Decomposing the Productivity-Wage Nexus in Selected OECD Countries, 1986-2013

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ABSTRACT

Standard economic theory predicts that in the long run, productivity growth ought to drive aggregate real wage growth. We consider this prediction in the case of 11 OECD countries, and find that eight of the 11 experienced slower median real wage growth than labour productivity growth over the 1986-2013 period. We decompose the gap between labour productivity growth and median real wage growth into four components: wage inequality, changes in the importance of employer contributions to social insurance programs, differences between the prices of output and consumption, and changes to labour's share of income. The decompositions ultimately show that there is no common cause for the productivity-wage gap, though most countries did see wage inequality grow and labour's share of income fall to some degree over our period of study.

In the face of growing inequality in advanced economies, the OECD (2014) has initiated a significant research effort aimed at understanding and promoting inclusive growth. The aim is to advance policies to ensure that the benefits of growth are broadly shared. Across OECD countries, governments are searching for ways to ensure that subsets of society are not left behind by economic growth. For example, the Canadian government has installed a Cabinet Committee on Inclusive Growth, Opportunities and Innovation with the mandate to "[consider] strategies designed to promote inclusive economic growth, opportunity, employment and social security" in Canada.

These efforts are timely because evidence on wage growth suggests that economic growth has not been broadly shared in recent decades. In eight of the 11 OECD countries examined in this article, median real wage growth since the mid-1980s has not kept pace with labour productivity growth. The size of the growth gap between labour productivity and median real wages differs across countries, but the qualitative pattern is consistent: workers are growing more productive, but those productivity gains are not being matched by growth in the typical worker's wage.

Economic history and economic theory suggest that labour productivity growth should

generate rising living standards for workers over time, so the apparent disconnect between labour productivity growth and wage growth is puzzling. What factors account for it? In this article, we show that the gap between labour productivity growth and median hourly earnings growth can be decomposed into contributions from the following four sources:

- rising earnings inequality;
- changes in the importance of employer contributions to social insurance programs as a form of labour compensation;
- rising relative prices for consumer goods; and
- a decline in labour's share of aggregate income.

Each of these components has its own implications for the welfare of workers. To the extent that the productivity-earnings gap simply reflects a rising share of labour compensation being paid in the form of employer contributions to social insurance plans, for example, it is not obvious that workers are any worse off. On the other hand, rising earnings inequality or a decline in labour's share of income might represent more serious obstacles to broad-based prosperity.

We perform the decomposition for 11 OECD countries: Canada, Denmark, France, Finland, Germany, Ireland, the Netherlands, Norway, Spain, the United Kingdom, and the United States. The decompositions show that the productivity-wage growth gap has no single common cause across the countries, but most countries did experience rising earnings inequality and a decline in labour's share of income over our period of study. The decompositions typically run from the mid to late 1980s through to 2010 or 2013, depending on the availability of household survey data for a given country.

The article is comprised of five sections. The first discusses literature that provides context for our analysis. The second section describes our framework for decomposing the gap between labour productivity growth and median real hourly wage growth. Section three presents the results of the decomposition. The fourth section discusses wage growth throughout the wage distribution in more detail. Section five concludes.

Literature Review

The failure of real wages to keep pace with labour productivity is not a new observation. Fisher and Hostland (2002) observe that labour productivity outstripped real wage growth in Canada from 1994 to 2001. Bartlett and Tapp (2012) found that labour productivity growth outpaced labour compensation growth from the mid-1990s through to 2012 in Canada. The gap, however, is not limited to Canada. The International Labour Organization (2015) observed that labour productivity growth exceeded real wage growth from 1999 to 2013 in developed countries across the board.

Decompositions allow analysts to identify the proximate sources of the gap between labour productivity growth and real wage growth. In a study of the American non-farm business sector from 1970 to 2006, Feldstein (2008) found that average real wage growth was indeed lower than labour productivity growth. The difference was a matter of prices. When he adjusted wages for inflation using the non-farm business sector output price index (rather than the consumer price index), he found that wages grew at approximately the same rate as labour productivity.

For research that relates the growth of wages and labour productivity, Feldstein stresses the importance of accounting for differences in price indexes and the importance of using total compensation (i.e. including supplementary labour income and fringe benefits) instead of only wages and salaries when calculating a wage for comparison with labour productivity. We

heed both of Feldstein's concerns in our analysis.

While Feldstein's decomposition provides a framework for relating labour productivity growth to average wage growth, he fails to consider how wage growth was actually experienced by the workers near the median - a better measure of the wage of the typical 'middle class' worker. Sharpe *et al*. (2008a; 2008b) consider how wage growth was experienced by the median worker, decomposing the gap between labour productivity growth and real median wage growth in Canada into four contributing factors: rising inequality, poor terms of trade for labour, a decrease in labour's share of income, and measurement inconsistencies.[2] They find that from 1980 to 2005, labour productivity grew 1.26 percentage points per year faster than median real earnings. They decompose the gap into their four factors, attributing 0.35 percentage points per year to inequality, 0.42 percentage points per year to terms of trade for labour, 0.25 percentage points per year to labour's share of income, and 0.25 percentage points per year to measurement issues. This report follows the method of Sharpe *et al*. but extends the analysis to ten additional OECD countries.

Pessoa and Van Reenen (2012) perform a decomposition of median wage growth and productivity growth similar to the one presented in Sharpe *et al*. (2008b) for the United Kingdom and the United States. They propose that there are two different types of measurements for the divergence - "gross decoupling" and "net decoupling". The former measures differences in growth between labour productivity and median hourly real earnings, while the latter measures differences in growth between labour productivity and average labour compensation per hour (deflated with the same deflator). Gross decou-

pling accounts for changes to labour's share of income, labour's terms of trade, changes median and mean hourly earnings, and the wedge between labour compensation and earnings, while net decoupling only accounts for changes to labour's share of income. Ultimately, Pessoa and Van Reenen (2012) find little evidence of net decoupling in the UK, but significant gross decoupling in the United States and the UK. In the UK, gross decoupling was driven by differences between mean and median earnings and the wedge between earnings and labour compensation.

Pessoa and Van Reenen (2012) recognize that both gross decoupling and net decoupling are important policy indicators. Gross decoupling relates the "true middle" of the earnings distribution to labour productivity. It also deflates earnings with the CPI and labour productivity with the GDP deflator, capturing any difference in the prices faced by firms and workers. This is an important distinction to make because firms and consumers can at times face very different prices. Changes in capital equipment prices affect firms more than consumers, for example.

Net decoupling, on the other hand, is important because it challenges one of the main stylized facts cited by economists - labour's stable share of income. Pessoa and Van Reenen observe that net decoupling could occur for many reasons, including shocks which disturb the long run equilibrium, technological bias against labour, changes to the level of competition in the market (in the product market it results in setting higher prices, while in the labour market it results in setting lower wages), and finally changes to labour supply due to structural phenomena like globalization.

Mishel and Gee (2012) use the methodology developed by Sharpe *et al* (2008b) to compare

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2   The term "measurement inconsistencies" refers to the combined effect of employer social contributions and changes in hours of work per worker.

the growth of median real wage in the United States with labour productivity. Like most of the literature, they also find a significant gap between growth in labour productivity and median real wages: 1.56 percentage points between 1973 and 2011. Rising wage inequality accounted for 0.61 percentage points, while labour's terms of trade accounted for another 0.44 percentage points. They specifically point to the erosion of labour standards, globalization, high trade deficits, and the rising share of capital depreciation in GDP to explain both growing inequality and the changes in the distribution of income towards capital.

