

Almosova, Anna; Voigts, Simon; Burda, Michael

Conference Paper

Social Security Contributions and the Business Cycle

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2017: Alternative Geld- und Finanzarchitekturen - Session: Business Cycles I, No. F07-V3

Provided in Cooperation with:

Verein für Socialpolitik / German Economic Association

Suggested Citation: Almosova, Anna; Voigts, Simon; Burda, Michael (2017) : Social Security Contributions and the Business Cycle, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2017: Alternative Geld- und Finanzarchitekturen - Session: Business Cycles I, No. F07-V3, ZBW - Deutsche Zentralbibliothek für Wirtschaftswissenschaften, Leibniz-Informationszentrum Wirtschaft, Kiel, Hamburg

This Version is available at:

<https://hdl.handle.net/10419/168134>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Social Security Contributions and the Business Cycle

Anna Almosova

Humboldt Universität zu Berlin and CRC 649

Michael C. Burda

Humboldt Universität zu Berlin, CEPR, IZA and CRC 649

Simon Voigts

Humboldt Universität zu Berlin and CRC 649

Abstract: This paper examines magnitudes and business cycle dynamics of social security contributions (SSC). In most OECD countries studied, we document a negative covariation of payroll tax burdens with GDP and GDP growth at business cycle frequencies and lower, falling in booms and rising in recessions. We assess the overall magnitude of the distortion following Barro and Redlick (2009). For most countries, average marginal SSC tax rates exceed overall average rates, but the latter tracks the former tightly. Changes in average payroll tax burdens are mostly accounted for by tax schedule changes, and not to changes in the earnings distribution over time. SSC rates behave similarly to estimated values of the “labor wedge” (Chari et al. 2007, 2016) in these countries.

JEL Codes: E24, E32, J32, H55

Keywords: business cycle, payroll tax, social security contributions, labor wedge

This paper has benefited from the research assistance of Thomas Dengler, Tobias König and Judith Sahling and from the comments of Thiess Büttner, Peter Egger, Rick van der Ploeg, participants at the 2016 CES-Ifo Area Meeting in Public Economics and the DFG SPP 1764 Third Internal meeting for useful comments. The support of the Collaborative Research Center 649 and Schwerpunktprogramm 1764 of the German Science Foundation (Deutsche Forschungsgemeinschaft) is gratefully acknowledged.

1. Introduction

Throughout the developed world, social insurance programs – including unemployment benefits, work disability insurance programs, health insurance, old-age pensions as well as other programs aimed at social inclusion – redistribute a significant share of a country's national income. This redistribution is financed to a large part by social security contributions (SSC). Representing more than half of the total tax on labor income in OECD member countries, SSC are little different from dedicated payroll taxes, and dominate the difference between employers' costs of labor and the direct monetary benefit received by workers. Even though workers' take-home earning may be supplemented by real or perceived benefits paid for by social security programs, it is still likely that SSC constitute a distortionary wedge in the worker-firm relationship.¹ In 2013, total SSC in OECD countries amounted to about \$4.4 trillion, or about 9 percent of GDP; in some economies, social security contributions represented as much as 19 percent of a country's GDP or 40 percent of total labor compensation.

This paper investigates the cyclical behavior of social security contributions in 25 OECD countries over the period 1960-2015. To our knowledge, the origins and the dynamics SSC over the business cycle have yet to be systematically studied.² We document that for a majority of countries and time intervals, average SSC rates (defined as the total SSC divided by the total gross labor compensation) vary counter-cyclically with respect to growth and output, especially at business cycle frequencies, declining in booms and rising in recessions. This feature is not shared by all countries, especially those in which the value-added tax and

¹Gruber (1997) argues that labor supply may be higher despite lower take-home pay and thereby offset the distortion if workers associate additional compensation with payroll taxes (i.e. health benefits, pension rights, unemployment insurance) not purchased in the market; yet there is no reason to expect this offset to be perfect.

²Burda and Weder (2016) report similar regularities in a smaller group of countries and show how countercyclical labor taxation increases the volatility of unemployment and vacancies in a DSGE model with labor market frictions. See also Gali et al (2007) and Vegh and Velutin (2013).

other sources of general revenue cross-subsidize social security budgets. Because payroll taxation represents the average burden of a worker-job match in a frictional labor market, this cyclical behavior has potentially important implications for labor market dynamics.³

There are two prominent reasons for the cyclical behavior of payroll taxation. First, holding tax schedules constant, shifts in the distribution of gross labor earnings change the SSC burden relative to the wage bill if, for example, the tax schedule consists of different piecewise linear brackets. Second, the tax schedule may itself be adjusted in order to meet revenue shortfalls in recessions and trim surpluses in boom. A “Bismarckian” balanced budget principle requires increases in SSC rates in downturns to offset a declining tax base; it may mandate rate cuts in good times. In order to quantify the relative importance of these two alternatives, we propose an accounting framework to decompose the movement in average SSC rates. We find that the lion’s share of observed changes in annual average contributions rates is directly due to adjustments in statutory tax schedules. Using ideas from Barro and Redlick (2008) we show that these average tax fluctuations are highly correlated with effective marginal tax rates, with the latter exceeding the former in almost all cases. Our estimates are correlated with estimates of the “labor wedge” described by Chari et al (2007) and Brinca et al (2016) in their business cycle accounting framework.

The rest of the paper is organized as follows. Section 2 presents the data and long-run observations. Section 3 discusses long-term characteristics of social security contributions in our sample. Section 4 shows empirical findings on cyclical properties of contribution rates and proposes a decomposition to assess the reasons for this behavior at cyclical and lower

³As discussed below in more detail, the possibility that this distortion may fluctuate over time may offer an account of cyclical variation of output and employment at business cycle frequencies (see Chari, et al. 2007). Burda and Weder (2016) show that a countercyclical payroll tax burden driven by a balanced budget constraint can help explain the Hall-Shimer anomaly. Voigts (2015) shows that the nominal incidence of social security contributions for households and firms in model with nominal rigidities can overturn tax liability equivalence and significantly affect the nature of business cycle fluctuations.

frequencies. Section 5 investigates the behavior of the SSC tax burden using a business cycle accounting framework along the lines of Chari, et al. (2007). Section 6 concludes.

2. Data description and trends

2.1 Average contribution (payroll tax) rates

We construct our standard measure of average social security contributions paid by firms and workers and expressed as a fraction of total wage costs (henceforth: SSC rate) using two time series published by the OECD.⁴ These annual data from 25 advanced countries range from 1960 to 2015. The first times series, “Social Security Contribution Received by General Government,” includes contributions to pension funds, disability and health insurance, as well as unemployment insurance and related programs.⁵ The second series is “Compensation of Employees”, defined as the sum of wages, salaries and social insurance contributions paid by employers directly or on behalf of their employees.

Table 1 displays SSC relative both to GDP and overall labor compensation and shows that they are significant in OECD economies. In Austria, France, Germany, and the Netherlands, SSC account for about 20% of GDP and more than 30% of total labor compensation. For most other European countries in the sample, social contribution account for 10-15% of GDP and around 20-30% of total labor compensation, while less than 5% of GDP or 10% of total labor compensation in the US, Canada and New Zealand.⁶ Since we are interested in the size of labor market distortions in a form of a “labor wedge”, we focus only on the sum of employer and employee contributions, and exclude personal income taxes and

⁴ *OECD Economic Outlook 95* (2015).

