983.

We then calculated the deviation of the relative standard deviation from the HP-filter trend:

$$trend_{deviation_{year}} = ln(relative\_standard\_deviation_{year} - ln(hp\_filter\_trend_{year}) \quad (25)$$

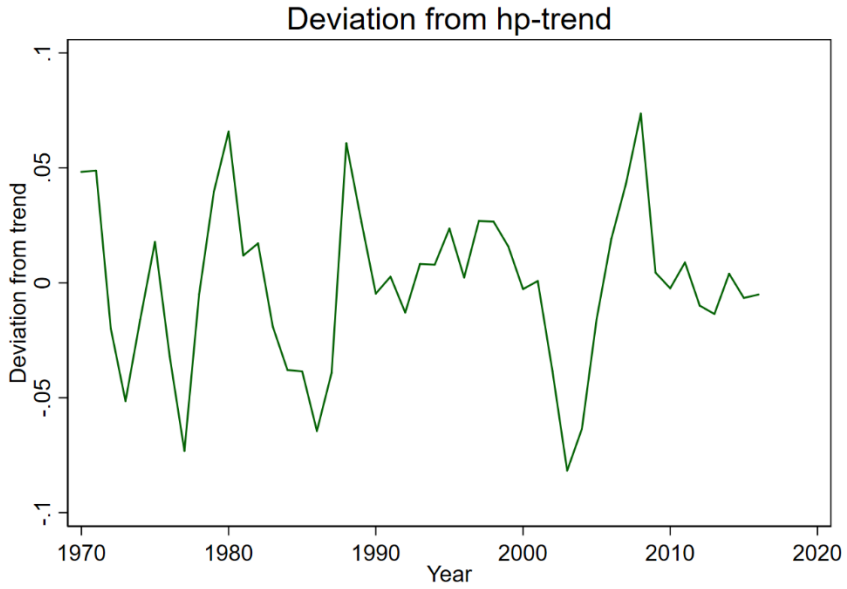


Figure 3: Deviation from the trend. Source: SSB, own calculations

Figure 3 clearly highlights the different periods of wage convergence and divergence in our sample. Especially notable here is the time period in the beginning of the 2000s, where a strong negative deviation from the trend turned into a strong positive deviation from the trend. This reflects the strong divergence in wages in this time after a short convergence of wages in 2003.

We also run the following regressions to test our hypothesis that there has been an overall divergence in wages that is split in a smaller convergence and divergence time period:

(26) $$relative\_standard\_deviation_{year} = \alpha_0 = \alpha_0 + \alpha_1 * year_{year} + \varepsilon_{year}$$

Sigma convergence coefficients

	(1) Convergence_1970-2016	(2) Convergence_1970-1983	(3) Convergence_1983-2016
Year	0.0140***	-0.0167***	0.0216***
	(0.00113)	(0.00231)	(0.000687)
Constant	-26.67***	33.88***	-41.94***
	(2.243)	(4.557)	(1.374)
Observations	47	13	34
R^2	0.774	0.826	0.969

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table 2: Sigma convergence, by time period. Source: SSB, own calculations

Looking at the coefficients in Table 2 we see that our hypothesis postulated by the graphical analysis still holds when running regressions accordingly. Column 1 shows the correlation

between the standard deviation over time during the time span from 1970 to 2016. We see a highly significant (on the 1% level) and positive coefficient, showing that overall the standard deviation increased over our sample period, indicating a clear divergence in wages. We also see the above-mentioned opposing trends depended on the time period. Until 1983 there has been a negative and significant trend of the standard deviation (column 2), indicating wage convergence in that time. Since then there has been a positive and significant trend (column 3), indicating the opposite, namely wage divergence. Our models also have a relatively high explanatory power with R^2 being consistently larger than 0.7. The regression results for the later time period starting in 1983 even shows an R^2 of 0.969, hence an exceptionally high explanatory power.

Overall, when considering the full time span looking at the graphical and the econometrical analysis, we may unequivocally conclude that there has been a clear divergence in sector wages in Norway since 1970. The divergence is notably split in two time periods, in which wage convergence occurred until 1983 and wage divergence since then.

5.1.2 Beta convergence

The concept of beta convergence is widely used to detect convergence between wages, real GDP per capita and other macroeconomic measures in the context of the convergence theory, often in combination with sigma convergence. A negative correlation between the initial wage and its average growth rate indicates beta convergence, meaning a higher starting point in wages is resulting in a less rapid growth.

In order to calculate beta convergence, we first calculate the average annual growth rate by regressing the log-transformed wages on the year:

$$ln\_wage_{sector,year} = \delta_0 + \delta_1 * year_{year} + \upsilon_{sector,year} \quad (27)$$

The α_1-coefficient gives us the average annual growth rate of wages in the different sectors. In the next step, we obtain the β-convergence coefficient by regressing the wage growth on the initial wage in 1970:

$$wage\_growth_{sector} = \beta_0 + \beta_1 * inital\_wage\_in\_1970_{sector} + \tau_{sector} \quad (28)$$

A β_1-coefficient <0 indicates beta convergence, while a coefficient >0 suggests a divergence of wages. The regression results we obtain confirm our hypothesis of wage divergence

between different sectors in Norway since 1970 (see Table 3).

Beta convergence coefficients

	(1) Convergence_1970-2016	(2) Convergence_1970-1983	(3) Convergence_1983-2016
Ln_Wage_1970	0.00852*	-0.0190**	
	(0.00466)	(0.00665)	
Ln_Wage_1983			0.0187***
			(0.00553)
Constant	-0.0894	0.251***	-0.211***
	(0.0578)	(0.0824)	(0.0686)
Observations	20	20	20
R^2	0.157	0.313	0.387

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table 3: Beta convergence, by time period. Source: SSB, own calculations

Similar to the results for sigma convergence we observe an overall divergence in wages over the full time span due to a β_1-coefficient that is larger than 0, which is statistically significant on the 10% level. Wage convergence can be seen between 1970 and 1983, which coincides with the results for sigma convergence in the same period. In column 2 we see a negative and significant (on the 5% level) coefficient indicating divergence of wages during the first years. After 1983 we can see that wages diverged strongly. We obtain a positive and highly significant (on the 1% level) β_1-coefficient indicating the divergence (see column 3).

The graphical analysis further confirms our assumption of wage divergence between sectors in Norway (see Figure 4).

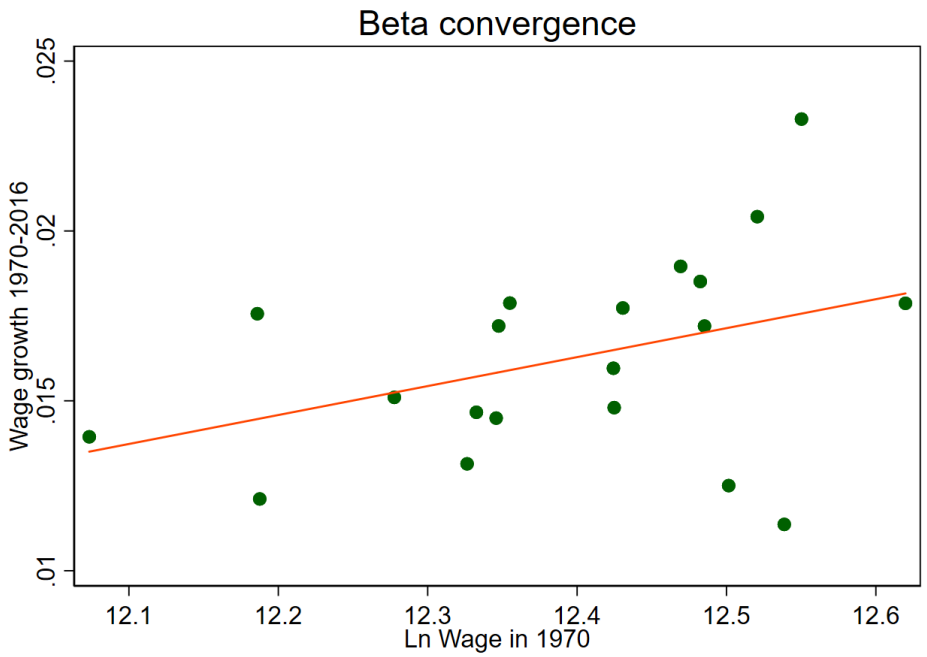


Figure 4: Beta convergence between sectors in Norway 1970-2016. Source: SSB, own calculations

When adding a trend line, we see a positive correlation between the initial wage in 1970 and the average annual wage growth. These findings also confirm our statement from chapter 5.1: The lower the initial wage in 1970, the lower the wage growth since then. This leads to divergence in wages. Note that the graphical analysis so far just looked at the overall development over the whole time span. We may divide the sample in two time periods to observe certain differences in divergence depending on the time.

Similar to our regression results we see that only looking at the full sample does not tell the whole truth. The graph showing the relationship between the initial wage and wage growth from 1970 to 1983 reveals a convergence in wages in this time period (see Figure 5). A negatively sloped trend line proves this point. After 1983 however, we see a clearly positively sloped trend line indicating divergence of wages until today.

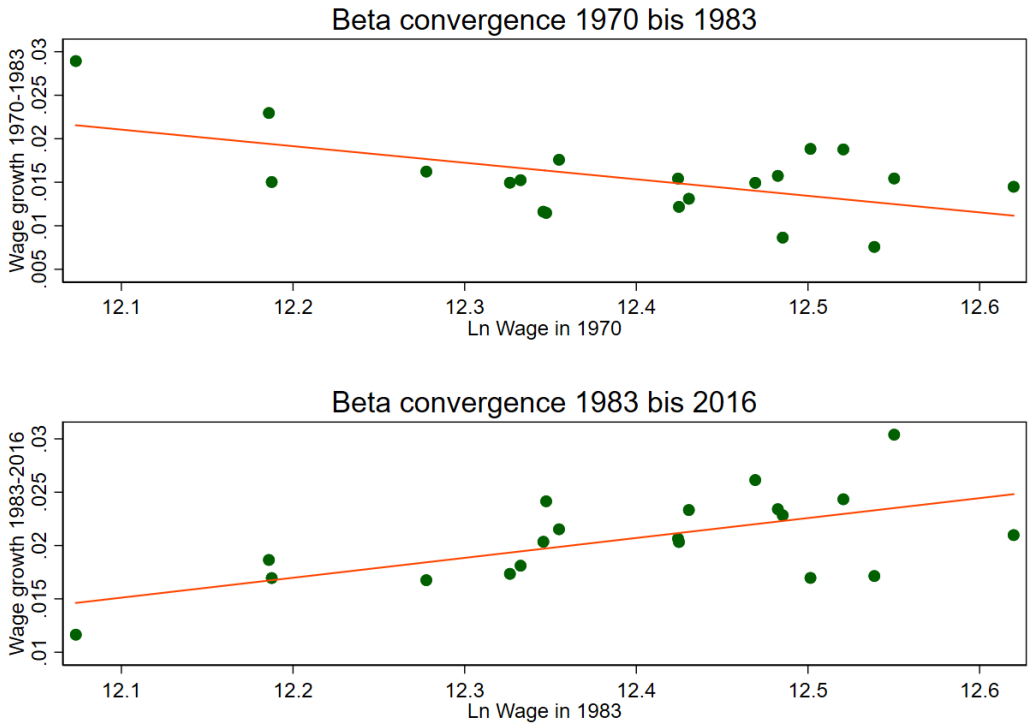


Figure 5: Beta convergence between sector in Norway, by time period. Source: SSB, own calculations

This leaves us with the conclusion that Norway experienced a clear divergence in wages during the last decades. We confirmed this hypothesis by using econometrical and graphical analysis based on sigma- and beta convergence. All measures show the same picture of overall diverging wages that can be divided into two relevant time periods. One convergence period from 1970 to 1983 and one, stronger divergence period from 1983 to 2016. The latter dominates the former, thus leading to overall divergence in wages from 1970 to 2016.