A recent OECD study by Schwellnus *et al.* (2017) provides an analysis of the decoupling of median wages from productivity in OECD countries for the 1995-2013 period based on trends in labour's share and the ratio of median to average wages. It finds that labour productivity grew faster than median wages in 15 of 24 countries.

Empirical Framework

Our decomposition of the gap between labour productivity growth and median real hourly earnings growth follows the approach developed in Sharpe *et al.* (2008a). In this section, we formally describe this approach.

Decomposition Method

The starting point for the decomposition is the following accounting identity:

$$\frac{Y_L}{P_C \times L} = \frac{Y_L}{P_Y \times L} \times \frac{Y_L}{Y} \times \frac{P_Y}{P_C} \qquad (1)$$

Here, Y_L is total nominal labour compensation, P_C is the price of consumption goods, and L is total hours worked. Y is total nominal output (or income) in the economy and P_Y is the price of output.

Thus, the ratio $Y_L/(P_C \times L)$ denotes average real hourly labour compensation in units of con-

sumption goods (i.e. the "consumer wage"). On the right-hand side, the ratio $Y/(P_Y \times L)$ denotes real output per hour in units of output goods; that is, labour productivity. Y_L/Y is labour's share of total income in the economy. The remaining term P_Y/P_C is the relative price of output goods in terms of consumption goods; following the literature, we will refer to this as "labour's terms of trade."

For any variable X, let the notation $\Delta\%X$ denote the per cent growth rate of X. Then expressing equation (1) in growth rates, we obtain:

$\Delta\%$Average Real Hourly Compensation = $\Delta\%$ Labour Productivity + $\Delta\%$ Labour Share $\Delta\%$ Labour Terms of Trade   (2)

Our goal is to explain changes in the gap between labour productivity and median real hourly earnings. Let $\Delta\%$ Gap denote the productivity-earnings growth gap. Formally, it is defined by:

$\Delta\%$ Gap = $\Delta\%$ Labour Productivity   (3)
- $\Delta\%$ Median Real Hourly Earnings

Rearranging (2) and using (3) to eliminate labour productivity growth, we obtain:

$\Delta\%$ Gap = $\Delta\%$ Average Real Hourly Compensation -   (4)
$\Delta\%$ Median Real Hourly Earnings -
$\Delta\%$ Labour Share-$\Delta\%$ Labour Terms of Trade

Now, the change in average real hourly earnings relative to median real hourly earnings is an indicator of the change in earnings inequality over time. Thus, we define the change in inequality as:

$\Delta\%$ Inequality =
$\Delta\%$ Average Real Hourly Earnings -   (5)
$\Delta\%$ Median Real Hourly Earnings

Finally, we need to relate average real hourly compensation to average real hourly earnings.

The difference between these two measures reflects the impact of changes in employer contributions to social insurance programs:

Δ% Average Real Hourly Compensation -
Δ% Average Real Hourly Earnings =   (6)
Δ% Employer Social Contributions

Substituting (5) and (6) into (4) yields the overall decomposition:

Δ% Gap = Δ% Inequality +
Δ% Employer Social Contributions -   (7)
Δ% Labour Terms of Trade -
Δ% Labour Share

equation (7) is the final decomposition formula.

We find the accounting approach very useful. It draws our attention to the relationships between the productivity earnings gap and several other economic phenomena such as: rising earnings inequality, the changing impact of laws governing employer contributions to social insurance programs. It lends a disciplined, quantitative characterization to those relationships. It suggests areas for future research that might clarify the causal mechanisms at play.

The decomposition in equation (7) does not, on its own, justify any statements about cause and effect and does not explain the trends observed. To address such questions would require a structural model that explains why each of the components change the way it did.

Data Sources

Our analysis relies on two data sources: national accounts and household surveys.[3] For estimates based on national accounts data, we employ the OECD National Accounts from the OECD Stat public-use database. For estimates that rely on household surveys (median and average earnings from household surveys), we rely on the micro-datasets made available by the Luxembourg Income Study. Table 1 details the specific survey(s) used for each country. The length of our time series varies by country with household survey availability. Generally, the series span from 1986 or 1987 to 2010 or 2013. Germany and Ireland are the two exceptions to the rule, with our time series for the two countries spanning 1994 to 2010.[4]

To create our median and average wage series for each country, we used the annual labour income for both part-time and full-time employees from the relevant household survey. We excluded self-employed from our sample when generating the distribution of annual labour income in a given country because of data issues in differentiating labour income from returns to capital.[5] In order to create average hourly real wage and median hourly real wage estimates, we then divided through by the average hours worked per person employed and deflated each series with the CPI.[6]

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3   The data series used in this article can be found at http://csls.ca/reports/csls2016-16-DataAppendix.pdf.

4   Ireland began in 1994 simply due to data availability. We opted to begin our German series in 1994 because it was the first household survey after East and West Germany were reunited, and we lack microdata from East Germany prior to the Wall coming down.

5   The primary difficulty with self-employed data is that their annual income comes both from the labour the self-employed put in their business and the return on the capital they have invested. Most countries have tax systems set up in such a way that dividends from a business are treated differently than salaries paid out from the business. As such, the self-employed will naturally take into account tax implications when deciding how they will be remunerated in a given year. By excluding the self-employed, we avoid any changes to labour income which are the result of changes to the tax treatment of dividends. Moreover, as our decomposition is an exercise in growth, so long as "true" self-employed labour income did not grow faster or slower than labour income did for employees, we do not lose any information by dropping the self-employed.

Table 1: Household Survey Microdata Sources

Country	Survey(s) Used by LIS
Canada	Survey of Consumer Finance (1987, 1991, 1994, 1997), Survey of Labour and Income Dynamics (1998, 2000, 2004, 2007, 2010)
Denmark	Law Model (1987, 1992, 1995, 2000, 2004, 2007, 2010)
Finland	Income Distribution Survey (1987, 1991, 1995, 2000, 2004), Survey on Income and Living Conditions (2007, 2010, 2013)
France	Family Budget Survey (1984, 1989, 1994, 2000, 2005, 2010)
Germany	German Social Economic Panel Study (1994, 2000, 2004, 2007, 2010)
Ireland	Living in Ireland Survey (1994, 1995, 1996, 2000), Survey on Income and Living Conditions (2004, 2007, 2010)
Netherlands	Additional Enquiry on the Use of (Public) Services (1983, 1987, 1990), Socio-Economic Panel Survey (1993, 1999), Survey on Income and Living Conditions (2004, 2007, 2010)
Norway	Income Distribution Survey (1986, 1991, 1995, 2000, 2004), Household Income Statistics (2007, 2010)
Spain	Family Expenditure Survey (1980, 1990), Spanish European Community Household Panel (1995, 2000), Survey on Income and Living Conditions (2004, 2007, 2010, 2013)
United Kingdom	Family Expenditure Survey (1986, 1991, 1995), Family Resources Survey (1994, 1999, 2004, 2007, 2010, 2013)
United States	Current Population Survey – March Supplement (1986, 1991, 1994, 1997, 2000), Current Population Survey – Annual Social and Economic Supplement (2004, 2007, 2010, 2013)

Source: Luxembourg Income Study

Decomposition Results

This section presents and discusses the decomposition results. We begin with an overall summary of the results. We then devote one subsection to detailed analysis of each of the four components: earnings inequality, employer social contributions, labour's terms of trade, and labour's share of income.