⁵ Households can make social security payments to the government or a governmental or non-government agency, or even private social security funds, with a breakdown varying over different countries. Transfers to non-government funds are not included in our measure. For example, in the Netherlands, private disability insurance is not included in government social security receipts (See OECD 2007). We repeated our analysis for several countries using social security payments by households and obtained very similar results.

⁶ Because we only analyze contributions into a social security system and not payments that employees receive from social security funds, our measures in Table 1 understate the size of the social security system (in Canada or Denmark, for example).

indirect taxation (e.g. value-added taxes), which affect the taxation of household income deriving from market activity in general. The first and second columns summarize the size of the labor wedge and a magnitude of government interventions rather than the overall importance of the social security system in a particular country, captured in third column.

<Table 1 here>

Define τ_t^A , the average SSC rate in year t , as simply the ratio of social security contributions to the wage bill:

$$\tau_t^A = SSC_t / wage\ bill_t$$

Figure 1 presents τ^A for all countries of our sample.⁷ While the OECD computes similar indicators, ours aggregates over all types and sums employer and employee payments. It is reasonable to assume that it is the total SSC payment on a unit of labor earnings that a worker and a firm take into account when entering into an employment contract and may be thought of as the unconditional average SSC rate faced by a worker-employer match. The average SSC rate thus a good indicator of labor market distortions due to social security taxation.

<Figure 1 here>

2.2 Marginal payroll tax rates

Average SSC rates displayed in Figure 1 and in the first column of Table 1 do not necessarily provide an accurate measure of the distortionary impact of labor taxes, because they do not represent the marginal tax burden arising from SSC. Barro and Sahasalul (1983, 1986) and Barro and Redlick (2009) construct average marginal tax rates series with US data

⁷The OECD constructs “Average rate of employees’ social security contributions” and “Average rate of employers’ social security contributions” for eight different household types. See: <http://stats.oecd.org/Index.aspx?DataSetCode=AWCOMP#> Both OECD indicators are calculated starting from year 2000, while our series begin in 1960 for most countries.

to address this issue (see also Joines 1981 and Seater 1982). The idea is to construct a weighted central tendency of marginal tax rates for individuals at various points of the earnings distribution in the economy. The weights measure the relative importance of a particular individual.⁸ In a similar spirit, we construct series of average marginal SSC rates with data on tax codes taken from the OECD database “Taxing Wages 2016”, which covers 32 countries from 1981 to 2015. The dataset provides complete annual data for each country’s tax schedule, including tax brackets and respective rates for non-linear schedules.⁹ Almost all countries in our sample have separate tax schemes for employers and employees. For our purposes, marginal rates for corresponding tax brackets on either side are simply added together, resulting in a consolidated payroll tax schedule for the worker-firm match.¹⁰

SSC schedules differ considerably across OECD countries in our sample: In 2015, Belgium, Hungary, Greece, Finland, New Zealand and Slovenia had a flat payroll tax schedule, while Iceland, Denmark and Spain use lump-sum payments or fixed minimum contributions for all workers. The remaining countries in the sample have progressive or regressive tax schemes with different marginal SSC rates applied to different levels of earnings. In 2015, 10 of 26 countries covered by our dataset capped social security contributions at some earnings level above which the marginal SSC rates is zero. Countries with a maximum taxable level of income were Austria, Canada, Germany, Greece, Israel, Italy, Netherlands, Slovak Republic and Spain. Figure 2 displays SSC tax schedules for six representative countries in 2015, with level of labor compensation subject to social security

⁸ Barro and Sahasakul (1983) use shares of individual consumption in aggregate consumption as weights, other approach might be income-weighted or population-weighted averages.

⁹ Our dataset and detailed descriptions of the social security systems are available on request.

¹⁰ This procedure ignores lump-sum payments and fixed minimum contributions. These payments are independent of the business cycle and, presumably do not distort the margin concerning hours worked. We also ignore the fact that in some countries tax schedules vary depending on the family status. For this reason, some countries with a complex tax structure (e.g. Norway) were excluded from our dataset. All threshold values for earnings are reported at an annual basis.

contributions on the horizontal axis, and the corresponding marginal SSC rate applied on the vertical axis.

<Figure 2 here>

We use this information to construct a rough measure of marginal SSC taxation for countries represented in the OECD database “Distribution of gross earnings of full-time employees.”¹¹ This dataset consists of annual observations of nine wage deciles of the gross earnings distribution of full-time employees in 27 OECD countries for 1975-2010 (in hourly, weekly, monthly or annual frequency depending on the country). We apply the statutory contributions schedule to standardized annual earnings including the cap to each of the i^{th} deciles $i \in \{1, 2, \dots, 9\}$ of the contemporaneous earnings distributions (excluding here employers’ contributions) and arrive at a marginal tax rate τ_{it} (i.e. the SSC tax rate applicable to additional gross compensation). An unweighted average over the nine marginal rates yields the following “average marginal tax rate” $\bar{\tau}_t = \frac{1}{9} \sum_{i=1}^9 \tau_{it}$. For a given year and country, observations can be constructed only if data for both the tax schedule and wage distribution are available. For 13 countries in our OECD sample, this requirement is satisfied for 10 years or more. Figure 3 displays the time series of average marginal rates (red dashed lines), as well as average SSC rates described in Section 1 (blue solid lines). In all countries except Austria, Canada and Japan, average marginal rates are higher than the average SSC tax burden. The reason is that aggregate consolidated tax schedules are regressive (and/or truncated) in most countries as evident from Figure 2, so low-income workers tend to face the highest marginal rates. The results suggest that average rates understate the distortionary effect of SSC.

Consider the following simple example. A population consists ten families: two with gross earnings of 20,000, four with gross income of 40,000, three earning 60,000, and one earning 100,000, and these families face a truncated SSC schedule that levies a uniform 30%

¹¹Available under <http://www.oecd.org/els/emp/39606921.xls>

tax on gross income up to 65,000, but 0% on income above 65,000. Then the average SSC tax rate (τ) in this ten-family economy is about 9.0%; the average marginal rate defined as $\tau_t^* = \sum_{j=1}^{10} \min(\tau_{jt}, \tau_t^{\max}) / 10$ for the tax threshold $\tau_t^{\max} = 0.3$ is 27%, three times the average burden.

It also appears that the average payroll or SSC tax rates moves closely with the marginal rate, which represents an average impact of statutory rates at the margin for nine representative earners. For each country, the correlations between the two is presented in the panels of the graph and support this assessment. The average tax rate appears to be a good rough indicator of levels and especially changes in the marginal distortion for the average marginal tax rate, or the tax rate relevant for labor supply decisions.

<Figure 3 here>

3.3. Tracking the origins of changes in average marginal tax rates

Given the rich source of payroll tax schedules available, it is possible to explore the source of the change in τ over time. The average tax burden can change for a number of reasons. First, the tax schedule may change. Changing rates or contribution ceilings can have large effects on aggregate contributions actually paid. Second, the distribution of earnings may shift, implying higher rates applied for the marginal income, or possibly lower rates, if the marginal income lies above the cutoff threshold income level. This shift need not only involve the first moment of the distribution, because shifts in variance, and higher moments also matter for the overall tax burden.

Let expand our example of the previous section. Suppose that the economy experiences 10% earnings growth, so two families earn 22,000, four earn 44,000, three earn

66,000, and the top family earns 110,000.¹² For the three families at 66,000, the marginal tax rate has dropped to zero, while tax revenues have risen but only from the lower six families, so the average marginal tax rate is now 8.9, but the average marginal rate has fallen to 18%.