To further improve our concluding remarks, we make use of an alternative measure, the so-called Gini coefficient, to investigate divergence developments of wages in Norway.

5.2 Gini coefficient

The Gini coefficient is a widely used and well-known inequality measure that was invented and published by Corrado Gini in 1912. It is displaying inequality on a range between 0, meaning perfect equality (= every sector has the same wages), to 1 perfect inequality (= one sector has all the wages). Hence, the closer the coefficient is to 0, the more equal the distribution of e.g. wages is. While the Gini coefficient is normally used to measure the

inequality between individuals of a certain population, it can also be employed to measure inequality between different sectors. The coefficient is calculated in the following way:

$$G = \frac{1}{n}(n + 1 - 2\frac{\sum_{i=1}^{n}(n + 1 - i)y_i}{\sum_{i=1}^{n} y_i}) \quad (29)$$

G represents the Gini coefficient with *i = 1* to *n* sectors indexed in non-decreasing order with wage *yi < yi+1*. This measure takes all differences between all wages and totals the absolute difference. The advantage of the Gini coefficient is its simplicity and comparability across different samples, as well as its utility for intertemporal analysis (Farris, 2010). Furthermore, it satisfies the "four Dalton principles" which are:

- Anonymity principle: It does not matter which sector has high or low wages, it only matters how large the differences are
- Relative income principle: It does not care about the absolute value of the wages
- Population principle: The size of the sectors does not matter
- Transfer principle: Income redistribution from a richer sector to a poorer sector leads to a more equal distribution

We use the measure to calculate the inequality between different professions. In this case, a Gini coefficient of 1 would suggest that one sector is collecting all earnings. In order to detect certain divergence or convergence in our data, we look at the development of the Gini coefficient over the full time span.

5.3 Divergence or Convergence based on Gini coefficients

Divergence or convergence can be discussed in the light of increasing or decreasing inequality. When the inequality of wages between different sectors increases over time, we can assume a diverging wage path, while the opposite is true for decreasing inequality. Hence, with Gini coefficients as an inequality measure, we may indirectly address the core question of this thesis: Have the real wages between professions in Norway diverged from each other or converged between 1970 and 2016? For this purpose, we look at the development of Gini coefficients between 1970 and 2016. We note a divided development in two periods in which inequality went in different directions.

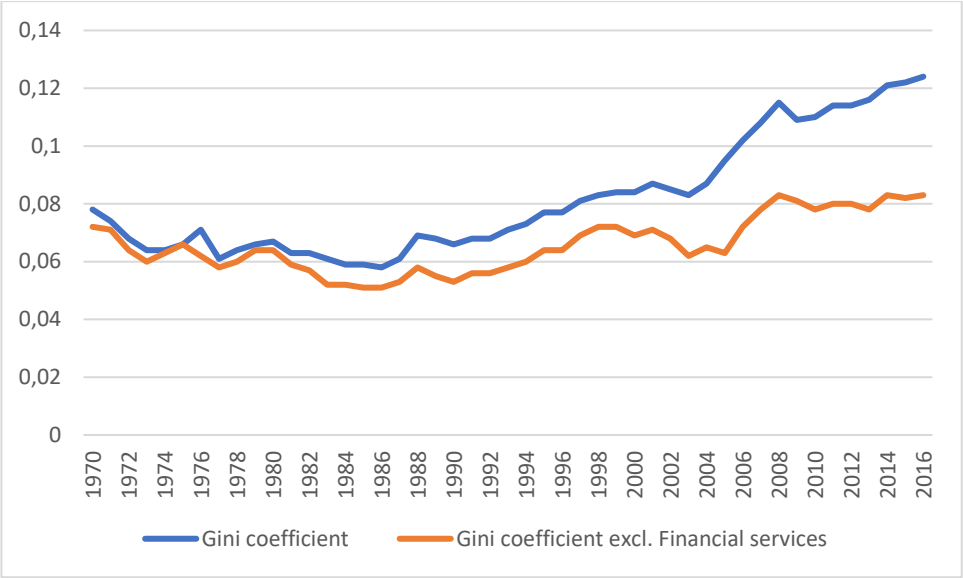


Figure 6: Development of the Gini coefficients between selected sectors in Norway. Source: SSB, own calculations

As can be seen in Figure 6, the wage development in the 1970s was rather "narrow". Differences between professions were low and decreased further during the 1970s until the mid-1980s. Since then, the gap started to widen continuously until 2016, as the Gini coefficient evolved from 0.06 to more than 0.12. It should be said that the general inequality between professions in Norway is rather low when looking at the figures. Even though inequality has increased, the coefficient remains close to 0, which indicates a fairly equal distribution.

The primary source for inequality and the widening gap between sectors may be found in the financial sector. Without this sector, the initial inequality in 1970 would have been slightly lower with a Gini coefficient of 0.078 with the financial sector and 0.072 without. More importantly, the rise in inequality over time would have been less drastic if it would not have been for the financial sector. Overall inequality rose to a maximum of 0.124 in 2016, while inequality would have risen to 0.083 without the financial sector.

However, from the mid-1980s and onward inequality also increased without the financial sector, and was only interrupted by economic crises. The burst of the dot-com bubble in the beginning of the 2000 and the subsequent short downturn of the Norwegian economy represented one such crisis. Later, the financial crisis in 2008 decreased overall inequality for a short period of time, before it rose again. In contrast, the inequality without the financial sector remained fairly stable after the financial crisis and has not been exceeding its pre-crisis

inequality level until 2016. This development shows that financial sector wages increased strongly as soon as the crisis was overcome.

After the usage of sigma and beta convergence as well as Gini coefficients we can conclude that the hypothesis of diverging wages made in chapter 4 can be seen as confirmed Since the mid-1980s wages diverged driven by strong real wage growth in some sectors like the financial sector, while other sectors were left behind, such as the hotel and food service sectors.

Wages are mostly determined by demand and supply of labor, similar to normal goods. Hence, in the next chapters we are looking at factors that affect either the demand side, the supply side or both sides of wages and wage formation in Norway. We analyzed productivity and immigration as factors that affect the supply side of labor, the financial sector, trade, the public sector, and how skill-biased technological change affects the labor demand side. Finally, we look at policies affecting wages, more specifically the impact of labor unions.

Please note that some factors determine both the supply and demand side of labor (for instance trade). In these cases, we decided on one dominating side in order to be able to categorize the factors.

6. Supply factors

6.1 Productivity in Norway

Growth rates of labor productivity differ widely across sectors. Some industries are characterized by high productivity growth (like the manufacturing industry) while others suffer from lower productivity growth, like many service sector industries. This is similar in most countries and has to do with specific characteristics such as labor intensity or exposure to international competition. Norway is no exception.

Norway has been regarded as a highly productive country with a high standard of living and prosperous economy in its modern times. According to the OECD, Norway has over the last decades had the highest overall labor productivity of all OECD countries, accompanied by high growth (OECD, 2016). But does that mean that every single sector and industry in Norway operates on a high productivity level and experiences high growth?

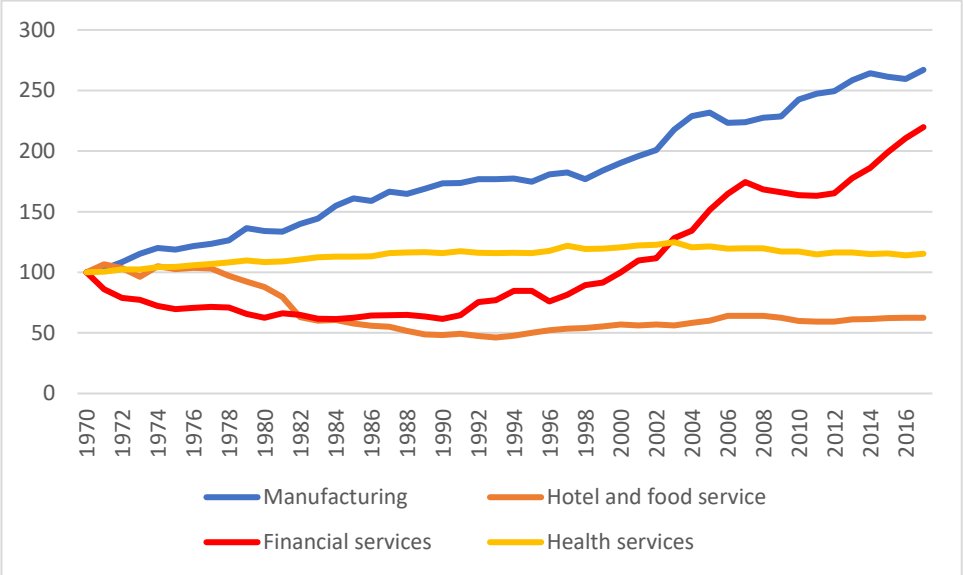


Figure 7: Productivity growth in Norway in selected sectors (1970 = 100). Source: SSB, own calculations

As we can see in Figure 7 the productivity development in selected sectors is in line with international developments. The manufacturing sector shows a strong productivity growth, while the hotel and health sectors experienced low, or even negative productivity development. Development of productivity can explain a large part of wage divergence in

Norway between these sectors over the last 45 years and can be seen when we look at the wage development in the same time span (see Figure 8).

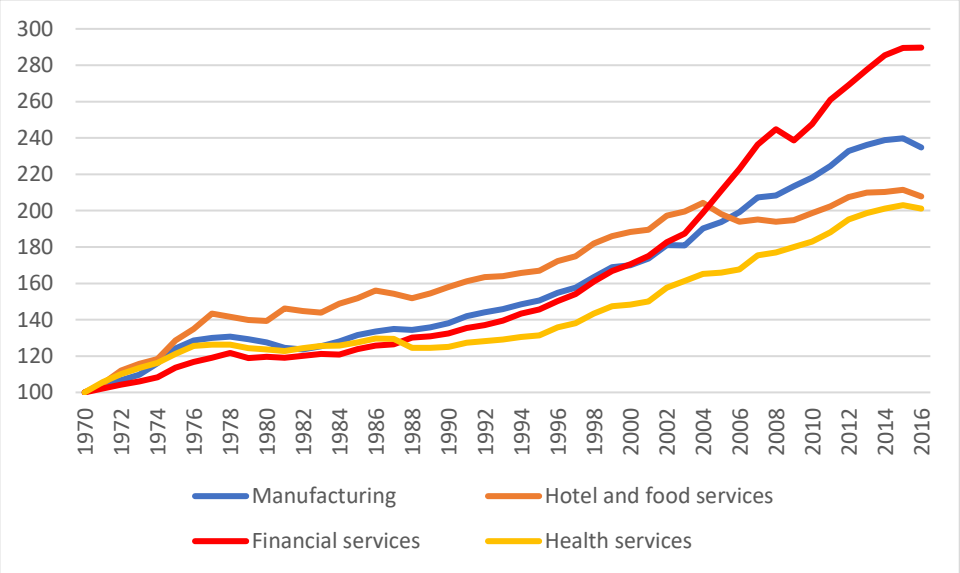


Figure 8: Real wage development in Norway in selected sectors (1970 = 100). Source: SSB, own calculations

Wages developed the strongest in sectors with high productivity growth like the manufacturing sector and the financial sector (especially starting in 2000), while the hotel and health industry experienced lower wage growth. The underlying causes for different developments in productivity and consequently wages will be discussed in the following chapters.