Summary of Results

The decomposition results are summarized in Table 2. Overall, eight out of the 11 OECD countries studied saw labour productivity grow faster than median real hourly wages (Chart 1). The gap was largest in the United States, at 1.47 per cent per year from 1986 to 2013. On the other end of the spectrum, Spain, Norway, and Ireland all experienced faster median hourly real wage growth than labour productivity growth, resulting in a shrinking productivity-wage gap over their respective time periods.

The importance of the four components of the gap varied significantly by country. In Canada and the United Kingdom, rising inequality was the largest contributor to the gap. In Germany, the United States, and Norway, labour's terms of trade had the largest absolute effect on the gap. In Finland and the Netherlands, labour's falling share of income was the largest contributor to the gap.

The size of a component of the gap within a country can give some indication to policymakers where action may need to be taken to reduce the productivity-wage gap.

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6   Admittedly, using average hours worked in an economy to generate an hourly wage series from the micro-data is not ideal. Ideally, the household surveys would also include a weekly or annual hours worked variable, from which we could create hourly wage (more recent surveys do tend to include such variables, but changes over short periods are less informative for productivity research). However, as average hours worked is driven by full-time workers, we can interpret the general decline of average hours worked as a representative trend for all full-time workers. As our decomposition deals in growth rates rather than levels, our use of average hours worked to generate hourly wages should not introduce bias into our results, particularly for wages levels in the middle of the distribution (i.e. median and average). Bick *et al.* (2016) present a more detailed breakdown of the decline of hours across high income countries.

Table 2: Decomposition of the Gap between Labour Productivity and Median Real Hourly Earnings Growth into Four Components, Selected OECD Countries, 1986-2013 (average annual rate of change)

	Labour Productivity	Median Real Hourly Earnings	Gap	Inequality	Employer Social Contributions	Labour Terms of Trade	Labour Share
	Growth (per cent per year)			Percentage Point Contributions to the Gap			
United States	1.63	0.15	1.47	0.52	0.24	0.57	0.16
Germany+	1.39	0.05	1.34	0.38	-0.07	0.59	0.44
France‡	1.71	0.88	0.83	-0.06	0.71	0.18	0.01
Denmark*	1.61	0.97	0.64	0.01	0.67	0.02	-0.06
Canada*	1.18	0.57	0.62	0.36	0.15	-0.02	0.12
United Kingdom	1.65	1.26	0.39	0.49	0.10	-0.32	0.11
Netherlands‡	1.27	0.98	0.29	0.09	-0.13	0.06	0.26
Finland†	2.20	2.06	0.14	0.11	-0.22	-0.04	0.29
Spain	1.05	1.29	-0.24	0.23	-0.27	-0.01	-0.18
Norway‡	1.80	2.09	-0.28	0.22	0.26	-1.16	0.38
Ireland+	3.75	4.11	-0.36	0.88	-2.03	0.20	0.57
				Per Cent Contributions to the Gap			
United States	--	--	--	35.0	16.0	38.4	10.9
Germany+	--	--	--	28.4	-5.0	43.7	32.7
France‡	--	--	--	-7.7	85.1	21.5	1.1
Denmark*	--	--	--	1.9	104.5	3.4	-9.7
Canada*	--	--	--	58.3	23.9	-2.5	20.0
United Kingdom	--	--	--	125.4	25.9	-81.0	28.2
Netherlands‡	--	--	--	31.4	-44.5	22.2	90.0
Finland†	--	--	--	79.3	-152.6	-29.2	198.0
Spain	--	--	--	-94.9	113.7	4.6	75.9
Norway‡	--	--	--	-78.3	-90.5	410.5	-133.7
Ireland+	--	--	--	-248.2	569.9	-55.6	-159.7

Note: *1987-2010, †1987-2013, + 1994-2010, ‡1986-2010. All others are 1986-2013.

Source: CSLS calculations from OECD National Accounts data and household survey microdata from the Luxembourg income Study: http://csls.ca/reports/csls2016-16-DataAppendix.pdf

Chart 1: Gap between Labour Productivity and Median Real Hourly Wages Growth, Selected OECD Countries, 1986-2013 (percentage points per year)
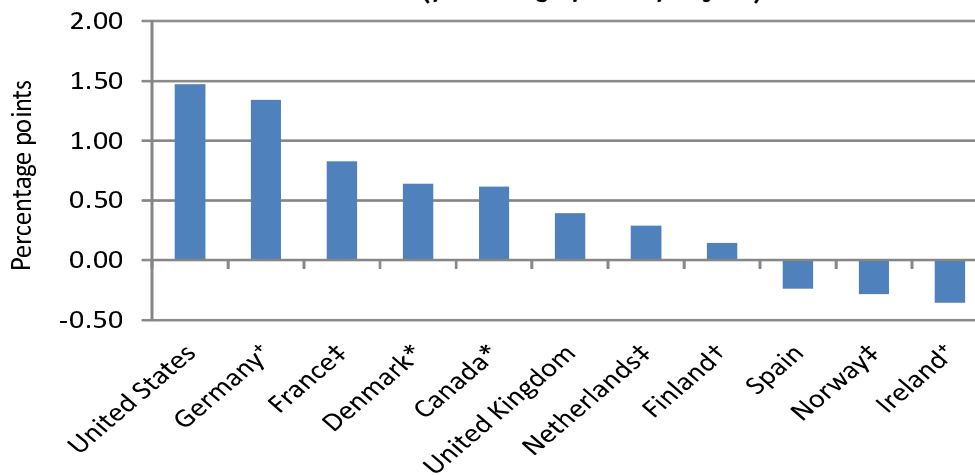
Note: *1987-2010, †1987-2013, + 1994-2010, ‡1986-2010. All others are 1986-2013.
Source: Table 2

Table 3: Average and Median Real Hourly Earnings, Selected OECD Countries, 1986 - 2013 (average annual rate of change)

	Average Real Hourly Earnings	Median Real Hourly Earnings	Inequality Component
	A	B	C = A - B
United States	0.67	0.15	0.52
Germany[+]	0.43	0.05	0.38
France‡	0.81	0.88	-0.06
Denmark*	0.98	0.97	0.01
Canada*	0.93	0.57	0.36
United Kingdom	1.75	1.26	0.49
Netherlands‡	1.07	0.98	0.09
Finland†	2.17	2.06	0.11
Spain	1.52	1.29	0.23
Norway‡	2.31	2.09	0.22
Ireland[+]	4.99	4.11	0.88

Note: *1987-2010, †1987-2013, + 1994-2010, ‡1986-2010. All others are 1986-2013.
Source: Household Survey Microdata from the Luxembourg Income Survey