4. Trend and cyclical properties of SSC rates

4.1. Low frequency movements

Before considering business cycle frequency properties of our constructed series in Section 3, we examine the medium to long trends in the average social security contributions rate. It is instructive to begin with the case of Germany, the largest EU economy with an extensive social security system that is financed to a large extent by SSC. Figure 4 shows that, over 45 years, Germany experienced a secular rise in the level of SSC rates of almost 15 percentage points, peaking in 1998. This rise was reversed somewhat in the time since then, especially after 2003-4, the years of the Hartz labor market reforms. The sharp rises in social contributions coincide with periods of sharp economic downturn or structural change (the two oil crises of the 1970s, the German reunification episode).

<Figure 4 here>

The hypothesis that growth downturns are followed by increases in SSC rates finds support in many of the countries examined in this study. Figure 5 presents cross-correlograms up to order 10 for the annual data of the countries with sufficient observations for leads and lags of annual growth ($\Delta \ln Y_t$ with τ_{t+i} for $i = -10, -9, \dots, 0, \dots, +9, +10$). The most salient finding is a robust statistical significance of the correlations of current $\Delta \ln Y_t$ with τ_{t+i} for $i > 0$ (future payroll tax rates) of the continental European countries Austria, Belgium, France, Italy, Spain, and Sweden as well as their “Bismarckian offshoots” Japan, South Korea and the United

¹² If the cap is not adjusted for inflation, the distinction between real and nominal wage gains is irrelevant.

States. The correlation of rates with future output, while negative in these countries is less strong and consistent. In contrast, countries with insurance programs in the tradition of Beveridge (the UK, Canada, Australian, and New Zealand) show little or no correlation.¹³ This raises the general suspicion that the SSC rates are driven by economic conditions. A leading hypothesis is that rising wage bills make more resources are available for redistribution purposes.

<Figure 5 here>

Policies which reinforce distortions in downturns have potentially severe consequences for allocative efficiency. Daveri and Tabellini (2000) present evidence that labor taxation is a first order cause of high unemployment in OECD economics at low frequencies; it stands to reason that they could also act as a wedge in the sense of Chari et al. (2007, 2016) and possibly represent a “smoking gun” responsible for business cycle dynamics.

4.2. Cyclical properties of SSC rates

The findings presented in Figure 4, while relatively unambiguous for some countries, may be confounded by low-frequency trends in the data. During the sample period, growth was on a downward trend while the scope of social insurance programs were expanded across the OECD, so the strong negative correlations may be spurious due to a low-frequency, common trend. In this section, we report results for several detrending procedures and study the association at business-cycle frequencies corresponding to a periodicity of roughly 2-7 years. We also examine the robustness of correlations over the sample for signs of potential sub-sample instability.

Table 2 provides a first account of these dynamics. The first two columns show the average level of the SSC rate over the two sub-periods, while the third and fourth columns

¹³The findings of Burda and Weder (2016) suggest that over the period 1970-2010, the Netherlands and Sweden moved from a Bismarck-style regime to a Beveridge one, while the US has moved in the opposite direction since the 1980s.

present coefficients of variation over those same subperiods. For roughly half the countries, the average payroll tax burden has increased, sometimes significantly, as in Germany. The last two columns present correlations of HP-filtered trend deviation of average SSC rates and the natural log of output for the two subsamples as well as the entire period. Over the entire interval, the results roughly confirm the split identified in the previous section between continental European countries with negative correlations (Austria, Belgium, Finland, France, Germany) versus the Beveridge countries (UK, the Scandinavian countries, the US, and the Netherlands, and Italy). The subperiod correlations reveal regime shifts for the US, Sweden, the Netherlands, Iceland, South Korea and Spain. Of these, only Sweden and the Netherlands moved from a Bismarck to the Beveridge paradigm. The US seems to have moved in the opposite direction.

<Table 2 here>

The HP filter has been criticized for inducing spurious cyclicity (e.g. King and Rebelo, 1993, Cogley and Nason, 1995). To examine the robustness of our findings, we compute the correlations using alternatives to HP-filtered data: 1) first differences, 2) the band-pass filter (Burnside and Christiano, Fitzgerald, 2003) with lower and upper periodicity bounds of (2, 8) and (3, 7), returning components with frequencies in the interval $[\pi/4, \pi]$ and $[2\pi/7, 2\pi/3]$, respectively. The results are collected in Table 3 for the sample 1960-2012. To facilitate the comparison between correlations derived under different filtering methods, the last column shows a one-dimensional plot of the magnitudes of the four correlation coefficients for each country.

<Table 3 here>

Table 4 again shows correlation coefficients for different filters, but with SSC rates leading or lagging one period. We report dynamic correlations because a reaction of SSC rates

to business cycle fluctuations can potentially be delayed, provided that it is caused by adjustments in the tax schedule. The reason is that policy action might be subject to a decision lag as well as to a data collection lag.

<Table 4 here>

In most countries, the lead of average SSC rates is indeed strongly countercyclical, and this finding is robust to the detrending method. For Germany, the UK, Denmark, Finland, Japan, Norway and Canada, dynamic correlations for one period ahead average SSC rates are negative and even stronger than contemporaneous correlations. For the UK, the Czech Republic and Denmark, the contemporaneous correlation is positive (see Table 2), while the correlation between GDP in period t and the average SSC rate in period, $t+1$ is negative. Italy and Norway appear to have a positive co-movement of average SSC rates and the log of GDP both contemporaneously and with average SSC rate lead one period. In the US the contemporaneous correlation become negative after 1990, as we pointed out in the context of Table 2. Correlation of SSC rate lead is however positive when the whole time period is considered.

We conclude that average SSC rates are counter-cyclical for many, but not all OECD countries. This dynamic pattern of social security contributions appears counter-intuitive: It implies that the distortionary wedge between labor costs of a firm and the net wage received by a worker worsens in business cycle downturns. The social security system may thus amplify business cycle shocks through the economy. More strikingly, SSC rates exhibit correlations with output at lower than business cycle frequencies, consistent with the findings of Daveri and Tabellini (2000).

5. Deconstructing the Mechanism: Reasons for cyclical SSC rates

Time variation in average SSC burdens observed in Figures 1 and 3 can originate either in discretionary policy adjustment of the tax schedule,¹⁴ or, given the structure of the SSC schedule, from the cyclical behavior of the wage distribution over time. To see how variability in the wage distribution can affect the average SSC rate, consider for example a regressive tax schedule as in Germany, France or Spain (see Figure 2). An overall increase in gross earnings during an expansion moves a larger fraction of taxable income falls into brackets with lower tax rates, so the average tax rate declines. Furthermore, if the tax schedule features a cut-off value of taxable income (as in Germany, France and Spain), a surge in gross earnings implies that a higher fraction of total gross compensation exceeds this threshold and is therefore not taxed at all. Similarly, a decline in earnings during a downturn means that a larger fraction of gross labor income falls into lower tax brackets with higher marginal tax rates (or lies below a cut-off value), so the average SSC rate is higher. Since tax schedules are not strictly linear for most countries in our sample, variability in the wage distribution is a potentially important driver for the observed variability in average SSC rates.