Productivity in the manufacturing sector

One major driver of relatively high productivity in the manufacturing sector is the intensity of research and development. While R&D investments in Norway are relatively low compared to other countries, there are large differences in R&D investments between sectors in Norway. In Norway the manufacturing sector has the highest share of total R&D investments (Foyn, 2017). The reason for this is the capital intensity that spurs R&D investments in order to improve productivity in the production process, either through newer and better machines, or to create completely new products.

Competition in the manufacturing sector is tough, not only domestically but also internationally. This leads to an additional factor in explaining the positive productivity development in the manufacturing sector. In order to keep up with and possibly beat the competitors, companies in this sector is pressured to work more productive and innovate. A

large share of the products manufactured in Norway is exported, and consequently in fierce competition with products from the world market. Especially a high wage country like Norway needs to continuously improve their competitiveness to not lose ground against low wage countries. In high wage countries, the higher the competition, the higher the need for increasing productivity to keep costs at a reasonable level.

Productivity in the financial sector

The financial sector experienced a completely different productivity development when compared to the manufacturing sector, depending on the time period. Productivity in the financial sector was declining by 40% between 1970 and 1990. However, since the 1990s the productivity in this sector accelerated and experienced the highest growth rates of the sectors examined in this thesis. Labor productivity increased by nearly 360% between 1990 and 2016. One of the supporting factors for this was the consolidations after the banking crisis that led to efficiency improvements and increasing usage of ICT (Hagelund, 2009). Increasing efficiency of information exchange in electronic networks and automation may be seen as the main driver of the accelerating productivity gains (Chauhan, 2018). How sensitive the productivity development in the financial sector reacted to the financial crisis can be seen after 2007, where productivity growth was negative for the first time since the mid1990s. However, the shock was quickly overcome, and the positive development continued just a few years later.

Another factor for the improved productivity could have been increasing R&D investments in the financial sector. Since 1999 the R&D expenditures in this sector quadrupled from around 250 million NOK to close to 1 billion NOK (Foyn, 2017).

Productivity in the health sector

The health care sector has significantly lower productivity growth than many other sectors. Over the last decades the growth in productivity has been rather flat, with an average annual productivity gain of just 0.3%. There are several underlying factors that explain this development. Some research indicates that the health care sector is inherently incapable of reaching the same productivity growth rates as other sectors. This is mainly due to the high labor intensity of the sector. High labor intensity limits the ability of efficiency gains and in turn the productivity.

Other research suggests that productivity in the health sector is not actually lower than in other sectors, it is simply improperly measured. In order to calculate the productivity, many measures exclusively look at quantitative values. The output is often measured through spending adjusted for inflation, which does not account for improvements in quality. Hence, a situation where the quality of the health care sector is improving significantly, but is not included in the productivity measure, could thus lead to low productivity growth. Studies accounting for quality improvements find significantly higher growth rates in health care productivity. This has also been true for the Norwegian health system, partly due to a large ownership reform in 2002 (Anthun, 2017).

Independently from the fact that productivity measures in the health care sector might (or might not) be misleading, the potential for efficiency gains in this sector is large. Telemedicine, individualized treatments, artificial intelligence, waste reduction, new payment methods are likely to lead the way to improvements in both the quantity and the quality of health care, and thereby overall improvements in productivity (Bourla, 2018; Sheiner, L., Malinovskaya, A., 2016).

Productivity in the hotel sector

The hotel sector is part of the service sector, which has traditionally had a flatter productivity development than the manufacturing sector (McMahon, 1994). Moreover, the hotel sector shows the weakest development of all investigated sectors. Between the late 1970s and the late 1980s productivity dropped sharply and never truly recovered. This sector is, like the health care sector, a very labor-intensive sector. 30% of the industry's revenues are spent on salaries, compared with 14% for Norwegian businesses as a whole (Ministry of Trade and Industry, 2012). The hotel sector is highly depended on Norway as a tourist attraction. The drop in productivity stopped around 1990 when the number of arrivals in Norwegian hotels started to increase strongly. From then on the productivity developed slightly positive in line with the strong development in arrivals number in subsequent years (see Figure 9). However, growth rates remained still lower than in other sectors.

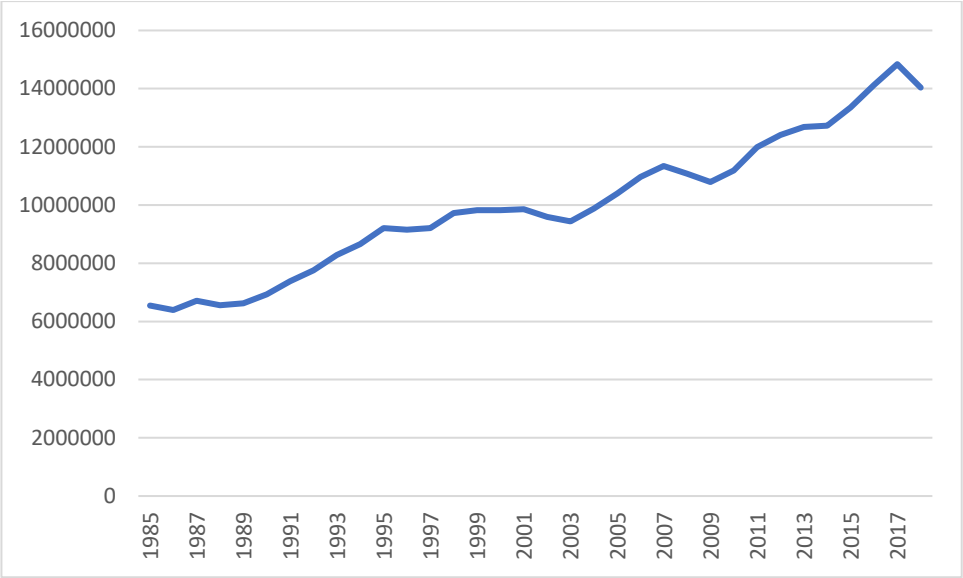


Figure 9: Hotel arrivals in Norway. Source: SSB

Even with strong tourism numbers, the possibilities to increase productivity is low due to high labor intensities and difficulties for automatization. Low productivity growth and international competition keep high pressure on wages and pushes them down. Another factor affecting the hotel sector is poor working conditions preventing productive workers from entering this sector. Its reputation includes low pay, long working hours and high labor fluctuations. Hence, high productive workers rather do not opt for working in this sector, leaving it to low productive workers to enter the hotel workforce (McMahon, 1994).

6.2 Immigration

Norway is a popular target country for immigrants. A strong job market, high standards of living and a generous welfare state are attracting on a yearly basis thousands of immigrants amounting to 14 % share of the population with an immigration background (Dzamarija, M., Steinkellner, A., 2018). The largest groups among immigrants in Norway are from Poland, Sweden, Somalia and Lithuania.

Standard wage theory would expect a certain pressure on wages when immigrants are entering a country and consequently the labor market. An increase in labor supply leads to a downward pressure on wages for a given demand. However, research shows varying results when it comes to the effect of migration on wages. While the inflow of low-skilled refugees in the Danish labor market seemed to have a positive effect on natives' wages, as natives specialize and thus increase their wage, other results are found in Norway (Foged & Peri, 2015).

Researchers from the Frischsenter in Norway found that immigration pushed low-skilled native Norwegians out of the labor market and thereby increased inequality while the study by Orten and Solli (2015) showed a positive effect for wages among native Norwegians, especially among lower educated natives, when considering the degree of substitution between an equally qualified immigrant and a Norwegian.

It is difficult to detect a causal relationship between immigration and wage development due to the fact that immigration is an endogenous variable determined by wages itself. The higher the wages in the target country, the higher the incentive to migrate. An additional complication is that immigration is rather a process than a one-time event. Measuring the direct effect without the influence of other factors is therefore difficult. Missing control groups are another obstacle as suitable country control groups unaffected by the treatment are rare.

In order to overcome the above-listed problems, we make use of an institutional change that led to a large increase of immigration in a short period of time, an immigration shock, that was affecting certain sectors almost exclusively. We examine the 2004 expansion of the European Union to estimate the causal effect of immigration on wages in certain sectors.

On the 1st of May 2004, the European Union welcomed 10 new countries to become a member of the economic and political union. These countries were Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia. Becoming a member of the EU has large implications for a country, as it requires the acceptance of the "four freedoms" that govern the freedom of movement for goods, services, capital and persons. These four elements shall move freely between the member states of the EU (Brinke, 2017). For our analysis, the freedom of movement for persons is especially interesting. This rule implies that every citizen of an EU-country is automatically allowed to live and work in any other EU-country without the need for a visa, permit or others. This led to large migration flows from the economically weaker Eastern European countries to the economically stronger countries in western and Northern Europe. Norway, as part of the European Economic Area (EEA), must accept all of the four freedom principles and is therefore similarly exposed to migration streams as countries within the EU.