Chart 2: Ratio of Average to Median Hourly Real Wage, Selected OECD Countries, 2013
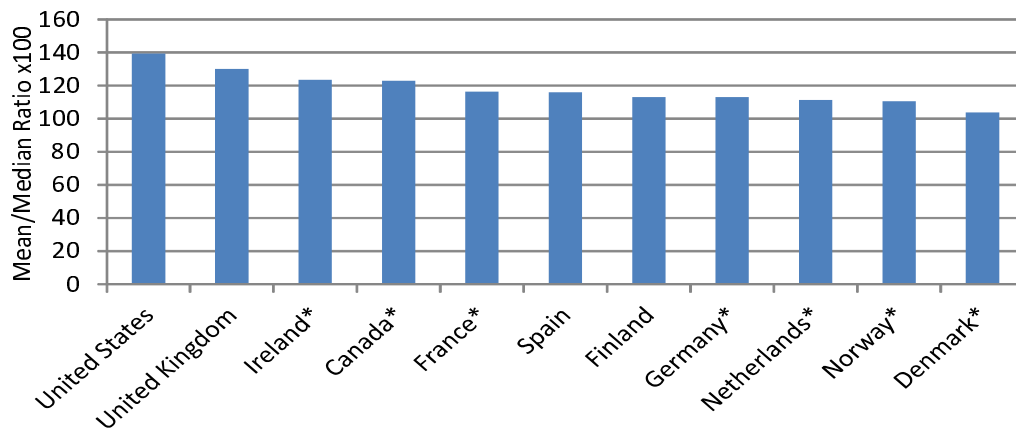
Note: *2010
Source: Household Survey Microdata from the Luxembourg Income Survey
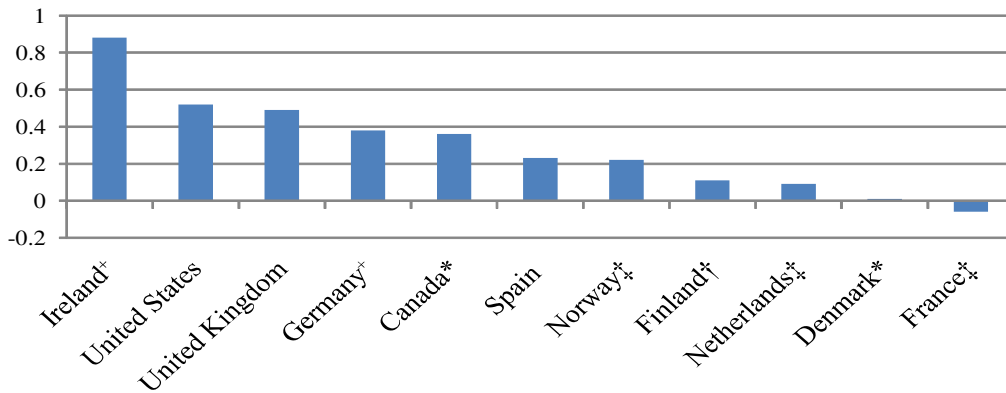
Wage Inequality

The wage inequality component is the gap between the growth rates of average and median real hourly earnings. Empirically, earnings distributions within OECD countries are positively skewed; the mean is greater than the median because the mean is dragged upward by very high earners. When earnings at the top of the distribution grow more quickly than those in the middle of the distribution, the mean rises rela- tive to the median and earnings inequality rises. This would imply that the gains from labour productivity are flowing disproportionately to workers who were already high earners relative to the median worker, so Δ% Inequality contrib- utes positively to Δ% Gap.

The 11 OECD countries in our sample had different experiences with inequality growth over their respective periods. Generally in line with the wage inequality literature, most coun-

Chart 3: Inequality Component, Percentage Point Contribution to the Gap, 1986-2013 (per year)

Note: *1987-2010, †1987-2013, + 1994-2010, ‡1986-2010.

tries experienced rising inequality in recent decades according to our measure. As shown in Table 3, only France saw wage inequality fall overall, though median hourly real wage growth only outpaced average hourly real wage growth by 0.06 percentage points per year.

As Chart 2 demonstrates, the level of wage inequality also varied significantly across countries: in 2013 in the United States the average real hourly wage was 139.5 per cent of the median hourly real wage, while in 2010 in Denmark the proportion was only 103.9 per cent. The level of wage inequality in a country is very much the result of how the median and mean have grown relative to one another over time.

Chart 3 illustrates the percentage-point contributions of the wage inequality component to the gap in the 11 OECD countries. Inequality made the largest contribution in Ireland, where the average hourly real wage grew faster than the median hourly real wage by 0.88 percentage points per year. Inequality made large contributions to the gap in both the United States and the United Kingdom as well, contributing 0.52 and 0.49 percentage points per year, respectively.

While evaluating the absolute percentage point contribution of equality to a country's

overall gap is important, Table 2 adds the dimension of what proportion of a country's gap is due to inequality. For example, despite inequality in Ireland making a large positive contribution to the gap, it was more than offset by the other three contributors. Contrarily, in the Netherlands and Canada inequality contributed more than 50 per cent of the gap, and in the United Kingdom it accounted for more than 100 per cent of the gap.

Overall, there is no doubt that wage inequality has been growing across the OECD for decades. In most cases, the average hourly real wage grew around 0.10 to 0.50 percentage points per year faster than the median hourly real wage — equivalent to somewhere between 2 and 10 percentage points more cumulative growth over a 20 year period. Evidently, these minor differences in growth can have major ramifications on the overall income distribution in the long run. It is, however, important to bear in mind that differences in growth between the median and the mean may fail to capture some important changes in the earnings distribution. In Section V, we discuss alternative measures of inequality to learn about wage growth throughout the wage distribution.

Chart 4: Employer Social Contributions Component, Percentage Point Contribution to the Gap, Selected OECD Countries, 1986-2013 (per year)
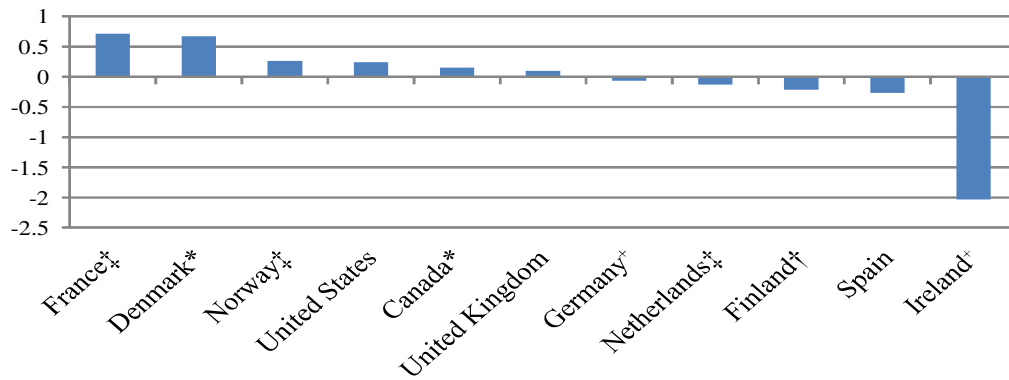
Note: *1987-2010, †1987-2013, + 1994-2010, ‡1986-2010.
Source: Table 2

Employer social contributions

In principle, the difference between average hourly earnings and average total labour compensation is that the latter captures employer social contributions (also called supplementary labour income) while the former may not.[7] It is possible that part of the gap between labour productivity growth and median hourly earnings growth is accounted for by workers receiving a growing share of their compensation in the form of employer contributions to social insurance programs rather than cash or in-kind earnings.[8] Whether this makes workers worse off depends on how much they value the social programs.