In this section we assess the relative importance of the two alternative explanations. To this end, we decompose changes in average SSC rates faced by nine representative earners into two components, one which captures changes caused by adjustments in tax schedules, and another one which is due to shifts in earnings distributions. We begin by constructing series of social security contributions by combining our dataset on tax schedules with data on gross labor earnings distributions. Again, we consider nine representative earners (indexed by i) associated with the nine deciles of the gross earnings distribution. In each period t , social security contributions paid by worker i with gross labor earnings of $W_{i,t}$ are given by

¹⁴ By “changes in the tax schedule” we mean all changes in the statutory tax scheme. This can be the adjustment of a single tax rate in a case of a linear schedule, or the adjustment of several tax brackets and corresponding rates in the case of a non-linear schedule.

$$SSC_{i,t} = \sum_{k=1}^K I(W_{i,t} - B_{k,t} > 0) \tau_{k,t} [\min(B_{k,t}, W_{i,t}) - B_{k-1,t}],$$

where $k \in 1, \dots, K$ indexes tax brackets of the SSC schedule $\{\tau_{k,t}, B_{k,t}\}$ stipulating tax rate $\tau_{k,t}$ applied to labor income greater than $B_{k-1,t}$ but less than $B_{k,t}$, where $B_{-1}=0$ and $I(.)$ is an indicator function.¹⁵ For this earner, $\tau_{i,t}^A = SSC_{i,t}/W_{i,t}$ and the overall synthetic indicator τ^{A*} of average payroll taxation over the nine deciles is simply the unweighted average of these nine average rates:

$$\tau_t^{A*} = \frac{1}{9} \sum_{i=1}^9 \tau_{i,t}^A$$

In contrast to average SSC rate τ^A computed in Section 2 as a ratio of two macro aggregates, this rate τ^{A*} is a synthetic average tax burden constructed from tax schedule data and computed using earnings data.

Because the two measures track each other fairly well, allows us to decompose year-to-year changes $\Delta \tau^{A*}$ as the sum of two components. The first, $\Delta \tau^S$ (for “statutory”);, is due to changes in the tax code between period t-1 and t applied to the distribution of earnings in period t-1. Formally,

$$\begin{aligned} \Delta \tau_t^S &= \frac{1}{9} \sum_{i=1}^9 \frac{\Delta SSC_{i,t}}{W_{i,t-1} L_{i,t-1}} \\ &= \frac{1}{9} \sum_{i=1}^9 \left\{ \sum_{k=1}^K \frac{I(W_{i,t-1} L_{i,t-1} - B_{k,t} > 0) \tau_{k,t} [\min(B_{k,t}, W_{i,t-1} L_{i,t-1}) - B_{k-1,t}]}{W_{i,t-1} L_{i,t-1}} \right. \\ &\quad \left. - \sum_{k=1}^K \frac{I(W_{i,t-1} L_{i,t-1} - B_{k,t-1} > 0) \tau_{k,t-1} [\min(B_{k,t-1}, W_{i,t-1} L_{i,t-1}) - B_{k-1,t-1}]}{W_{i,t-1} L_{i,t-1}} \right\} \end{aligned}$$

The second component τ^D (for “distribution”) is a residual, comprised of changes in the distribution of earnings at the tax structure in period t-1 plus second order effects due to the interaction of tax rate and earnings changes: $\tau^D = \tau^{A*} - \tau^S$.

¹⁵ We ignore lump-sum payments to social insurance, which are rare (Switzerland for example).

The plots for resulting changes are presented in Figure 6. For France, the wage component appears to offset the statutory component before 1990. After this point the SSC tax follows the policy component closely. Similar pattern is observed for the rest of the countries. Policy adjustments in the tax schedules are the primary source for the changes in total SSC payments. Table 5 additionally presents average absolute changes of actual average SSC rate, policy component, wage component and residual. The results show that average rate of change in SSC rates are close to the average rate of change in policy component. In Austria, France or UK the change in policy component is even stronger than the total change. The change due to the movements in wage distribution and residual counteract the changes due to policy and mitigate the total change. From the magnitudes we can conclude that policy component is a primary source for the total change in average SSC rates.

<Figure 6 here>

6. Interpreting SSC rates as a labor wedge

We have demonstrated a strong correlation of our SSC tax burden measure with output, both at business cycle and lower frequencies. Naturally, correlation is not causation, and a number of third factors might lie behind the macroeconomic co-movements. Yet any plausible explanation for a rise of SSC rates in a recession must appeal to 1) decline in employment 2) a decline in the wage bill 3) a reaction of the tax structure to compensate for the lost revenue. This mechanism is substantiated by our analysis of average statutory marginal tax rates, which also move upwards in recessions.

Crucial to any story, however, is the role of labor costs in explaining economic downturns. We conclude our analysis by comparing and investigating the properties of SSC rates with Chari et al.'s (2007) measure of the labor wedge and other measures of distortion in

their “business cycle accounting” framework for countries with sufficiently long series. This decomposition attributes components of deviations of realized GDP to four distortions from the path implied by the Ramsey-Cass-Koopmans optimal path. Chari et al. (2007) show that several broad classes of macroeconomic models can be mapped into four types of deviations from a putative steady state. While the method itself is not uncontroversial, it would seem that our measure of SSC rates should correspond, conceptually, to the labor market distortion described by Chari et al. (2007) as the “labor wedge”.

Table 6 presents correlations between our average SSC rates and three wedges computed with a business cycle accounting procedure. The first column compares average SSC and labor wedge which represents the discrepancy between marginal product of labor and a marginal rate of substitution of consumption for leisure. For most of the countries the correlation is positive and significant. This is especially true for the countries with highly countercyclical SSC rates: Germany, Greece, Finland, Japan, Belgium, Ireland, Poland, Canada, South Korea, Iceland and Spain. Countries with procyclical SSC rates have low or negative correlation between average SSC rates and labor wedge: USA, Hungary, Norway, and Czech Republic. We also computed government expenditures wedge and efficiency wedge. As we expected average SSC rates are negatively correlated with efficiency wedge and positively correlated with government consumption reflecting the idea of balancing tax revenues and spendings¹⁶. The evidence strongly suggests that SSC taxes embody an important labor market distortion of the type readily described by Chari et al. (2007) and Brinca et al. (2016).

<Table 6 here>

¹⁶ Similar correlations for Sweden can be found in Brinca (2013). Gali et al (2007), Hall (1997) discussed the countercyclical nature of labor wedge and Mulligan (1998, 2002) similarly shows that federal labor tax and labor wedge are highly correlated at low frequencies.

7. Conclusion

To the extent that the business accounting framework has any economic content, it should be possible to identify empirical counterparts to the distortions or “wedges” which prevent the representative agent from achieving the idealized path associated with the neoclassical growth model. We have identified one highly salient and measurable distortion in the labor market – payroll taxes or “social security contributions” as they are called in the OECD – which qualify as the empirical counterpart of the labor market distortion or “wedge.” Social security contributions rates co-move negatively with the business cycle in the majority of economies, especially in those in which social insurance is financed along the lines of Bismarckian principles. In good times when social insurance funds are flush with cash, contribution rates are cut; in bad times, rates are increased. Models of business cycle fluctuations that attribute a significant role to endogenous propagation arising from labor market distortions should thus directly model dynamics of the payroll tax as an important, if not central component of that mechanism. Models capable of explaining low frequency fluctuations of unemployment are in short supply and the payroll tax mechanism appears to be a promising avenue for progress in this area, especially in Europe.