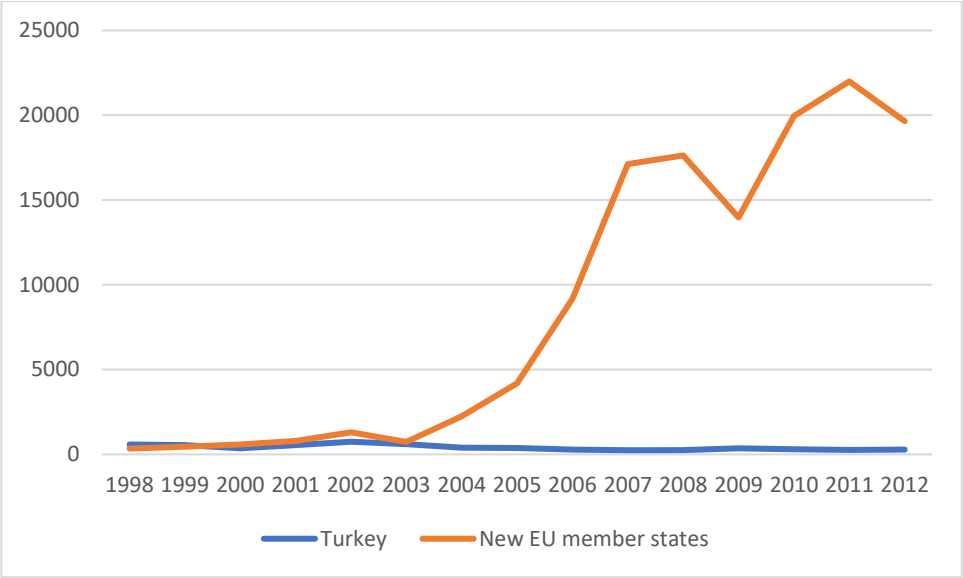


Figure 10: Net migration to Norway, by source country. Source: SSB, own calculations

In 2004, after becoming a member of the EU, many citizens of the new member states did indeed move to western European countries. The large wage gap between the countries provided high incentives to relocate. Norway was no exception from this development (see Figure 10). Net migration from the new member states (mainly from Eastern Europe) exploded, starting in 2004. Net migration rose from 740 in 2003 to 21994 in 2011, thus a total increase by 2900% in 8 years. This can be seen as an immigration shock for the Norwegian economy, as net migration numbers changed from one year to another by a significant amount. To verify that there was no other factor influencing migration streams to Norway, we can look on net migration from a country that was not impacted by the EU extension. We chose to examine migration from Turkey due to the share of Turkish migrants in Norway, which amounted to 11632 in 2018 (Dzamarija, M., Steinkeller, A., 2018). From this a general migration interest can be assumed. Migration from Turkey was approximately on the same level compared to migration from the new EU member states before the EU extension and showed no change after the extension. This indicates that the increasing migration was based entirely on more countries being part of the EU and achieving the freedom of movement.

Looking at the overall wages of Norway in order to determine the effect of migration on wages would not be helpful. We would need a comparable control country that did not experience any migration shock. Typically, Sweden or Denmark are used as control groups for Norway in empirical research due to their strong similarities of history, culture and public governance. However, in our case Sweden and Denmark cannot be used as control countries as they are

both parts of the EU and equally exposed to increasing migration from the new member states, although not as strong as Norway (379% and 230% in Sweden and Denmark, respectively, from 2003 to 2011) (Statistics Denmark, 2019; Statistics Sweden, 2019). In order to identify a control group for our research design, we make use of the fact that migrants are rather concentrated in certain sectors. In Norway, migrants from Eastern Europe, i.e. the largest group of the new EU member states, typically work in the construction sector while they are less represented in the manufacturing sector. In the following we examine the effects of a migration shock, mainly from Eastern Europe, on wages in the construction sector compared to the manufacturing sector with a Difference-in-difference design.

Difference-in-difference approaches can be used if certain assumptions are fulfilled. The trend of the dependent variable (in our case real wages) have to be parallel for the treatment and control group before the treatment. We assume that the trend of both groups would develop similarly if no treatment would take place. If there are trend differences after the treatment, this can be seen as the causal effect of the treatment on the treatment group. An additional assumption is the comparability of the control and treatment group, which is considered given in our case. Both sectors are significantly big in order not to be exposed to exaggerated wage fluctuations, and both sectors operate in the same economy.

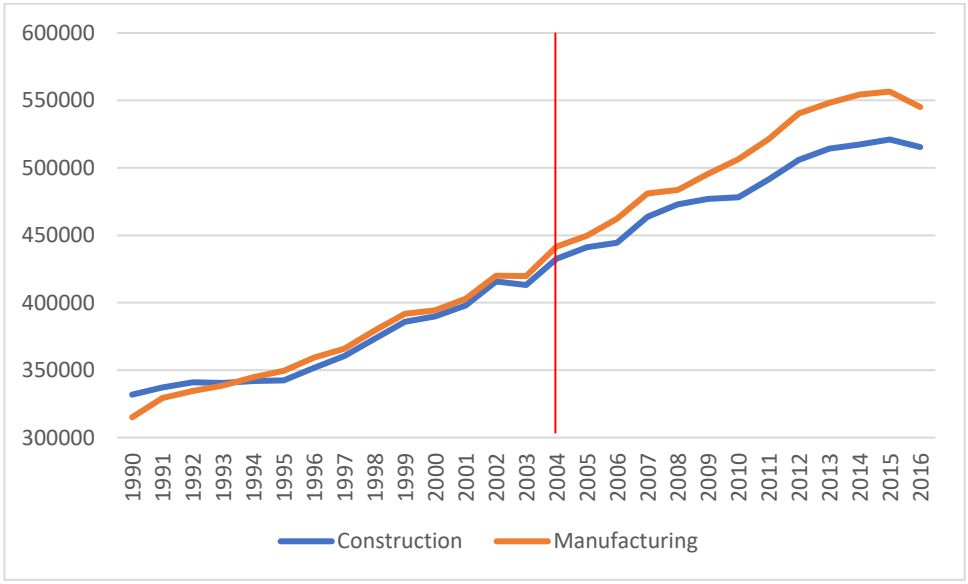


Figure 11: Real wage development in the construction and manufacturing sector. Source: SSB, own calculations

To check for parallelism, we can check the graphical development between the real wages in the construction sector and the manufacturing sector (see Figure 11). From this graph, we can

see that the real wage development of both sectors was close to perfectly parallel before the migration shock in 2004. Starting in 2004 the wages seem to diverge from each other so that the manufacturing sector is experiencing a higher wage increase than the construction sector. As our two assumptions are considered to be fulfilled, we can assume that this wage difference is attributable to the effect of migration on the construction sector. Using an interaction term, we estimated whether the difference in wages is statistically significant. We found that there is a negative effect of the treatment (migration shock) on real wages in the construction sector. However, the effect is not statistically significant. Thus, we can neither conclude that there is an effect of migration on wages, nor that there is no effect.

The reason why there seems to be no clear effect of increasing migration on the wage composition of the Norwegian economy can be found in the sturdy institutional framework in Norway. Labor unions are strong (see chapter 8.1) and regulations prevent migrants from being paid less than natives for the same work. The so-called “Allmenngjøring” decree regulates collective agreements in many industries (including that of construction), and it is also intended for people that are not part of labor unions or are migrants, as long as they cover the same work (Bergsli, 2016). Hence, the downward pressure on wages is partly prevented by regulations.

7. Demand factors

7.1 Financial sector

The financial sector is a major driver of overall inequality in the world. Not only are wages higher and increase faster in this sector, but it also contributes more to the whole economy today than 40 years ago. The OECD examined that rising inequality in the OECD countries resulted primarily from the high financial sector payments. Especially acknowledged in this context was the variable payments that depend on the performance of the financial institution and the individual employee. Wages in this sector accelerated in all major countries in the early 1990s and outperformed the wage development in other sectors (Denk, 2015). A variety of reasons exist in order to explain this development.

7.1.1 Rent sharing

The financial sector is known for being more profitable than other sectors. The rents produced by this sector are among the highest of all sectors and can be shared with the workforce, leading to higher payments than in sectors with lower profits (Lindley J. , 2014).

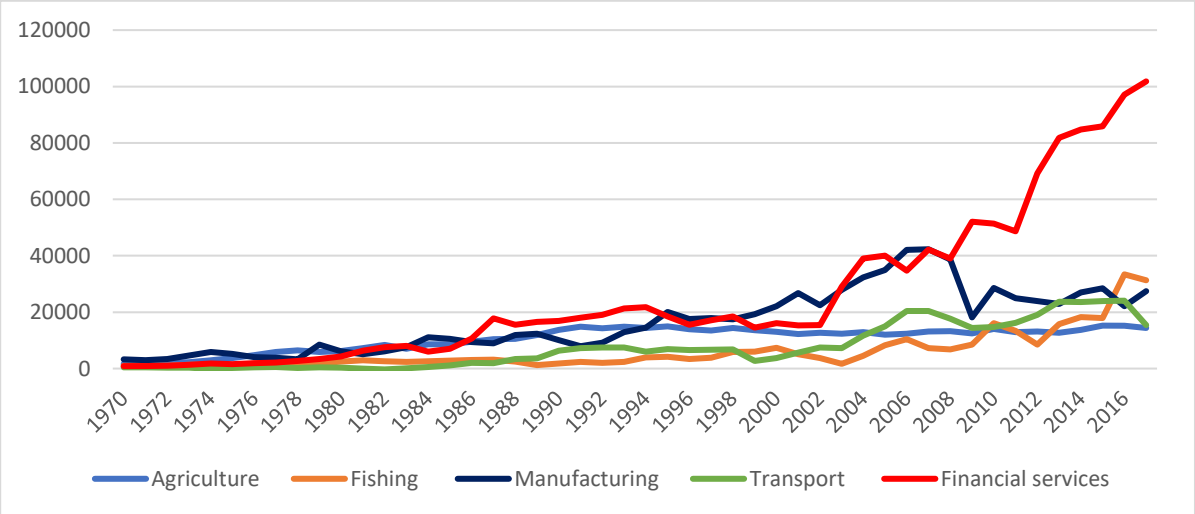


Figure 12: Operation surplus in Norway, by sector. Source: SSB, own calculations

In Figure 12 we observe a particularly strong increase in operational surpluses in the financial sector after 2000. This is in line with international developments. The financial sectors all over the world grew rapidly in the years from 2000 until the financial crisis, and from 2010 and

onwards. This gave room for large bonus payments to financial service workers that consequently profit from this development leading to high wage growth.

7.1.2 Skill intensity

One of the main reasons for finance wages outperforming other sector wages is the increasing skill intensity due to financial deregulation and increasing financial globalization (Boustanifar, Grant, & Reshef, 2014). Over the last decades, an educational shift within the occupational structure in the financial sector led to a shift from middle-skilled to high-skilled employees (Kaisergruber & Vogler-Ludwig, 2009). Today the financial sector has the highest share of high educated employees of all sectors (see Figure 13) and the share is expected to increase (Kallonen, 2015).

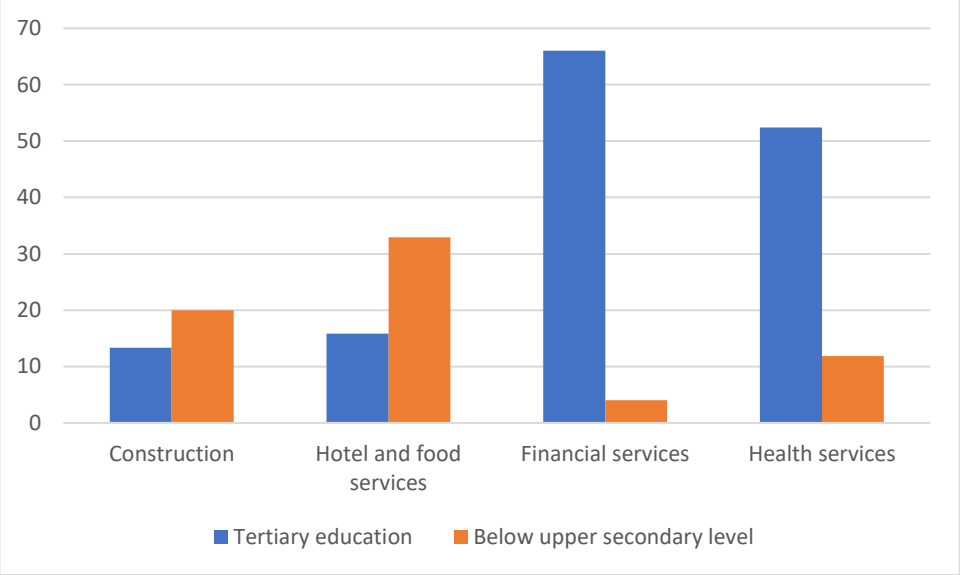


Figure 13: Share of employees with low and high education, by sector in 2017. Source: SSB, own calculations

The increasing demand for high-skilled workers is one explanation for the existing wage development in this sector, as high-skilled workers demand higher wages to compensate for their efforts in more education. There are several factors that drive the increasing skill intensity in this sector. One factor is the accelerated demand for credit, especially for households, which started in the 1980s in Norway and has continued up to 2016. The deregulation prior to the 1990s and the increasing standard of living of Norwegian households made it possible to afford more and higher loans. Using SSB data we calculated that domestic loan debt by households increased by 650% between 1995 and 2016 (Statistics Norway, 2019). This led to

an increasing demand for high-skilled workers in the banking sector for screening and monitoring these loans.