Employer social contributions as a share of labour compensation have been growing throughout the OECD over recent decades. In Canada, for example, employer social contributions as a share of labour compensation grew by about five percentage points from 1987 to 2010. This means that employer social contributions grew about 1.76 percentage points per year

faster than wages and salaries over the period (Uguccioni, Murray and Sharpe, 2016).

In practice, we draw average hourly earnings from household surveys and average hourly labour compensation from the National Accounts. We believe that employer social contributions are the main source of the growth discrepancy between the two series (and that is why we have named this component of the gap 'employer social contributions'), but it is likely that other measurement discrepancies between the two data sources are captured here as well. The definitions of labour income used in household surveys may differ across countries in subtle but important ways (e.g. in their treatment of bonuses or of non-cash income such as stock options). Sampling error in the surveys is another potential source of measurement discrepancies. (It is well known, for example, that the top per cent of earners is difficult to capture in household surveys).

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7   Supplementary labour income includes contributions employers make on behalf of employees to state-run schemes such as national pension plans, unemployment insurance, and workplace injury insurance, as well as health and dental insurance plans provided by the employer, sickness and life insurance, and retirement allowances.

8   It can be noted that definitional differences between the data sources for earnings and labour compensation, and changes in these differences over time, may also lead to different growth rates for earnings and labour compensation.

Chart 5: Labour's Terms of Trade, Percentage Point Contribution Per Year to the Gap, Selected OECD Countries, 1986-2013 (per year)
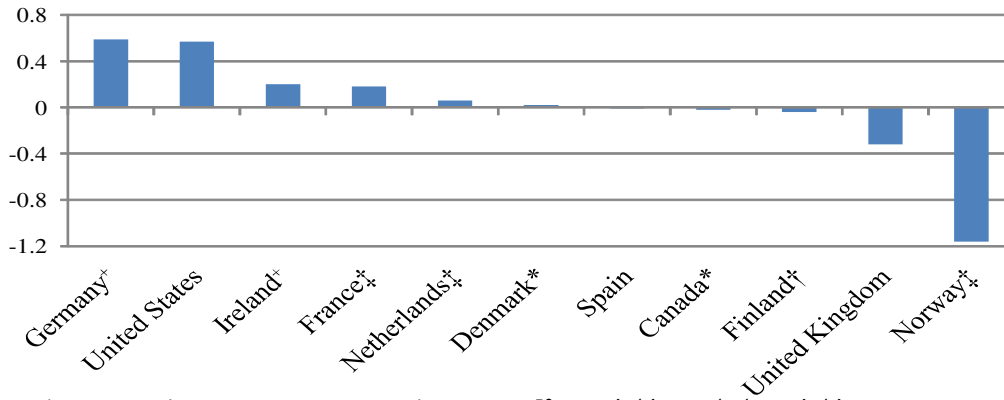
Note: *1987-2010, †1987-2013, + 1994-2010, ‡1986-2010. If no period is noted, the period is 1986-2013.
Source: Table 2

As shown in Chart 4, this component's contribution to the gap in Ireland, France, and Denmark exceeded 0.50 percentage points per year in absolute value. This indicates that there are significant differences between the labour compensation component of the SNA and the hourly earnings from the household surveys produced by the national statistics agencies in these countries, but further research is needed before a definitive conclusion is reached.

In per cent terms, employer social contributions (plus other measurement discrepancies) make considerable contributions to the gap in Ireland, Denmark, and France (Table 2). In Finland, Norway, and Spain employer social contributions make up a large share of the gap in relative terms.

Labour's terms of trade

The accounting identity in equation (1) includes two prices: the consumption goods price P_C and the output goods price P_Y. These average prices differ because, in general, the bundle of goods consumed by consumers is not the same as the bundle of goods produced in the domestic economy.[9]

Labour productivity is defined as the volume of output produced per hour of work, so the relevant price is P_Y. Workers ultimately want to use their wages to buy consumption goods, so the relevant price for measuring real labour compensation is P_C. The discrepancy between labour productivity and real labour compensation is therefore influenced by the ratio P_Y/P_C. Following the literature, we refer to this ratio as "labour's terms of trade."[10]

When Δ% Labour Terms of Trade > 0, consumer prices are falling relative to output prices. Everything else being equal, this increases workers' purchasing power relative to labour productivity, and hence reduces the gap between labour productivity growth and real earnings growth. That is why labour's terms of trade enter equation (7) with a negative sign.

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9   For example, countries produce goods that are exported to other countries rather than purchased by domestic consumers. The prices of those exports are included in the output price P_Y but not in the consumer price P_C.

10 Clearly, an analogy is being drawn between P_Y/P_C and the more common notion of "terms of trade," which is the ratio of a country's export prices to its import prices. Intuitively, P_C is the price of the goods workers buy and P_Y is the price of the goods workers produce. It is to workers' advantage when the price of what they sell increases relative to the price of what they buy, just as it is to a country's advantage when the price of what it sells (its exports) increases relative to the price of what it buys (its imports).

Chart 6: CPI and GDP Deflator Growth, Per cent Per Year, Selected OECD Countries, 1986-2013
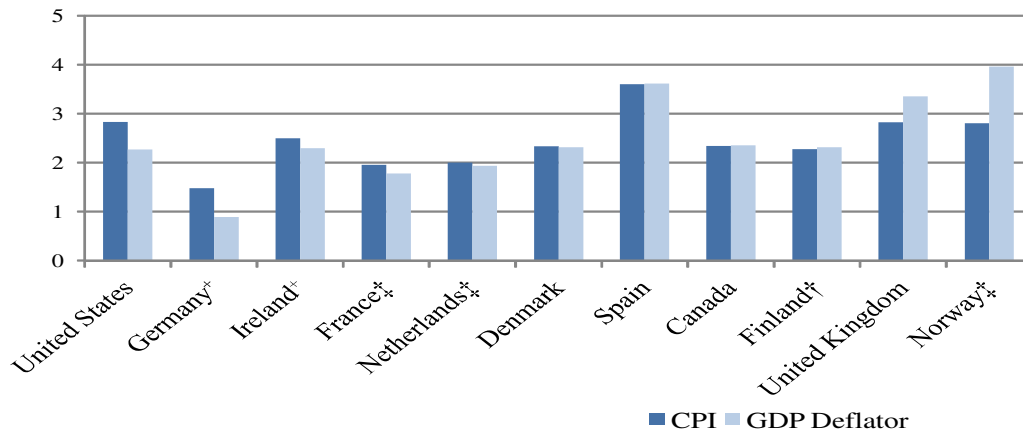
Source: OECD

Labour's terms of trade made a sizeable contribution to the gap in six of the 11 countries (Chart 5). Labour's terms of trade in Norway contributed -1.16 percentage points per year. Norway was the sole country where the GDP deflator outpaced the CPI by such a wide margin (3.96 per cent per year versus 2.80 per cent per year) (Chart 6). This is explained by much faster growth in export prices than consumption prices, driven by the commodity boom and large share of offshore oil and gas production in GDP.

Germany and the United States had the opposite experience than Norway did with labour's terms of trade. The two countries respectively saw the CPI grow 0.59 percentage points and 0.57 percentage points faster than the GDP deflator. In the United States, the relatively high rate of growth sustained by the CPI was driven by rising food, energy, and housing costs. In Germany, energy and housing prices were the primary sources of high CPI growth relative to the GDP deflator. In both Germany and the United States, investment goods prices grew much slower than the CPI. In the United States, prices for information technology goods, which represent a significant share of investment, have since the 1980s fallen drastically (e.g. the cost of

a computer with 1 gigabyte of RAM) which reduced GDP deflator growth.