References

- Robert J. Barro & Charles J. Redlick, 2009. "Macroeconomic Effects from Government Purchases and Taxes," *The Quarterly Journal of Economics*, Oxford University Press, vol. 126(1), 51-102.
- Barro, Robert J., and Chaipat Sahasakul (1983): "Measuring the average marginal tax rate from the individual income tax", *Journal of Business* 56(4): 419-452.
- Barro, Robert J & Sahasakul, Chaipat (1986) "Average Marginal Tax Rates from Social Security and the Individual Income Tax", *Journal of Business*, University of Chicago Press, vol. 59(4), 555-66.
- Benigno and Woodford (2003)
- Beveridge, William H. (1944): "The Government's Employment Policy," *Economic Journal* 54, 161-176.
- Brinca, P., Chari, V. V., Kehoe, P. J., & McGrattan, E. (2016). Accounting for business cycles. *Handbook of Macroeconomics*, 2, 1013-1063.
- Brinca, Pedro. "Monetary business cycle accounting for Sweden." *The BE Journal of Macroeconomics* 13.1 (2013): 1085-1119.
- Burda, Michael, and Weder, Mark. "Payroll Taxes, Social Insurance and Business Cycles," (with M. Weder) forthcoming, *Journal of the European Economic Association*.
- Chari, Varadarajan V., Patrick J. Kehoe, and Ellen R. McGrattan. "Business cycle accounting." *Econometrica* 75.3 (2007): 781-836.
- Chari, Varadarajan V., Patrick J. Kehoe, and Ellen R. McGrattan. "Accounting for Business Cycles", Staff report 531 (2016), Minneapolis FED
- Christiano, Lawrence J., and Terry J. Fitzgerald. "The band pass filter." *international economic review* 44.2 (2003): 435-465.
- Cogley, T., and J. M. Nason. "Effects of the Hodrick-Prescott filter on trend and." (1995).
- Gali, Jordi, Mark Gertler, and J. David Lopez-Salido. "Markups, gaps, and the welfare costs of business fluctuations." *The review of economics and statistics* 89.1 (2007): 44-59.
- Gruber, Jonathan, 1997, "The Consumption Smoothing Benefits of Unemployment Insurance," *American Economic Review*, March, 192-205.
- Joines, Douglas H. "Estimates of effective marginal tax rates on factor incomes." *Journal of Business* (1981): 191-226.
- Keynes, John M. (1942): *The Collected Writings of John Maynard Keynes Volume 27*. Edited by Donald Moggridge. Macmillan, Cambridge University Press, 217-8.
- King, Robert G., and Sergio T. Rebelo. "Low frequency filtering and real business cycles." *Journal of Economic dynamics and Control* 17.1 (1993): 207-231.
- Mulligan, Casey B. "Substitution over time: another look at life-cycle labor supply." *NBER macroeconomics annual* 13 (1998): 75-134.
- Mulligan, Casey B. *A century of labor-leisure distortions*. No. w8774. National Bureau of Economic Research, 2002.

Ravn, Morten O., and Harald Uhlig. "On adjusting the Hodrick-Prescott filter for the frequency of observations." *Review of economics and statistics* 84.2 (2002): 371-376.

Seater, John J. "Marginal federal personal and corporate income tax rates in the US, 1909–1975." *Journal of Monetary Economics* 10.3 (1982): 361-381.

Voigts, Simon (2015) "The distribution of payroll taxes between firms and workers and the business cycle," *CRC 649 Discussion Paper*, Humboldt University.

Appendix I. Data

Data Sources

OECD: “Economic Outlook”, Volume 2015 issue 2, source; http://www.oecd-ilibrary.org/economics/oecd-economic-outlook-volume-2015-issue-2_eco_outlook-v2015-2-en

OECD: “Taxing wages 2016”, source: <http://www.oecd.org/tax/tax-policy/tax-database.htm#ssc>

OECD: “Sickness and Disability Schemes in the Netherlands”, Country memo as a background paper for the OECD Disability Review. November 2007, source: <http://www.oecd.org/social/soc/41429917.pdf>

OECD: “LFS - Minimum wages and gross earning of full employees”. source: <http://www.oecd.org/employment/emp/lfs-minimumwagesandgrossearningsoffull-timeemployees.htm>

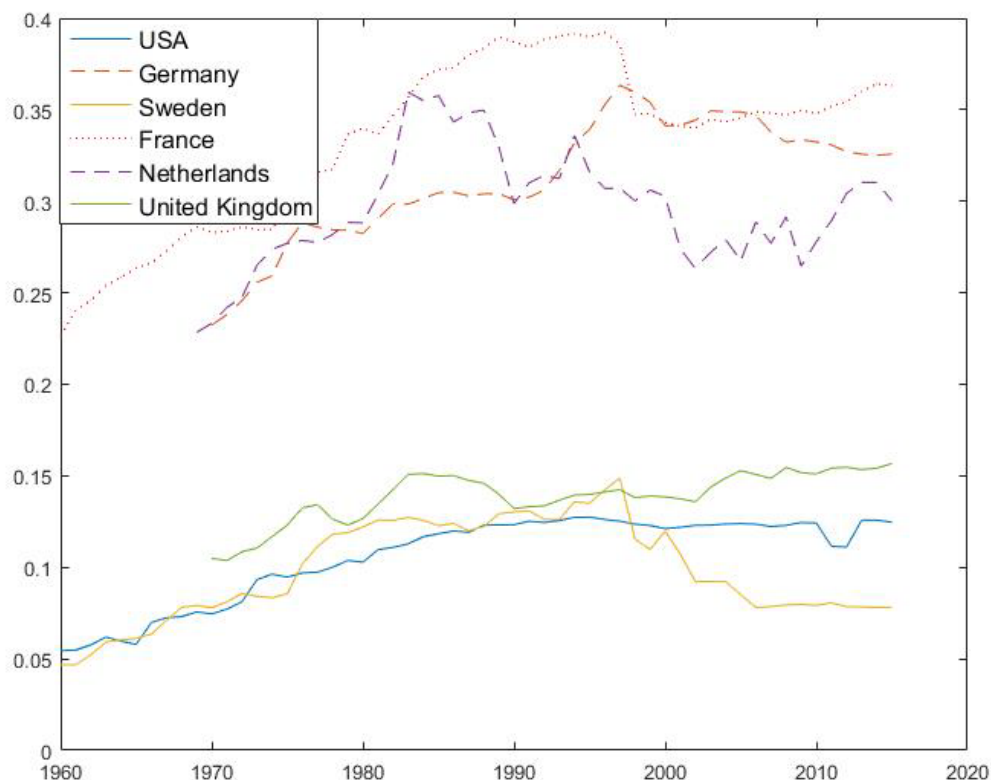
Eurostat: Taxation trends in the European Union Data for the EU Member States, Iceland and Norway, Statistical book, Eurostat 2014, source: http://ec.europa.eu/taxation_customs/resources/documents/taxation/gen_info/economic_analysis/tax_structures/2014/report.pdf