Another factor was the new inventions in the field of ICT that the financial sector profited from starting in the 1990s. This essentially drove the demand for skilled workers responsible for the implementation, monitoring, and application of these new technologies. Autor, Levy and Murnane (2003) found that computerization may explain 60% of the demand shift towards higher educated workers due to a labor composition moving from routine to nonroutine tasks. Furthermore, Célérier and Vallée (2017) found that the return on education on the financial sector is significantly higher than in all other sectors, leading to extraction of talent in this sector (Célérier & Vallée, 2017).

Finally, a factor contributing to skill intensity in the financial sector is the globalization of the sector with worldwide connection of financial institutions. Also, labor migration between these institutions and their countries is simple. The European Central Bank found that high wages in the financial sector attract skilled workers across borders, leading to increasing global competition (Boustanifar, Grant, & Reshef, 2014). High skill level in this sector and global competition provides a strong demand for financial workers that pushes up wages as the supply is not perfect elastic.

7.1.3 Situation in Norway

Looking at the data and our underlying theory from chapter 3 reveals that the financial sector is responsible for most of the rising inequality in wages between professions in Norway. Wages in this sector took off in the 1990s and only stopped for a short period of time after the financial crisis (see Figure 8). Similar findings are observed all over the OECD, where wages in the financial sector are increasing faster than in other sectors (Lindley & Mcintosh, 2017). This is supported by the fact that the financial sector has the largest share of high-income earners of all sectors. Over 40% of the top 0.1% earners in Norway are found in the financial sector, which is one of the highest numbers in the OECD (Denk, 2015).

Particularly variable payment schemes constitute one of the main reasons for the disparity of the financial sector. These types of extra payments represent over 11% of the total income of financial employees, compared to 2% for employees in other sectors in Norway. Such payments are depended on the economic situation of the institution, which can be observed in the period following the financial crisis of 2007. The decrease was exclusively induced by

variable payment schemes and bonuses , while the basic salary did not decrease but even increased(see Figure 14). However, employees in the financial sector experienced the relatively largest decrease in personal income.

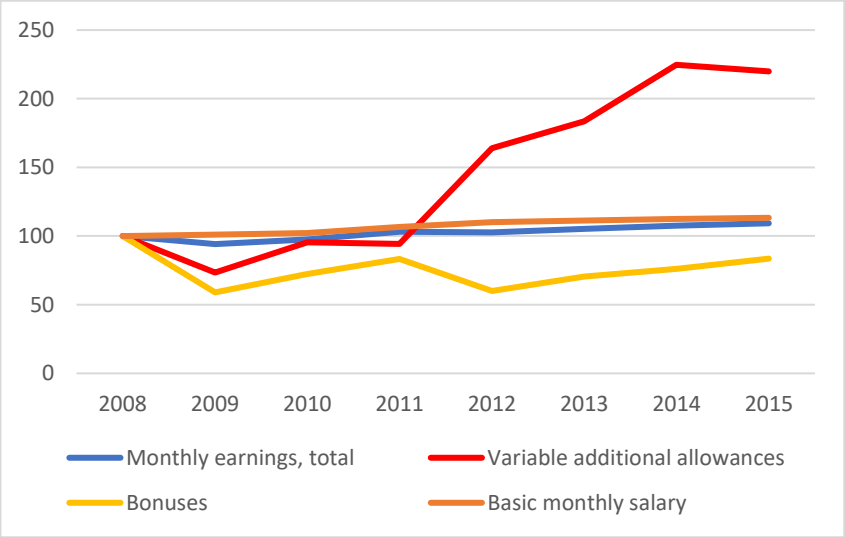


Figure 14: Financial sector earnings in Norway, by type of earnings. Source: SSB, own calculations

On the other side, wages increase more in good times when profits in the financial institutions are high. After 2010 wages started to increase again, driven by a heavy increase in variable additional allowances, whereas bonuses were kept at a low level and increased only slowly. Before the financial crisis, variable payments played a huge role in determining the actual income of employees as well in the financial district (Lunde & Grini, 2007). Not only is the share of employees receiving bonuses the highest in the financial sector, but the bonuses paid is also the highest. Thus, the Norwegian financial sector plays an important role when determining the income inequality between professions in Norway.

7.2 Trade

Over the last decades, the world experienced an accelerating degree of globalization and global integration, where more countries participate in trading an increasing amount of goods and services (Carluccio, 2015). Today around 25% of the global production is exported, and the value of global exports has increased by 3600% since World War II (Ortiz-Ospina, Beltekian, & Roser, 2018). In particular, the manufacturing sector is exposed to globalization. 70% of the global merchandise exports in 2017 were manufactured goods (World Trade Organization, 2018).

Especially the rise and integration of China in the world economy has had an enormous effect on global trade. Today China is the world's largest trader with combined exports and imports worth US$4.3 trillion (World Trade Organization, 2018). A major driver for this development can be attributed to China joining the World Trade Organization (WTO) in 2001, followed by drastically increasing export from China. Manufacturing prices in the U.S. decreased by almost 8% due to the supply of cheaper alternatives from China (Amiti, Dai, Feenstra, & Romalis, 2017). But not only the USA was exposed to increased trade with China. From 2001 to 2002 imports from China to Norway increased by 64% and continued to develop exponentially. Exports from Norway to China also increased but not as strong. The largest share of the increase in Norwegian imports came from machinery and transport equipment leading to increasing competition in this sector (Statistics Norway, 2019).

The Norwegian trade with the world increased strongly after 1994 when the European Economic Area (EEA) was established with Norway as a member state (Enstad, 2018). This international agreement promotes trade between the member states through reduced trade barriers, which imply free movement of capital, goods, services, and labor. Norway, Iceland, and Lichtenstein are thereby connected with the markets in the EU. Another boosting factor for international trade in Norway was the extension of the EU by 10 new states, mostly Eastern European countries. Imports from the largest new member state, Poland, increased by 87% in the three years after the EU extension, while exports to Poland more than doubled in the same time span. Hence, we can see that certain events that were influential in the Norwegian trade history may help us to examine if there is any effect of sudden trade boosts on the divergence or convergence of wages.

We want to examine if trade influences the wage composition within the Norwegian economy. Does increasing trade lead to rising divergence or convergence of wages between different sectors? In order to investigate this question, we make use of a graphical analysis comparing real wage development in two sectors that are differently exposed to international trade. One sector is the manufacturing sector with high exposure to trade, and the other is the public administration sector that is less exposed to trade. The manufacturing sector is exporting about 50% of its value added, thus displaying the high exposure to trade (OECD; World Trade Organization, 2015). In contrast, the public administration sector is chosen as this sector is significantly large in Norway yet not predominantly producing any tradable goods (McCarthy, 2017). This makes this sector a good control group in order to see if changes in trade activity

lead to divergence or convergence of wages in the manufacturing sector with respect to other sectors.

In order to have a measurement for trade development we apply the "openness of trade"-indicator that is compound by imports plus exports of a country (Departement for Business Innovation & Skills, 2015). This value of the indicator is higher the more open for trade a country is. In our analysis, we look at exports plus imports in NOK from 1970 to 2016.

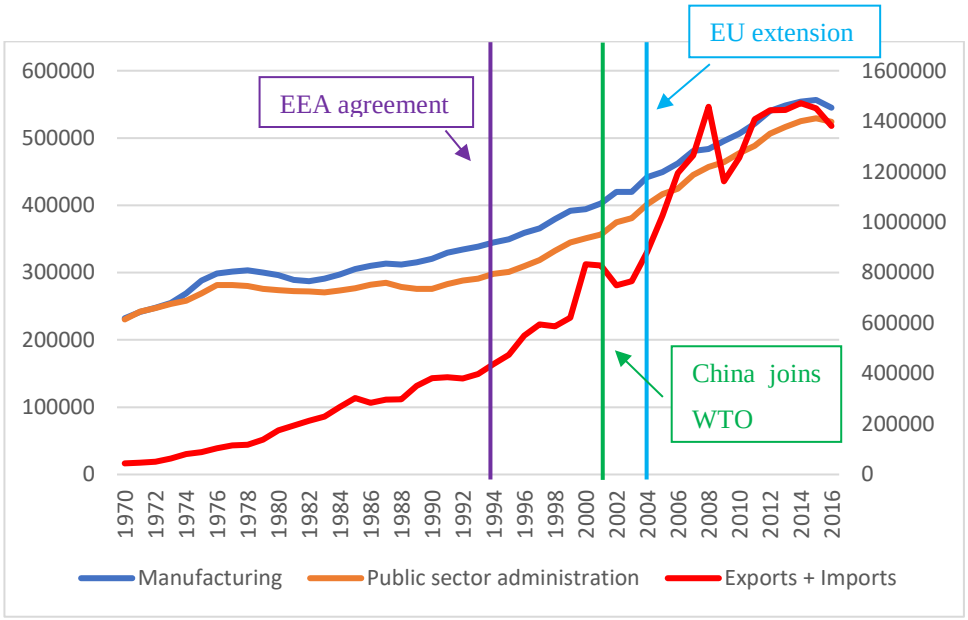


Figure 15: Real wages development in manufacturing and public administration (LHS) and development of exports + imports (openness of trade) (RHS). Source: SSB, own calculations

In Figure 15 we can observe the development of real wages in the two sectors and the development of the openness of trade in Norway from 1970 until 2016. After every major trade event in the 1990s and 2000s exports and imports increased substantially. The sum of all agreements (plus smaller agreements not mentioned here) led to a strong trade development in Norway over the last 30 years. To investigate if there has been any reaction to wages in trade open sectors, we must compare the development of real wages in the manufacturing and public sector administration. From 1990 we see a very slow and steady convergence between the two sector wages with the manufacturing wages increasing slightly less than the public sector administration wages. We also see a small kink in the wage development in the manufacturing sector after China joined the WTO. The general development of both wages, however, is rather similar.