Table 2 illustrates the relative importance of labour's terms of trade to each country's overall productivity-wage gap. The relative importance of labour's terms of trade in Norway is in part driven by it being the component largest of any of the 11 countries (Chart 5), but the relative size is even greater due to Norway's relatively small overall gap. Similarly, labour's terms of trade make a larger absolute contribution to the gap in the United Kingdom than in the United States or Germany because of the United Kingdom's relatively small overall productivity-wage gap.

Labour's share of income

Labour's share of income measures the fraction of aggregate income in the economy (i.e. GDP) which is paid to workers as compensation for labour. Up until quite recently, labour's share of income was considered constant by most economists, so much so that it became one of the main stylized facts presented in introductory macroeconomics courses. Labour's falling share of income over the past decades in OECD countries has been well documented (OECD,

Chart 7: Labour's Share of Income, Percentage Point Contribution to the Gap, 1986-2013 (per year)
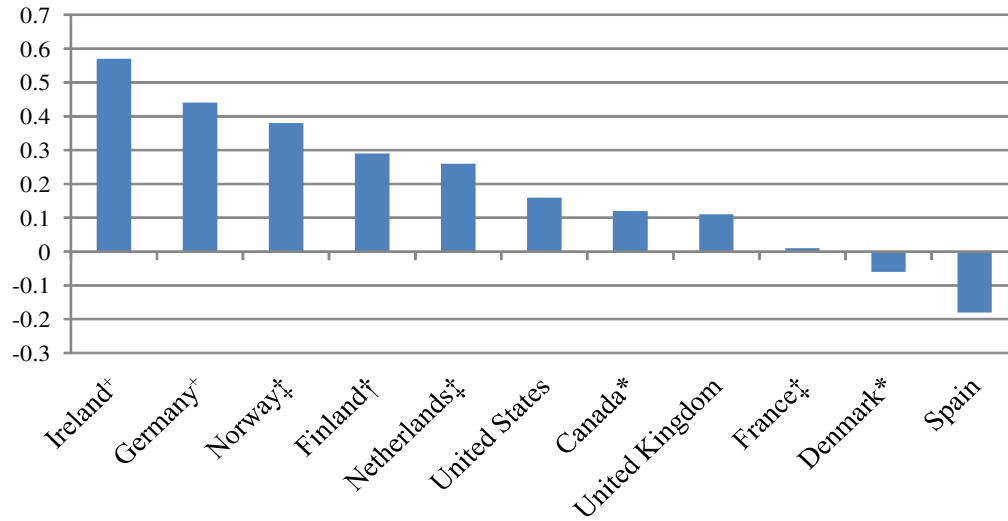
Note: *1987-2010, †1987-2013, + 1994-2010, ‡1986-2010.
Source: Table 2

2012; International Labour Organization, 2015).

Chart 7 presents the percentage point contribution to the wage-productivity gap made by changes to labour's share of income over time. Notably, in three of OECD's countries, Spain, Denmark, and France, labour's share of income either held steady or improved. Labour's share of income fell the most in Ireland, in large part as a result of capital's share increasing as foreign firms moved their headquarters there due to favourable tax treatment.

So far as the importance of labour's share of income to the overall productivity-wage gap, Table 2 presents the per cent contribution it made. In five of the 11 OECD countries studied (Finland, Ireland, the Netherlands, Norway, and Spain), labour's share of income made a contribution well in excess of 50 per cent.

Ultimately, a decline in labour's share of income over the period as a whole indicates that labour's bargaining power has been falling relative to that of capital. In terms of our decompo-

sition, a decline in labour's share of income over time leads to an increase in the overall gap.

The causes of labour's deteriorating bargaining power are hotly debated. One of the most trumpeted causes is globalization. Proponents argue that capital is far more mobile than labour in an increasingly globalized world, which makes the threat of outsourcing and offshoring far more credible. Due to the threat of offshoring from countries with less strict labour regulations and lower labour costs, workers are increasingly forced to accept lower wages.

Some argue that labour's deteriorating bargaining power is less a matter of globalization and more a matter of technological change which is biased against labour. For example, the OECD (2012) argues that the spread of information and communication technologies have led to major innovation and productivity gains over recent decades, but have also had the effect of replacing workers altogether. The result is an increase in capital's bargaining power, and a decrease in labour's — particularly for workers in highly repetitive jobs which naturally lend

Chart 8: Hourly Real Wage Growth for Median and the Top One Per Cent, Selected OECD Countries, 1986-2013 (average annual per cent change)
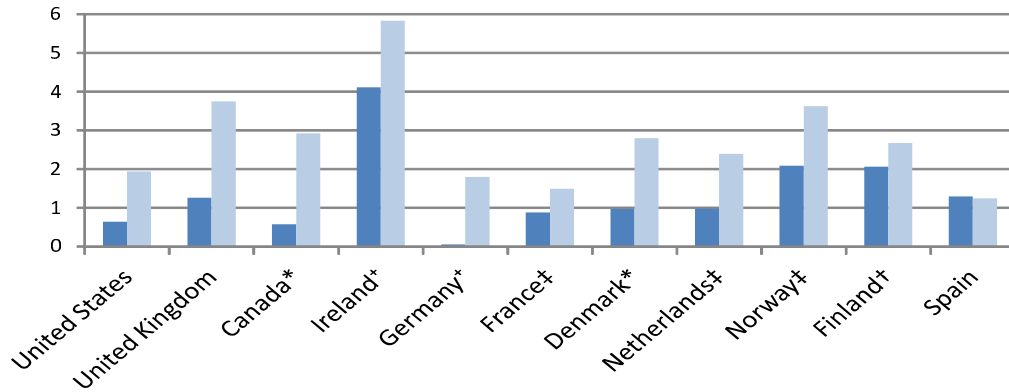
Note: *1987-2010, †1987-2013, + 1994-2010, ‡1986-2010.
Source: Household Survey Microdata from Luxembourg Income Survey

Chart 9: Ratio of the Average Wage of the Top One Percent to the Median Wage, Selected OECD Countries, 2013
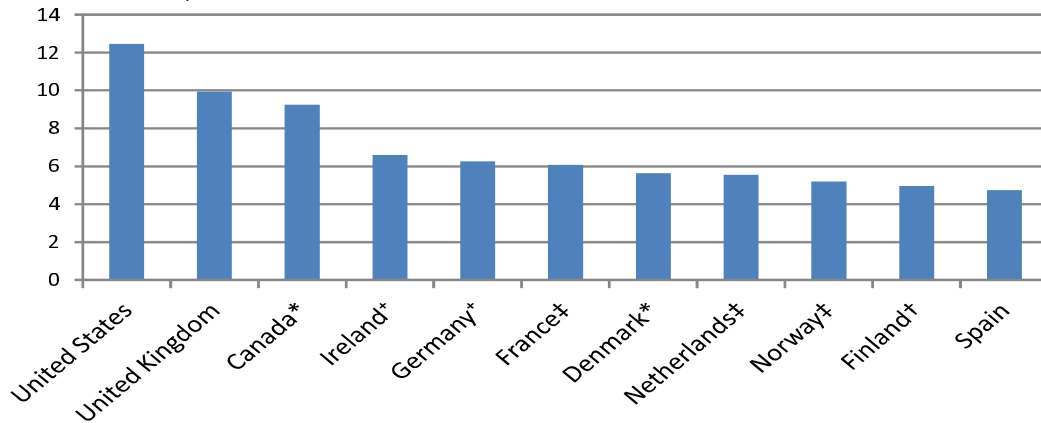
Note: *last year available is 2010.
Source: Household Survey Microdata from Luxembourg Income Survey

themselves to automation. Structural and institutional reforms may also have contributed to the reduction of labour's bargaining power.