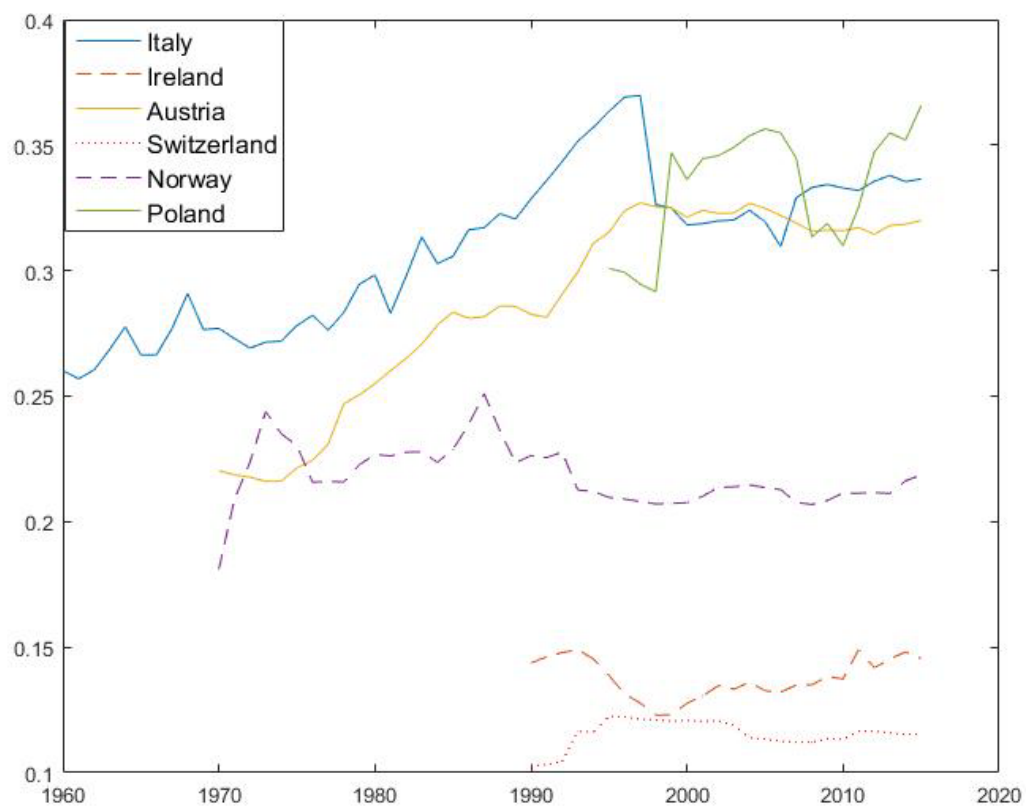
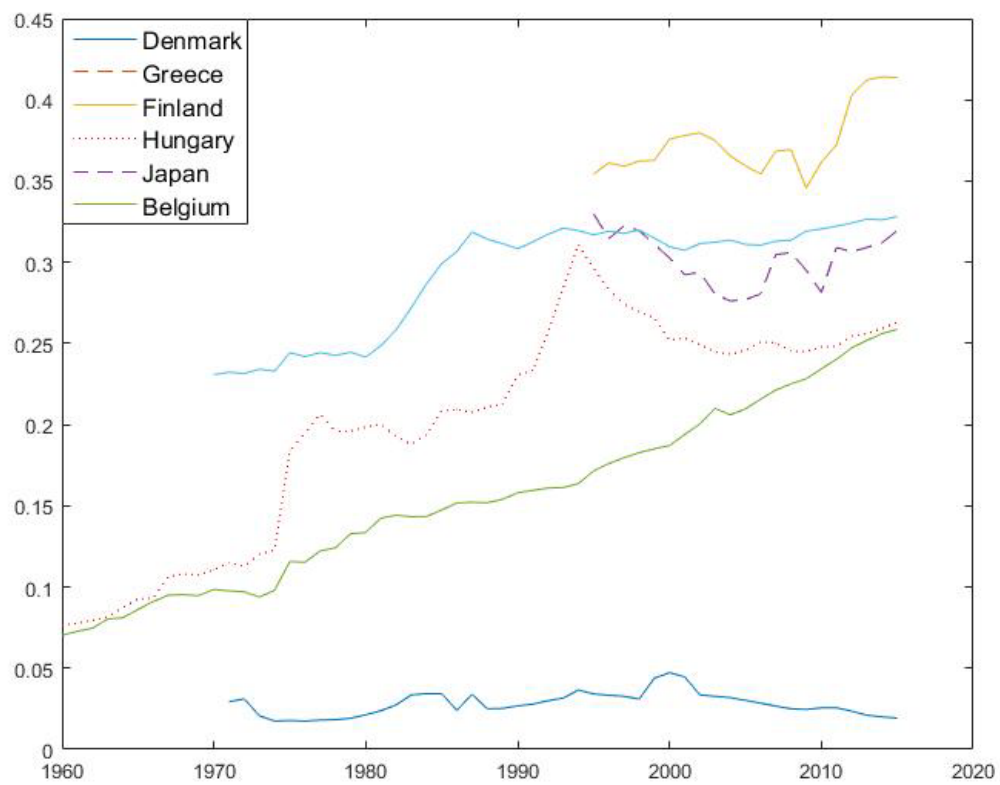
European Commission 201: VAT Rates Applied in the Member States of the European Union, 2015 source: http://ec.europa.eu/taxation_customs/resources/documents/taxation/vat/how_vat_works/rates/vat_rates_en.pdf