From this analysis, we cannot conclude that trade has had a significant negative or positive effect on wages in the manufacturing sector. The trade development does not seem to be determined by one specific shock leading to a complete change, but rather a long-term positive development that is making causal interpretations of trade effects on wages difficult.

7.3 Public sector

One argument to include the public sector in the discussion of wage development in sectors is the increasing amount of welfare services provided in Norway, which in turn influences the wage distribution. The discussion will first include how Norway as a welfare state affect wage development by providing public education. Then the discussion will focus on the growing share of produced public services, and how the costs of these affect other parts of the economy who provide a taxation base.

7.3.1 Norway - a welfare state

First, consider this description of a welfare state provided by Barr 2012 in the book "Economics of the Welfare State":

> «The welfare state exists to enhance the welfare of people who (a) are week and vulnerable, largely by providing social care, (b) are poor, largely through redistributive income transfers, or (c) are neither vulnerable nor poor, by organizing cash benefits to provide insurance and consumption smoothing, and by providing medical insurance and school education» (Barr, 2012, p. 8)

Norway is together with the other Nordic countries known for following the so-called "Nordic model", which is characterized by a large public sector and a particular focus on egalitarian objectives. Although the Nordic countries have a large public sector and high taxes, their average income is among the highest in the OECD countries, indicating comparably strong economic results. Empirical research has attempted to look at the size of the public sector and the economic performance, but without any clear evidence of any significant correlation. The relationship is clearer when public expenditure is decomposed. Thus, the role that the welfare state has on economic performance must include the structure and orientation of the state. For example, when discussing public expenditure Andersen (2015) underlines among other things the importance of what taxes are financing. The basic idea that automatically implies a trade-

off between equality and economic performance is a statement that is difficult to justify. Compared to many other countries, the Nordic countries are spending more towards active expenditure, which evidently has a positive effect on economic performance, given that the taxation is not distorting the economy otherwise (Andersen, 2015).

The Nordic countries are not only performing well economically but are also among the countries with the most equal income distributions. The publicly provided education may serve as an equalizing factor in income/wage distribution. Indeed, findings indicate that a relatively equal distribution of qualifications is a prerequisite of obtaining an equal income distribution (Andersen, 2015). Public provided education removes the social or economic constraints that individuals may face when deciding level of education and thus increase the supply of human capital. Consequently, active expenditure limits the number of individuals that are unable to support themselves through investments in the early phase of citizens' lives, deterring potential market failures. This contributes to an enhancement of the economic performance and equality in the society.

7.3.2 The public sector as a contributing factor for convergence or divergence

A challenge the public sector faces is the development of costs and the limited productivity gains within this sector. Baumol (1967) promotes the idea that some activities are technologically progressive. Increased productivity in these activities, in turn increases the wage demand, a cost that is offset by the production improvement. On the other side, there are activities where the quality of a service is directly connected to the amount of labor used to produce this. As wages move jointly, the relative costs in nonprogressive activities thereby increase (Baumol W. J., 1967). A concern Baumol points to is the development of prices in personal services. Baumol finds that over time the same services experience a slow productivity growth, and are as such referred to as "stagnant services" (Baumol W. J., 1993). The outcome of a steady cost increase in personal services, with constant higher exchange rate to manufactured goods, is what Baumol refers to as the "cost disease". Growing financial problems is the result if the tax-base, that are raised to pay for the public sector, expands at a faster rate than the inflation rate.

A result of increased productivity in almost every sector and no decline in productivity presents the opportunity of higher consumption in all goods and services, even the stagnant

services (Baumol W. J., 1993). Consumer preferences in OECD countries changed towards government services and other domestically traded services during the second wave of globalization. This phenomenon is observed in the much expanding public sector. During the entire 40 years period 1962-2002, the rate of employment in this sector has greatly increased, resulting in a workforce four times the size in 2002 than the case in 1962 (Hansen & Skoglund, 2008).

Since the 1970s, the wage development has in general been weaker in public sector relative to other sectors. This was especially the case in the 1970s. Perhaps the challenges of limited productivity growth and the costs of expansion in this sector were partly factors in the "losing" position in the wage development. Another plausible explanation for this development is found in the strong growth in relatively low-paid jobs within communal services, mainly involving healthcare and social services. In addition, employment growth in the public sector is to a large extent among part-time workers, who notably earn lower wages on average than full-time employees when calculated into full-time equivalents (Hansen & Skoglund, 2008).

In a recent SSB article discussing wages and differences during the last 20 years (1997-2017) it was found that the Gini coefficient is lower in the public sector than the private sector, following just above 0.15 versus 0.23 (Geier & Grini, 2018). This supports the assumption where wages are relatively high among low-skilled workers in the public sector and relatively low among high-skilled workers. A lower Gini coefficient in the public sector compared to the private sector may indicate that this sector is contributing to a more equal wage distribution and convergence of wages.

However, the differences in wages are growing at a faster rate in the public sector. This is shown by a 21.4% increase in the Gini coefficient in the public sector compared to the 7.7% increase in the Gini coefficient in the private sector (Geier & Grini, 2018). A consequence of the initially low Gini coefficient in the public sector is its vulnerability relative to change in rate. The rising inequality in wage level in the public sector can stem from numerous reasons. The share of employment structure between higher and lower paid jobs may cause a difference in the wage distribution. In the public sector, the average monthly wages differ whether an employee works for the state or the municipality where wages varied roughly between 48 000 NOK and 40 400 NOK in September 2017 (Geier & Grini, 2018). Also, as expressed by Hansen and Skoglund (2008) the composition of higher payed full-time versus part-time workers in the sector is relevant when understanding the comparably weak development in the

sector. Thus, the change in Gini coefficient does not unequivocally imply that wage development is due to changes in the wages of a specific worker.

7.4 Skill-biased technological change

Skill-biased technological change (SBTC) is a shift in the technology of production that increases demand for high-skilled labor and decreases demand for low-skilled labor due to an increase of relative productivity of high-skilled labor. This theory became more and more popular with the introduction of ICT and general digitalization developments in the modern world since the 1980s. New technologies turned out to be complements for high-skilled workers and substitutes for low-skilled ones (Violante, 2008). High-skilled labor is needed to develop, monitor and apply new information technology in production processes while low-skilled workers often are replaced by these new technologies. This shift in demand is often seen as one major driver in inequality developments since the 1980s in nearly all developed countries. Low-skilled workers experienced stagnating or even falling real wages in combination with rising unemployment in many OECD countries since the early 1980s. Not only in countries with historically higher inequality like the US, where less educated workers suffered from a real wage decline between 1979 and 1993 by 26%, did the skill-biased technological change lead to rising inequality. Many countries in Europe did also experience an equivalent development.

Most of the rising unemployment between 1979 and 1992 in Europe OECD countries was concentrated among low-skilled workers. Moreover, low-skilled workers wages declined relatively in many of these countries. This development is not surprising in light of the shift in demand in favor of high-skilled workers. Higher demand with short-term relative inelastic supply leads to higher wages while the declining demand for low-skilled workers decreased their wages.

New technologies are not only replacing low-skilled workers within a country, but it also makes it easier to outsource certain production segments to low-wage countries. This further increases the downward pressure for low-skilled workers while new resources are freed for high-skilled labor and hence increases demand for these accordingly.

Do we also see such a development induced by a skill-biased technological change in Norway? There are indications that this is the case.

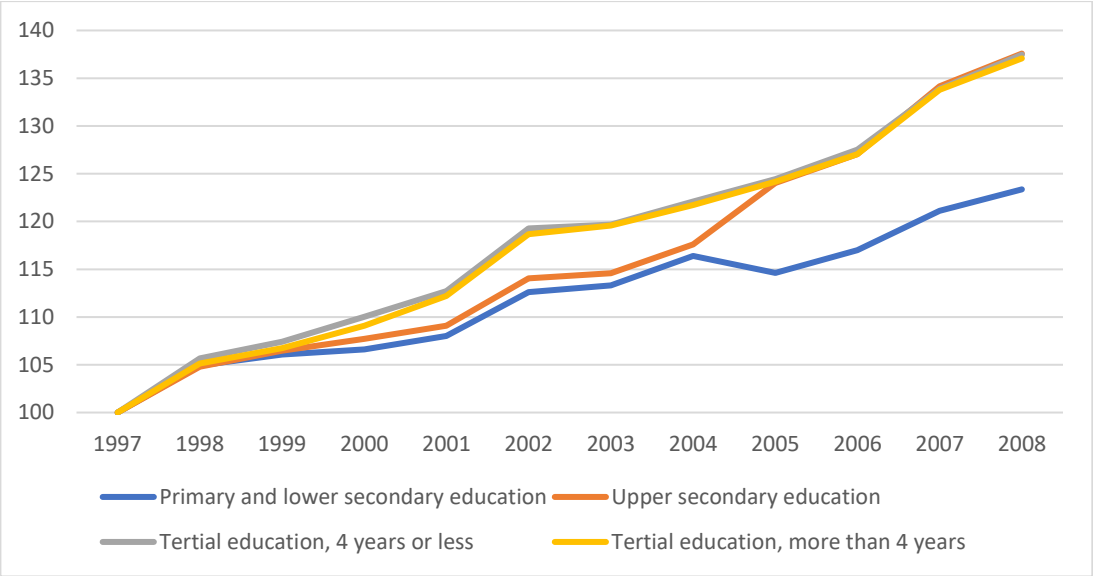


Figure 16: Real wage development in Norway, by education level (1997 = 100). Source: SSB, own calculations

When we look at the wage development depending on education level since the late 1990s, we see that this was in favor of high-skilled workers, while low-skilled workers experienced only a slight increase in wages (see Figure 16). Real wages of workers with primary and lower secondary education increased by 23% between 1997 and 2008, while real wages for workers with tertial education comparably increased by 37%. Hence, the return on education increased over time and widened the gap between low-skilled and high-skilled labor during these years. Today, workers with tertial education over 4 years earn roughly double the money compared to workers with primary or lower secondary education in Norway, on average (Statistics Norway, 2019). While it cannot certainly be stated that this development is exclusively attributable to skill-biased technological change, it seems reasonable to assume that SBTC plays a certain role.

However, this development was counteracted by a general shift of education in Norway. Today, Norway is one of the highest educated countries in the world. Norway scores 9th in the list of most educated countries, in which 43.06% of the adult population have completed some kind of tertiary education (Hess, 2018). This was not always the case. In the 1980s education levels of the adult population were considerably lower, and basic school level education was rather the rule than the exception. With large investments in education and the increasing need for high-skilled workers, the development shifted towards a more educated society. While the numbers differ from the OECD, the direction of the shift is still the same. According to SSB, from 1980 until today the share of the adult population having undertaken tertiary education

increased from 11.3% to 33.4%, while the share of the adult population with basic school level education decreased from 48.8% to 26.2%. This shift did most likely mitigate the skill-biased induced increase in inequality, as the shift in demand towards high-skilled workers was met by a shift in the supply accordingly. In other words, the rise in inequality would have been more severe if the education composition from 1980 remained, ceteris paribus. If this was the case, the need for high-skilled labor would not have been met with higher supply leading to a further decrease in low-skilled workers wages.