Alternative Measures of Wage Inequality

The measure of wage inequality used in the analysis so far has been to compare the national average median to hourly real wages. While this measure captures whether or not the distribution is becoming more positively skewed overall, it does not capture developments throughout the distribution. For example, it may be the case that the median is growing at a similar rate as the mean, but the tails of the distribution are being stretched apart as those on the left tail experience little growth and those on the right tail experience extreme growth or vice versa (i.e. the distribution's skew may remain largely unchanged but the height of the distribution may be changing). There are several alternative measures of wage inequality, such as the wage Gini coefficient, the ratio of the 90th percentile of wages to the 10th per-

Table 4: Top One Percent's Share of Total Labour Income, per cent, Selected OECD Countries, 1986 and 2013

	1986	2013	Percentage-point Change
United States	6.3	9.1	2.8
United Kingdom	4.5	7.6	3.1
Canada*	4.8	7.5	2.7
Germany*	4.5	5.5	1.0
Denmark*	3.6	5.4	1.8
France*	4.6	5.3	0.7
Ireland*	4.7	5.3	0.6
Netherlands*	3.8	5.0	1.2
Norway*	3.4	4.7	1.3
Finland*	3.8	4.4	0.6
Spain	4.4	4.1	-0.3

Note: *last year available is 2010.
Source: CSLS calculations based on microdata from Luxembourg Income Survey

centile, or the ratio of the 90th percentile to the 50th, as well as growth for the top one per cent of wage-earners. Unlike SNA data, household surveys allow us to investigate how the wage distribution is evolving by focusing on the wage growth experienced by certain percentiles or subsamples. Mechanically, this decomposition is the same as the decomposition we have been employing throughout this article, with one change: we supplement the median with a percentile such as the top 1 per cent of the statistic of interest.

Chart 8, which is based on microdata, compares the real hourly wage growth of the median worker in a given country with the average real hourly wage growth of workers in the top 1 per cent of wage-earners.

It shows the sobering fact that the wages of highly paid workers have greatly outpaced the wages of workers in the middle of the wage distribution. In all countries except Spain. It is also important to consider the levels of wages to gauge the degree of wage inequality in these countries. Chart 9 provides the ratio of the wage of the top one percent to median wage as a measure of the level of wage inequality in a given

country. The United States has by far the highest level of wage inequality using this measure, with the top one percent earning on average more than 12 times median income. Canada and the United Kingdom also have higher levels of inequality than the other 8 countries.

The proportion of the wage income of the top one per cent in total labour income has grown (Table 4). The OECD (2012) has documented labour's falling share of income, and found that removing the top one percent from labour income doubled the rate of decline of labour's share of income in Canada and the United States. In fact, the removal of the top one per cent from total labour income hastened the decline in labour's share of income in all of the OECD countries they studied except Spain.

Table 5: Decomposition of the Gap between Labour Productivity and Real Wages Growth at Six Points in the Wage Distribution, in Selected OECD Countries

United States, 1986-2013

	Per cent per year			Percentage Point Contribution			
	Labour Productivity	Hourly Real Wage	Productivity-Wage Gap	Inequality	Employer Social Contribution	Labour's Terms of Trade	Labour's Share of Income
25th percentile	1.63	0.15	1.47	0.52	0.24	0.57	0.16
Median	1.63	0.64	0.99	0.03	0.24	0.57	0.16
75th percentile	1.63	0.34	1.28	0.33	0.24	0.57	0.16
One Percent	1.63	1.94	-0.31	-1.27	0.24	0.57	0.16
the Rest	1.63	0.44	1.19	0.23	0.24	0.57	0.16
Below Median	1.63	0.56	1.06	0.11	0.24	0.57	0.16

Canada, 1987-2010

25th percentile	1.18	0.40	0.78	0.52	0.15	-0.02	0.12
Median	1.18	0.57	0.62	0.36	0.15	-0.02	0.12
75th percentile	1.18	0.68	0.50	0.24	0.15	-0.02	0.12
One Percent	1.18	2.92	-1.74	-1.99	0.15	-0.02	0.12
the Rest	1.18	0.80	0.38	0.13	0.15	-0.02	0.12
Below Median	1.18	0.40	0.78	0.53	0.15	-0.02	0.12

Denmark, 1987-2010

25th percentile	1.61	1.08	0.73	0.11	0.67	0.02	0.06
Median	1.61	0.97	0.64	0.01	0.67	0.02	0.06
75th percentile	1.61	1.05	0.56	-0.07	0.67	0.02	0.06
One Percent	1.61	2.80	-1.19	-1.82	0.67	0.02	0.06
the Rest	1.61	0.90	0.71	0.08	0.67	0.02	0.06
Below Median	1.61	0.42	1.20	0.57	0.67	0.02	0.06

Finland, 1987-2013

25th percentile	2.20	1.97	0.15	0.12	-0.22	-0.04	0.29
Median	2.20	2.06	0.14	0.11	-0.22	-0.04	0.29
75th percentile	2.20	2.04	0.07	0.05	-0.22	-0.04	0.29
One Percent	2.20	2.67	-0.55	-0.58	-0.22	-0.04	0.29
the Rest	2.20	2.06	0.05	0.03	-0.22	-0.04	0.29
Below Median	2.20	2.04	0.07	0.05	-0.22	-0.04	0.29

France, 1986-2010

25th percentile	1.71	0.64	1.07	0.18	0.71	0.18	0.01
Median	1.71	0.88	0.83	-0.06	0.71	0.18	0.01
75th percentile	1.71	1.22	0.48	-0.41	0.71	0.18	0.01
One Percent	1.71	1.49	0.22	-0.67	0.71	0.18	0.01
the Rest	1.71	0.78	0.93	0.04	0.71	0.18	0.01
Below Median	1.71	0.47	1.24	0.35	0.71	0.18	0.01

UK, 1986-2013

25th percentile	1.65	1.31	0.33	0.44	0.10	-0.32	0.11
Median	1.65	1.26	0.39	0.49	0.10	-0.32	0.11
75th percentile	1.65	1.50	0.14	0.25	0.10	-0.32	0.11
One Percent	1.65	3.75	-2.10	-2.00	0.10	-0.32	0.11
the Rest	1.65	1.62	0.02	0.13	0.10	-0.32	0.11
Below Median	1.65	1.30	0.35	0.45	0.10	-0.32	0.11

Ireland, 1994-2010

25th percentile	3.75	3.48	0.25	1.51	-2.03	0.20	0.57
Median	3.75	4.11	-0.36	0.88	-2.03	0.20	0.57
75th percentile	3.75	5.15	-1.43	-0.16	-2.03	0.20	0.57
One Percent	3.75	5.83	-2.10	-0.84	-2.03	0.20	0.57
the Rest	3.75	4.96	-1.24	0.03	-2.03	0.20	0.57
Below Median	3.75	3.75	-0.02	1.24	-2.03	0.20	0.57