Appendix II. Data Analysis

Tables and Figures

Figure 1: Average tax rates in OECD countries, 1960*-2015





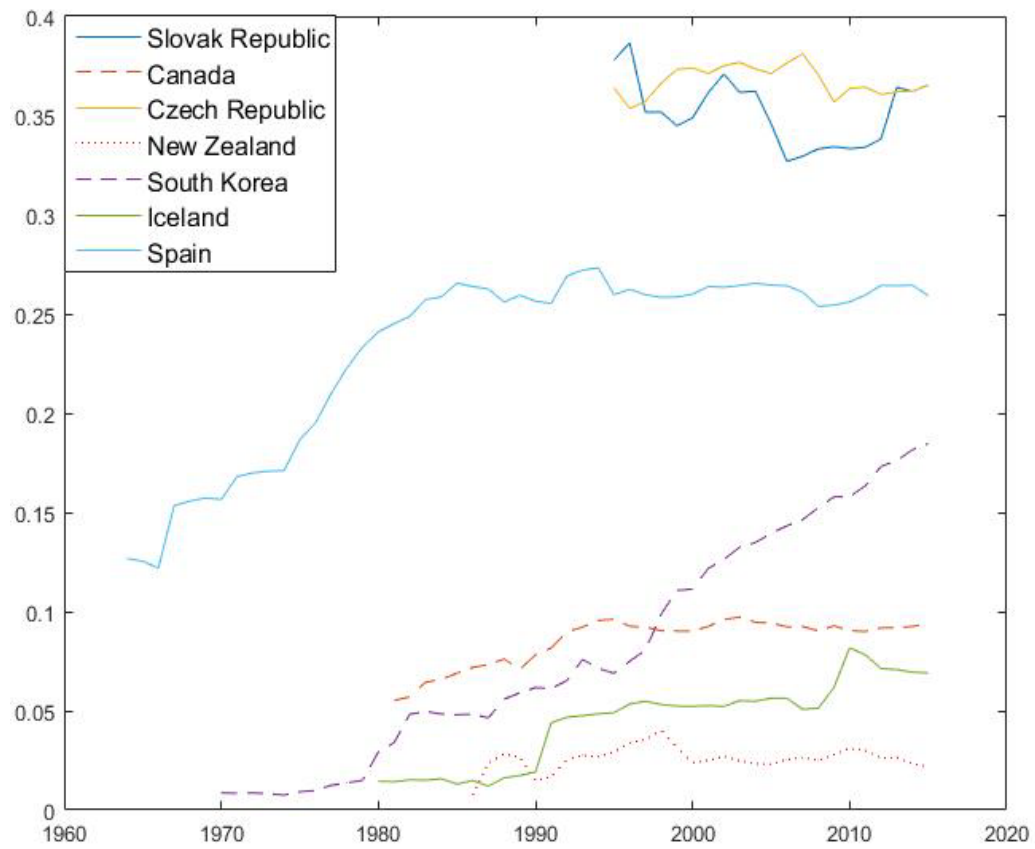
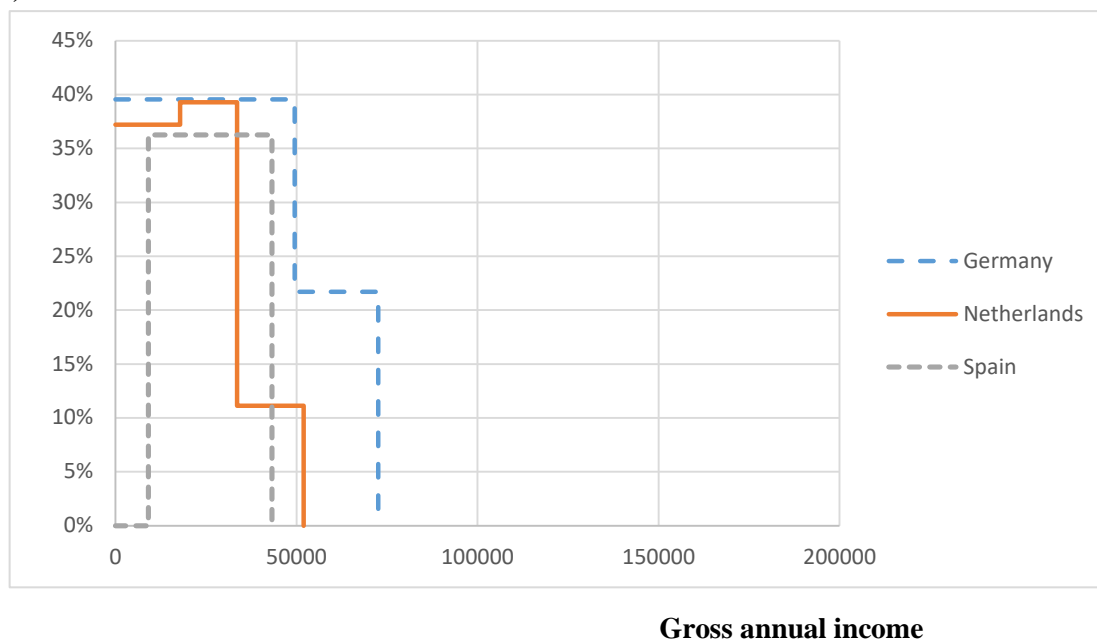
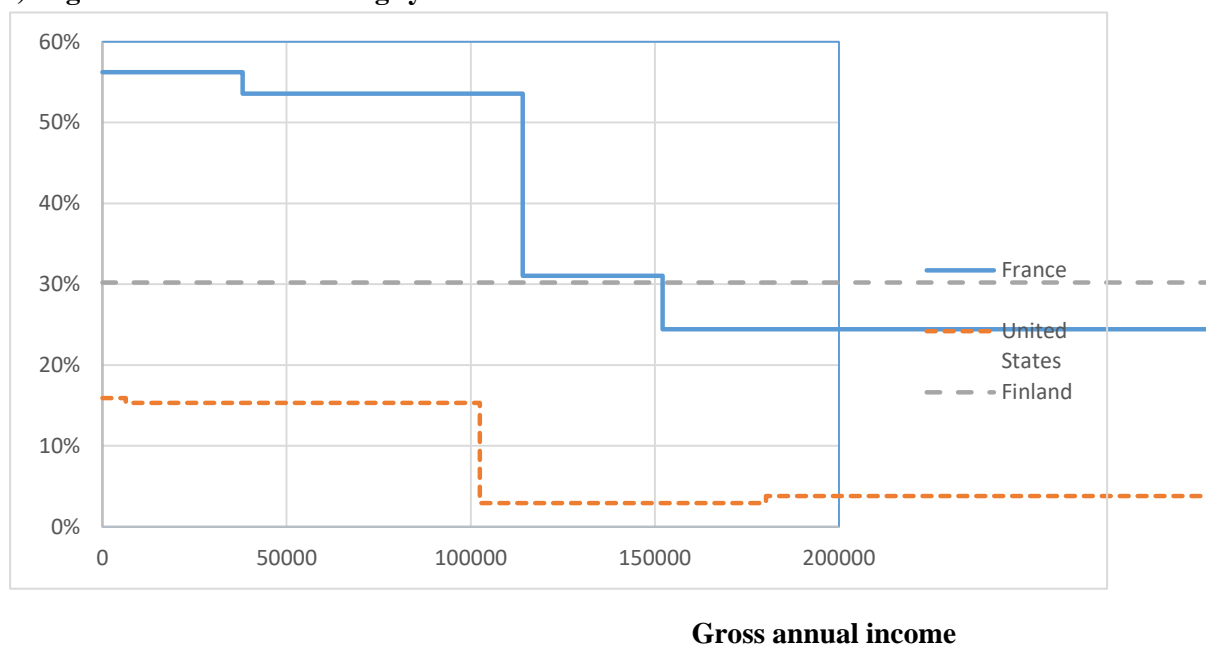


Figure 2: SSC tax schedules in 2015, six countries

a) Low threshold SSC levels



b) High threshold SSC funding systems



Source: OECD, authors' calculations

Figur

3 (%)