To apply these findings in the situation of between professions inequality we see that high-wages sectors traditionally seem to have a large share of high-skilled workers while low-wage sectors have a lower share. As can be seen in chapter 7.1 the financial sector has the highest share of workers with tertiary education, while the construction and hotel sectors have the lowest. The wage level corresponds accordingly.

8. Policy factors

8.1 Labor Unions

In the following the structural forming of wages will be assessed, particularly focusing on the role of labor unions in the development of wages. The objective is to examine the influence of labor unions on the distribution of wages, and thus the direction of the development towards convergence or divergence in the wage distribution. Wages are not legally determined. Thereby, arrangements such as five-week vacation, 37.5 hours work week and so forth are negotiated through the "collective agreement" (Tariffavtalen). In these negotiations the labor unions naturally have a central role (Nergaard, Barth, & Dale-Olsen, 2015). According to Arbeidstvistloven (labor disputes act) (2012) § 1.e collective agreement is defined as «an agreement between a labor union and an employer or employer's confederation regarding working- and wage terms or other working conditions». This definition states the important role of labor unions in negotiations regarding the development of wages.

The Scandinavian countries are known for a high degree of coordination in the forming of wages in the labor market and strong local labor unions. It has been argued by Barth, Moene & Willumsen (2014) that this combination is through structural changes and local efficiency resulting in high employment rates and growth in productivity (Nergaard, Barth, & Dale-Olsen, 2015). On these grounds it is presumed that labor unions present a relevant factor when explaining the distribution of wages in Norway.

8.1.1 The direction labor unions affect wage distribution

The Norwegian society is known to be egalitarian with the underlying opinion that people are equal. Norway is colored by not having had nobility, and this may have contributed to a collective spirit in the society and acceptance of labor unions providing a more equal wage development. Unions increase the bargaining power among low paid workers, they reduce wage inequality by negotiating at the group level, which equalizes within-group pay levels. Also, the collective agreements entail that companies covered by these have no cheaper alternative labor force to unionized workers. A source of the labor unions bargaining power is due to their collectiveness in negotiation. Their incentives are driven by the general good of the many, not a selected few. Helland et al. (2017) found by using Norwegian data that an increase in union density was positively correlated with an increase in mean wages, and also

that an increase in union density was negatively correlated with inequality within the occupation. Unions appear to be contributing to more equal wages both within occupations, and between sectors (Helland, Bol, & Drange, 2017).

8.1.2 The wage leadership model and the role of labor unions

To maintain the ability to compete internationally, the level of inflation must not exceed what is considered a sustainable growth in long-term perspective. The intuition of "the wage leadership model" (Frontfagsmodellen) is that it shall ensure wage growth within the country that over time is beneficial for firms' profitability, as well as maintaining sustainable development of macroeconomic parameters. It is necessary that the development in real wages is not higher than the productivity development in the competitive sector. The leading principle behind the wage leadership model is that in the long-run, the average wage growth must be equal to the inflation target, plus average growth in labor productivity in the economy (Holden, 2016). To manage this, the internationally traded goods sectors negotiate wages first and acts as a wage leader by forming the norm of wage settlement in the other sectors.

The possibility to form a wage leadership model may vary. Steinar Holden (2016) is describing three main requirements for a wage leadership model.

Firstly, Holden (2016) expresses that it is necessary to develop a common understanding among labor market parties about challenges and need for sustainable wage growth. Holden argues that both sides need to accept moderate wage growth as a public good that benefits members of both parties. Together the parties need to preserve the whole labor market as they essentially represent interests extending beyond the parties' own concerns.

To obtain acceptance in the outcome of the wage growth this development must be considered reasonable and just. In this context, it is commented that general economic policies and firm behavior are affecting wage moderation. I.e. when firms earn a higher profit, it is necessary for union members to see a positive effect on investments and jobs in contrast to dividend and executive pay. A hinder for acceptance of a moderate wage growth may be the sentiment that some groups capture an unreasonably large share. By this reasoning presented in Holden (2016), a wage development in a divergent direction could be a challenge when facing different sides in the labor market. Since acceptance of a sustainable wage development relies on all parties, the role of unions is in this perspective considered to contribute to a more equal development with wages converging towards the sustainable growth rate.

As earlier mentioned, Norway is highly coordinated in wage setting and there are institutional features which enhance cooperation on income policy. One institution is the Contact Committee (Regjeringens kontaktutvalg for inntektsoppgjørene), a committee headed by the prime minister, government and main organizations in the labor market. This committee discusses the basis for wage formation prior to actual wage setting. Also, there is the Technical Calculation Committee for wage settlements (Teknisk beregningsutvalg for inntektsoppgjør) which provides common statistical material before and after the wage negotiations. In this way, the factual foundation can be agreed upon among wage setters in the discussions. A common understanding of moderate wage growth is more achievable with the presence of these institutions.

Secondly, the establishment of a wage leader which negotiates first and thus sets the norm for the wage growth in other parts of the labor market is required in a wage leadership model. The wage leader (Frontfaget) in Norway is represented by Næringslivets Hovedorganisasjon [NHO] and Norsk Industri on the one side, and Landsorganisasjonen i Norge [LO] and Fellesforbundet on the other side. The result of the wage leadership negotiations forms the wage development in the other sectors and the collective agreement builds on the result of the sector-wise agreements.

Holden holds that for the wage norm to work well, the norm must be consistent with a satisfying and sustainable evolution of the economy. This involves that the norm cannot be too high compared to the inflation target. It must, however, have a desirable impact in the labor market in order to be accepted among the labor market parties (Holden, 2016). The basis for income growth is the following two sources; growth in productivity and benefits from foreign exchange trade. Hence, if the wage growth is equivalent to the sum of these sources, firms and employees will then have an equal income development (Bjørnstad, Jordfald, & Nymoen, 2015).

Productivity stands out as an important contributing factor in the discussion of possible development of wages. It is constraining the terms in the negotiation of wage development and is influencing bargaining power of labor unions by its relevance in a sustainable wage development. This is consistent with our earlier findings in subchapter 6.1 which shows the strongest wage development in sectors where productivity growth is highest. From this finding, noting how labor unions need to follow both a satisfying and sustainable direction in the economy, it appears that although they are expected to have a unifying effect on wages,

they are not able to counter the divergence tendencies caused by differences in productivity. The assumption presented by Baumol (1993) about wages moving together creating an unbalanced growth, may not always be the case, even though labor unions promote this direction. There seems that there exists a wage premium that awards the more productive sectors that go beyond a temporarily lagging behind off less productive sectors, although the development of wages in a divergent direction is fairly modest at this point in Norway.

Thirdly, Holden maintains that the success of the model hinges on whether the norm is followed elsewhere in the labor market, which needs to be ensured. It is pointed out that the influence of a wage leader must necessarily be stronger than what would be followed by minimum requirement in wage negotiations. For example, so-called "leap-frogging", meaning a higher wage growth than the norm, may undermine the role of the wage leader. To avoid "wage-wage spirals" where one or several strong groups are able to obtain a higher wage growth than the norm, Holden (2016) suggests aiming for constant relative wages across sectors and parts of the labor market, and limited scope of differences between firms. This focus supports that the result of strong coordination and labor unions in the labor market is influencing the wage distribution towards a direction of convergence. Labor unions are thus evaluated as a factor which provides more convergence in the wage distribution.

Holden presents three main mechanisms to ensure that the wage norm is followed. (1) Internal coordination within and among union federations and employer federations. In Norway's case, Holden points to LO and NHO which exert strong authority over the industry federations regarding bargaining and conclusion of collective agreements. (2) The existence of a mediation officer who makes proposals consistent with the wage leadership model and can in different ways interfere directly with the negotiation. (3) Arbitration as a mechanism to ensure the norm is followed, where political authority is allowed to interfere in labor market conflicts. In Norway the political authority may send the conflict to compulsory arbitration, performed by the National Wages Board (Rikslønnsnemda). This board is functioning as an objective and independent body whose decisions have an overruling effect. The board makes decisions according to the norm presented by the wage leader and is in this way supporting a moderate wage development.

8.1.3 Decreasing degree of organization

Although the labor unions are strong, the degree of organization has been somewhat reduced in later years. The degree of organization is an important feature since the number of workers in union affects how powerful the union is in that place of work, in addition to political influence and negotiation power in collective agreements. The degree of organization was reduced by 5 percentage points between 1995-2012. The organizational development was found to decrease more in the private sector than the other sectors, where the organization share of employees was close to 1/3. It may be questioned how low rate the union can maintain its central role in the private labor market. Other findings were that the largest decrease was among the age group 35-49 years, less organization for entrants in the labor market, and immigrants that stayed for a shorter period had a lower share of organization (reaching same level as natives after 10 years of residence in a country).
Despite the decrease in the degree of organization it has not been much change in the number of firms covered by collective agreements, number of firms with unions, and number of organized workers in the past 15 years (Nergaard, Barth, & Dale-Olsen, 2015).

8.1.4 Final remarks

Through this qualitative presentation of labor unions as a contributing factor in wage development, it is elaborated how labor unions are a central part of the system of wage formation in Norway. Labor unions influence the development of wages in the directions of convergence, as they focus on their members' interests as well as seeking to preserve a holistic societal view which benefits from a moderate wage development. The wage leadership model presents a foundation for practical execution of wage formation. Wage setting is coordinated between parties in the labor market, while also taking the effects in the overall economy into account.

The role of labor unions is considered to be strong in Norway, with a large share of the labor force as members, and their power is held through the structural basis of the collective agreements. The degree of organization has decreased since the early 1990s, but the role of the labor unions is not particularly weakened. It is, however, interesting to repeat the question raised by Nergaard et al (2015) in the context of membership basis in the private market; at how low rate can the labor union maintain its central role in the private labor market? There are, as formulated by Holden (2016), requirements for the wage leadership model. To remain

a functioning model that provides the preferred outcome of moderate wage growth, it is depended on the fulfillment of these requirements. There might be consequences reflected in the development of wages if the labor unions should continue to decline in organization, and possibly lose the source of power.

9. Comparison

To better understand our findings in an international context we compare the Norwegian wage development with that of other countries. Norway has one of the highest standards of living in the world. Different measures all confirm the top global standing of Norway. When looking at pure economic measures such as GDP per capita Norway scores 3rd within the OECD with only the city-state Luxembourg and Ireland ahead, whereas Ireland displays a special case due to blown up GDP numbers based on taxation rules that make companies register their headquarters in Ireland (OECD, 2019). When it comes to wages Norway is again in the top field with being 7th in the whole OECD (OECD, 2018). Taking different working hours into consideration leaves Norway on the 6th place (OECD, 2017).

Wages are not only high today, but they have also increased strongly over the last 30 years. Since 1990 Norway experienced the strongest real wage growth of all major OECD countries (see Figure 17).