Netherlands, 1986-2010

	Per cent per year			Percentage Point Contribution			
	Labour Productivity	Hourly Real Wage	Productivity-Wage Gap	Inequality	Employer Social Contribution	Labour's Terms of Trade	Labour's Share of Income
25th percentile	1.27	0.23	1.03	0.84	-0.13	0.06	0.26
Median	1.27	0.98	0.29	0.09	-0.13	0.06	0.26
75th percentile	1.27	1.24	0.03	-0.17	-0.13	0.06	0.26
One Percent	1.27	2.39	-1.13	-1.32	-0.13	0.06	0.26
the Rest	1.27	1.02	0.25	0.05	-0.13	0.06	0.26
Below Median	1.27	0.42	0.84	0.65	-0.13	0.06	0.26

Norway, 1986-2010

25th percentile	1.80	2.34	-0.56	-0.03	0.26	-1.16	0.38
Median	1.80	2.09	-0.28	0.22	0.26	-1.16	0.38
75th percentile	1.80	2.15	-0.37	0.16	0.26	-1.16	0.38
One Percent	1.80	3.62	-1.84	-1.31	0.26	-1.16	0.38
the Rest	1.80	2.25	-0.47	0.05	0.26	-1.16	0.38
Below Median	1.80	2.11	-0.33	0.20	0.26	-1.16	0.38

Spain, 1986-2013

25th percentile	1.05	1.39	-0.33	0.13	-0.27	-0.01	-0.18
Median	1.05	1.29	-0.24	0.23	-0.27	-0.01	-0.18
75th percentile	1.05	1.59	-0.53	-0.07	-0.27	-0.01	-0.18
One Percent	1.05	1.24	-0.19	0.28	-0.27	-0.01	-0.18
the Rest	1.05	1.53	-0.48	-0.01	-0.27	-0.01	-0.18
Below Median	1.05	1.28	-0.22	0.24	-0.27	-0.01	-0.18

Germany, 1994-2010

25th percentile	1.39	-1.43	2.82	1.86	-0.07	0.59	0.44
Median	1.39	0.05	1.34	0.38	-0.07	0.59	0.44
75th percentile	1.39	0.68	0.71	-0.25	-0.07	0.59	0.44
One Percent	1.39	1.80	-0.41	-1.37	-0.07	0.59	0.44
the Rest	1.39	0.36	1.03	0.07	-0.07	0.59	0.44
Below Median	1.39	-0.93	2.32	1.36	-0.07	0.59	0.44

Source: CSLS Calculations nased on microdata from Luxembourg Income Survey

We can also consider the first and third quartiles (i.e. the 25th and 75th percentiles), as well as the prevailing wage of the top one percent, the rest, or those below median wage.[11] For the three latter subsets, we use the average hourly real wage of the subset in our decomposition. We use the average of the subset rather than the median of the subset because we want to capture the effect of high or modest-income earners pulling the average in one direction or another: we want to estimate how wages have changed for the group on the whole.

Table 5 displays the decomposition results using alternative wage measures in place of the median wage for all 11 countries in our dataset (The results using the median are also displayed for the sake of comparison.) The productivity-wage growth gap in the United States is largest when the median wage is used. This reflects the fact that real wage growth over the 1986-2013 period was lower at the median than at other points throughout the wage distribution. That being said, four of the five alternative real wage measures grew more slowly than labour productivity over the period. Only the wages of the top one per cent grew faster than productivity growth.

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11 The latter three groups are subsets of the population. The top one per cent the subset of all those with income above the 99th percentile. The Rest is the complement of the top one per cent, and consists of all those who do not earn an income above the 99th percentile. The below median wage set is, as the name states, the subset of all of those with income below the 50th percentile.

Chart 10: Real Hourly Wage Growth by Percentile, United States, (average annual rate of change), 1986-2013
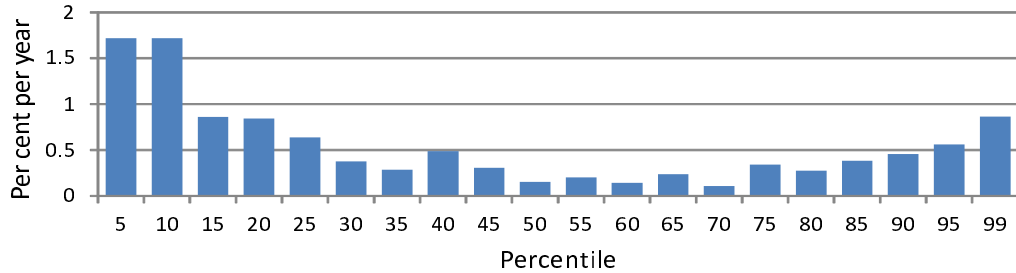
Source: CSLS calculations based on microdata from Luxembourg Income Survey

Chart 10 provides a closer look at the individual percentiles for the United States. Hourly real wage growth in the United States for the period studied was largely below 0.40 per cent per year roughly between the 35th and 70th percentiles. Otherwise, hourly real wage growth tended to be far closer to or above average hourly real wage growth for the whole wage distribution (0.67 per cent per year). By focusing on the median we inadvertently chose the group in the United States which appears to haveexperienced the least hourly real wage growth from 1986 to 2013.

These results convey a narrative all too familiar. In the United States, the middle income earners have experienced far less growth over the past decades than high or modest income earners.

The same picture obtained for most of the other 10 countries in Table 5. The hourly wage growth of the top one per cent exceed growth of productivity in all countries, even in the three countries where wage growth had exceeded productivity growth.

Conclusion

Labour productivity growth outstripped median hourly real wage growth for the past few decades in eight of the 11 OECD countries studied. For these countries, we decomposed the growing productivity-wage gap into four com-

ponents: inequality, employement contributions to social insurance, labour's terms of trade, and labour's share of income. The size of the productivity-wage gap varied by country, as did the components driving its growth. Increasing inequality and labour's falling share of income increased the productivity-wage gap in most of the countries studied.

The productivity-wage gaps in the United States and Germany were significantly larger than any of the other countries studied. The former's gap was largely driven by and labour's increasingly unfavourable terms of trade, while the latter's gap was driven by these two factors and a decline in labour's share of income.

We also show that despite indications of growing wage inequality in 10 of the 11 OECD countries, our inequality measure fails to capture a number of aspects of the overall evolution of the wage distribution. For example, while the ratio of average to median wages in the United States has shown overall increases, there has been increased equality between middle and modest income earners.

Future research should seek to reduce the likihood that measurment error or definitional differences across countries are responsible for differences in trends. Wage data may be improved by using household surveys directly as opposed to accessing them through the Luxembourg Income Study. For example, using the

Labour Force Survey for Canada it is possible to create an annual wage series without needing to interpolate missing values from 1997 to 2016.

The lack of inclusive growth we observe in many OECD countries has significant societal implications. There may be less political support for productivity-enhancing policies in the future if the benefits of productivity growth are not shared equitably. The incentives for employees to work hard may diminish if they believe that they are not receiving their "fair share" of the firm's productivity gains. Finally, the current taxes and transfers system may not be well equipped to offset the growing trend of wage inequality among workers if it was designed assuming labour productivity growth will lead to real wage growth for all workers.

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