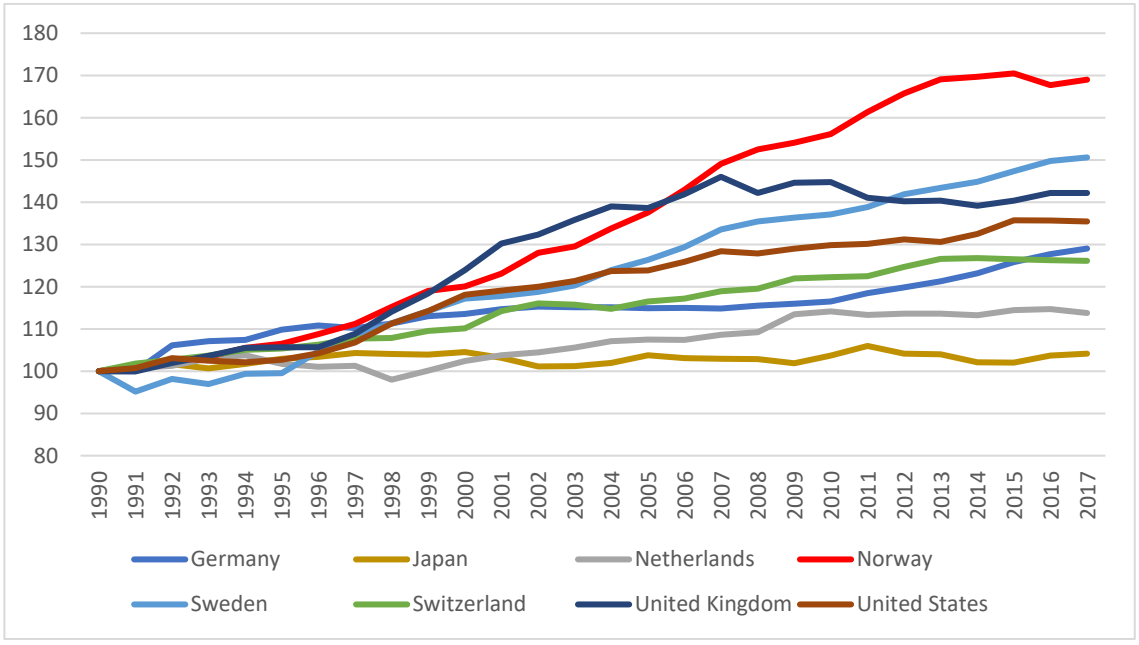


Figure 17: Real wage growth, by country (1990 = 100). Source: OECD, own calculations

Wages are here measured as the total wages divided by numbers of employees in the total economy which is further adjusted with a measure for hours worked, all in constant 2016 USD prices. We compare USA, Switzerland, UK, Germany, Japan, Sweden, Norway, and the Netherlands. With little surprise traditional high wage countries like Switzerland and the USA

are on top of the wage list in 1990 and today. Countries with the lowest average wage in this comparison used to be Sweden and Norway, while today Sweden and Japan come in last. This already indicates that Norway managed to develop out of being one of the poorest countries in our list. Indeed, the situation for Norway today is significantly different to its state in 1990. At that time, the average wage in Norway was 77% of the average of the other seven countries, while today this changed to 102%. The development is even more impressive when we compare Norway to countries that played in the same wage league, i.e. excluding Switzerland and USA. In this case the average wage in Norway developed from 83% of the average of the other countries in 1990 to over 112% today in less than 30 years (OECD, 2018). While Norway increased its wages heavily during this time, some countries nearly stagnated in their real wage growth, namely Japan and the Netherlands. Therefore, we can see a clear divergence of wages between countries. The reason for that is in line with the findings of the previously discussed Solow model: Differences in productivity. In general, the countries with the highest real wage growth also experience high productivity growth over the same time. The big exception here: Japan (see Table 4).

Country	Real wage growth	Productivity growth
Norway	69%	47%
Sweden	50%	46%
USA	35%	36%
Germany	31%	35%
Switzerland	26%	20%
Netherlands	13%	21%
Japan	4%	45%

Table 4: Real wage growth and productivity growth 1990-2017. Source: OECD, own calculations

Real wage growth has several effects. The positive effect is that workers can afford more goods with the money they make. The negative side is that in general higher real wages imply higher costs for companies and hence lower competitiveness. However, this problem can be

avoided when productivity is increasing in the same way as real wages. In this case, the competitiveness remains unchanged and higher real wages do not cause the same problems than in a situation without sufficient productivity growth. This is what we see in the case of the OECD. The overperformance of Norwegian real wages over the last decades was justified by productivity growth that was much stronger than in other advanced economies. Although, only until 2005. Labor productivity measured in GDP per hours worked in constant prices increased in this time by 47% in Norway while in other countries productivity rose less. Only Sweden and the UK had a similar productivity development to Norway (OECD, 2018). After 2005 until today Norway did not overall improve their labor productivity but continued to raise real wages which decreased their competitiveness against competing economies of the OECD. Other economies also experienced a slow-down in productivity after 2005, yet in contrast to Norway they often slowed down real wage growth that kept the competitiveness in line with other countries.

We also want to compare wage development in certain professions in Norway with other countries. High productivity growth did also lead to a strong overall economic development. Norway grew with the highest growth rates since 1970 compared to countries like the USA or the UK (OECD, 2018). Here, we compare Norway to the US as the world leading economy and to the UK as Norway's number one trading partner with 21.6% of all Norwegian exports going to the UK (Workman, 2019).

One peculiarity about Norway is that normally the broad population profits from this kind of economic progress due to the low-income inequality, also between professions in contrast to for example the USA where income inequality between different professions is higher. However, Norway did experience a stronger divergence of wages than the USA or the UK since 2000 when comparing a similar number of professions (see Table 5).

Beta convergence coefficients

	(1) Convergence Norway	(2) Convergence USA	(3) Convergence UK
initial_wage_Norway	0.0246		
	(0.0155)		
initial_wage_USA		0.00903	
		(0.0101)	
initial_wage_UK			-0.000341
			(0.00279)
Constant	-0.293	-0.0190	0.00873
	(0.198)	(0.0300)	(0.0169)
Observations	9	7	8
R^2	0.265	0.139	0.002

Standard errors in parentheses
* p<0.10, ** p<0.05, *** p<0.010

Table 5: Beta convergence since 2000, by country. Source: SSB, Bureau of Labor Statistics, Office for National Statistics, own calculations

While the UK experienced a convergence of wages since 2000 (indicated through the slightly negative beta coefficient), Norway and the USA experienced wage divergence i.e. positive beta coefficients. Norway had the strongest tendency for divergence. Note, however, that none of the beta coefficients are statistically significant.

The high real wage growth combined with increasing inequality in Norway shows that the increase of standard of living since 2000 was not equally distributed over all professions. Some professions (namely the financial sector, see chapter 7.1) profited significantly more than others. Similar, but weaker developments can be found in the US and UK. Both countries increased their real wages by around 15% since 2000 with the financial sector being the main driver for inequality due to the higher increase in real wages. This sector increased wages by 39% in the US and 60% in the UK compared to 2% and 0% in the manufacturing sector. However, the inequality rise was less strong than in Norway. Hence, Norway reduced the inequality gap to the US and UK.

Overall, we can conclude that rising inequality and diverging wages between professions are not an occurrence exclusive to Norway, but more a general trend in most countries. However, while Norway increased real wages strongly over the last decades compared to other countries, inequality did also increase more severe than elsewhere.

10. Conclusions

In this thesis, we answer the question if there has been divergence or convergence between wages in different sectors in Norway over the last 50 years. Our findings show that a certain convergence of wages took place until the mid-1980s, with decreasing inequality and strong real wage development of all considered sectors. Since the 1990s however there has been a considerable divergence of wages between different professions with the steepest increase in the early 2000s. The analysis was performed by employing various econometric approaches such as sigma convergence, beta convergence, and the Gini coefficient. Using sigma convergence, we found a clear decrease in the standard deviation of wages until 1983 indicating wage convergence. After 1983 the standard deviation is increasing continuously (with only occasional breaks around recession periods) until today leading to an overall divergence of wages over the time span. Similar results are found when looking at beta convergence. Until 1983 there is a negative, since then a positive and significant relationship between average annual growth rates and the initial wages. That indicates convergence of wages until 1983 and divergence afterward. Finally, we confirmed our finding by using the Gini coefficient that shows similar results like the convergence measures.

The main factor that drove divergence was a strong wage performance of the financial sector that other sectors could not keep up with, leading to rising inequality between the sectors. The main wage winners during the last decades, besides the financial sector, have been the manufacturing sector and the public administration and defense sector, all which experienced wage growth over 125% since 1970. The clear losers have been the agriculture and transportation sectors with wage growth under 100% since 1970.

We have investigated different factors contributing to wage divergence over time and found productivity as one main factor. Productivity has always been central both in growth and convergence theory. It is one of the profound drivers for economic development explaining differences in economic outcomes internationally and nationally. The same was the case in our analysis. Productivity is one main driver of wage developments over time. Diverging productivity is leading to diverging wages. This has been evident in our analysis in the case of high productivity sectors like the financial and manufacturing sectors on one side, and low productivity sectors like the hotel and health sector on the other side. Different developments in productivity are clearly responsible for divergence of wages between different sectors in Norway.

However, we also found many other important factors that could have a potential impact on the wage formation in Norway, affecting wages either from the supply or demand side. On the supply side, we found that immigration leads to a downward pressure on wages in sectors heavily exposed to large immigration inflows, which in turns leads to increasing wage divergence.

From the demand side, we see a very clear effect of the financial sector on wage inequality. Strong profit developments followed by high bonus payments in the last 20 years combined with high skill intensity, led to outstanding wage developments in this sector that were not followed by any other observed sector. International trade may have an effect on wage divergence, although the effect seems to be rather small. The dominant public sector in Norway seems to function as a converging factor. In general, the public sector is less unequal than the private sector due to relatively high wages for low-skilled workers and relatively low wages for high-skilled workers. The last observed demand factor in our analysis concentrated on the changing skill demand. We found that some sectors increased their demand for high-skilled workers more than other sectors, which contributes to diverging wages as high-skilled workers expect a certain skill premium to pay off educational efforts.

The last examined factor is a policy factor affecting both the demand and the supply side. Labor unions play a crucial role in the Norwegian economy. The wage leadership model is used to prevent strong divergence in wages and make every sector profit from economic developments. While there have been signs of decreasing unionization, we do not believe that this development has been strong enough to be a main responsible for increasing divergence of wages between sectors.

Finally, we looked at the Norwegian wage development in an international context. Norway has by far had a greater wage growth over the last decades compared to other industrialized countries. While wage growth in Norway was booming, not all sectors profited the same way. Increasing inequality between sector wages indicated that there have been clear winners and losers of this development. The same findings can be seen in other countries such as the USA, which has experienced increasing inequality in wages between their major sectors, although slightly less severe than in Norway over the last 20 years. Thus, our findings have international implications and Norway is not alone with wage divergence between sectors.

In order to tackle the rising problem of sector wage inequality policies should concentrate on the factors that are the main contributors for this trend. One could introduce actions to investigate and identify potential ways to increase productivity in low paid sectors like the hotel sector, where labor intensity makes productivity growth harder to achieve than in more capital-intensive sectors such as the manufacturing sector. Additionally, it is important to prepare for exogenous shocks, e.g. immigration shocks, to keep negative effects as little as possible. Further developments of factors that prevent divergence, like labor unions and the organization of wage setting, should be considered.

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