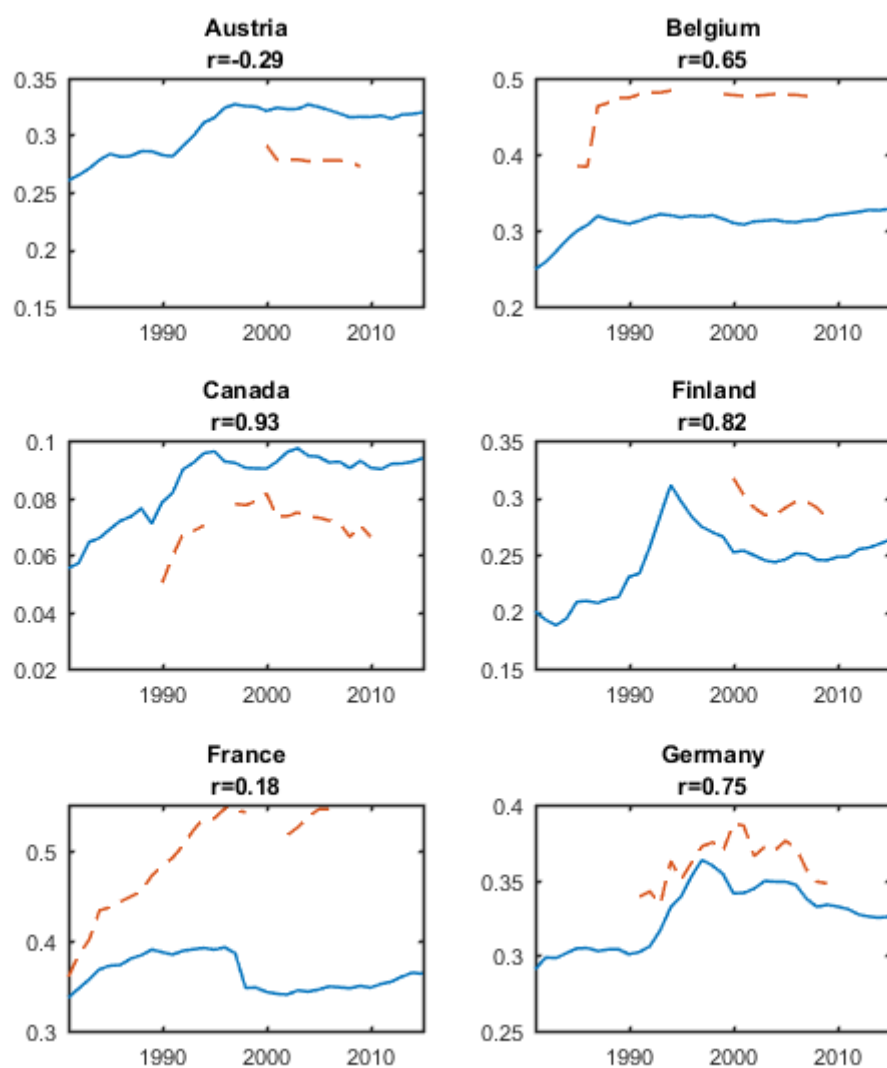


Figure 3 5 (continued): Overall average (solid line) and average marginal (dashed line) SSC rates (%)

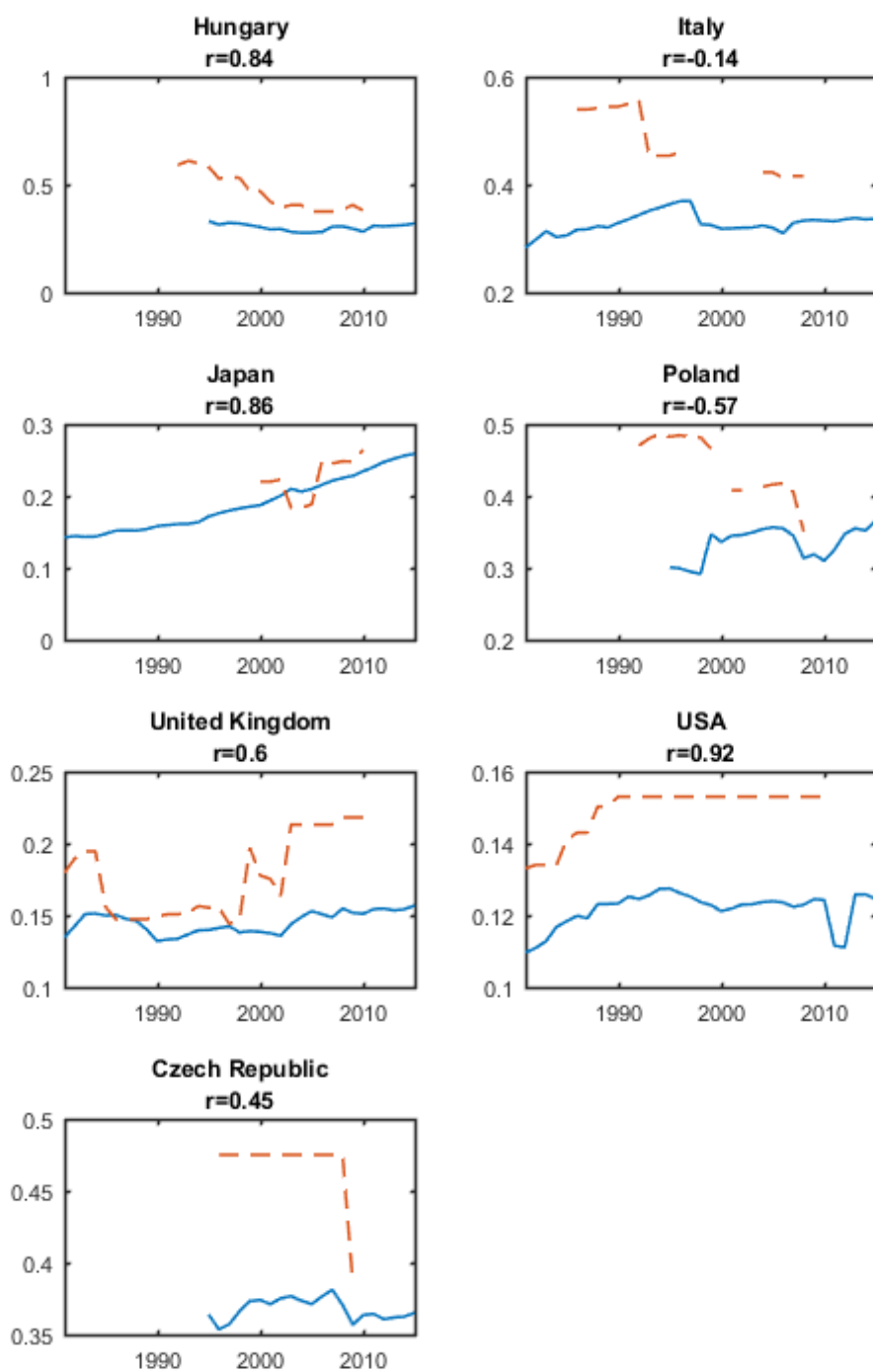
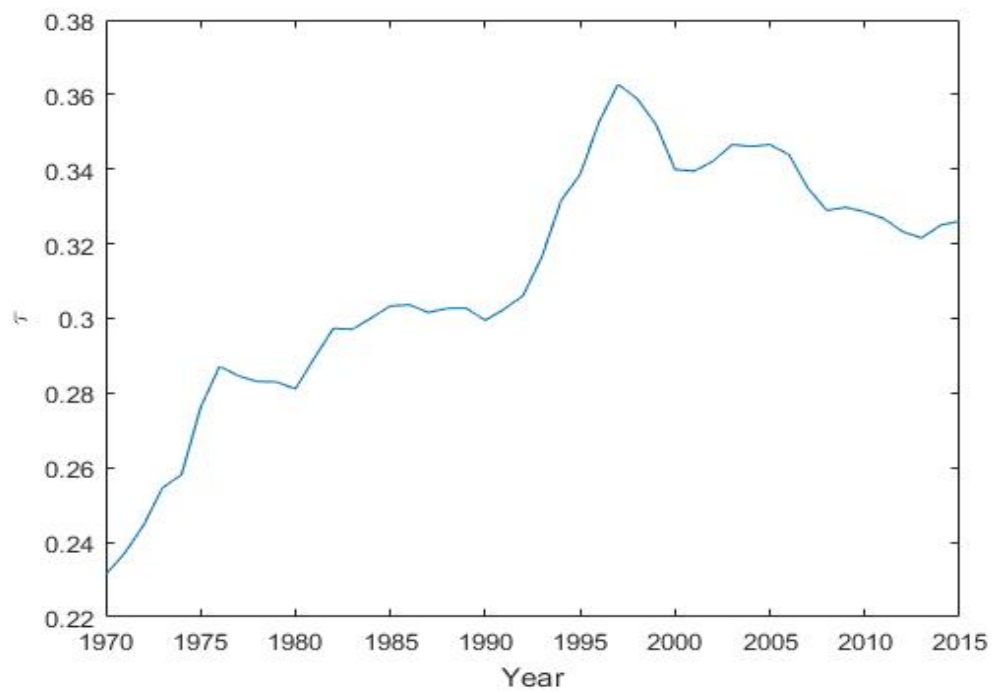
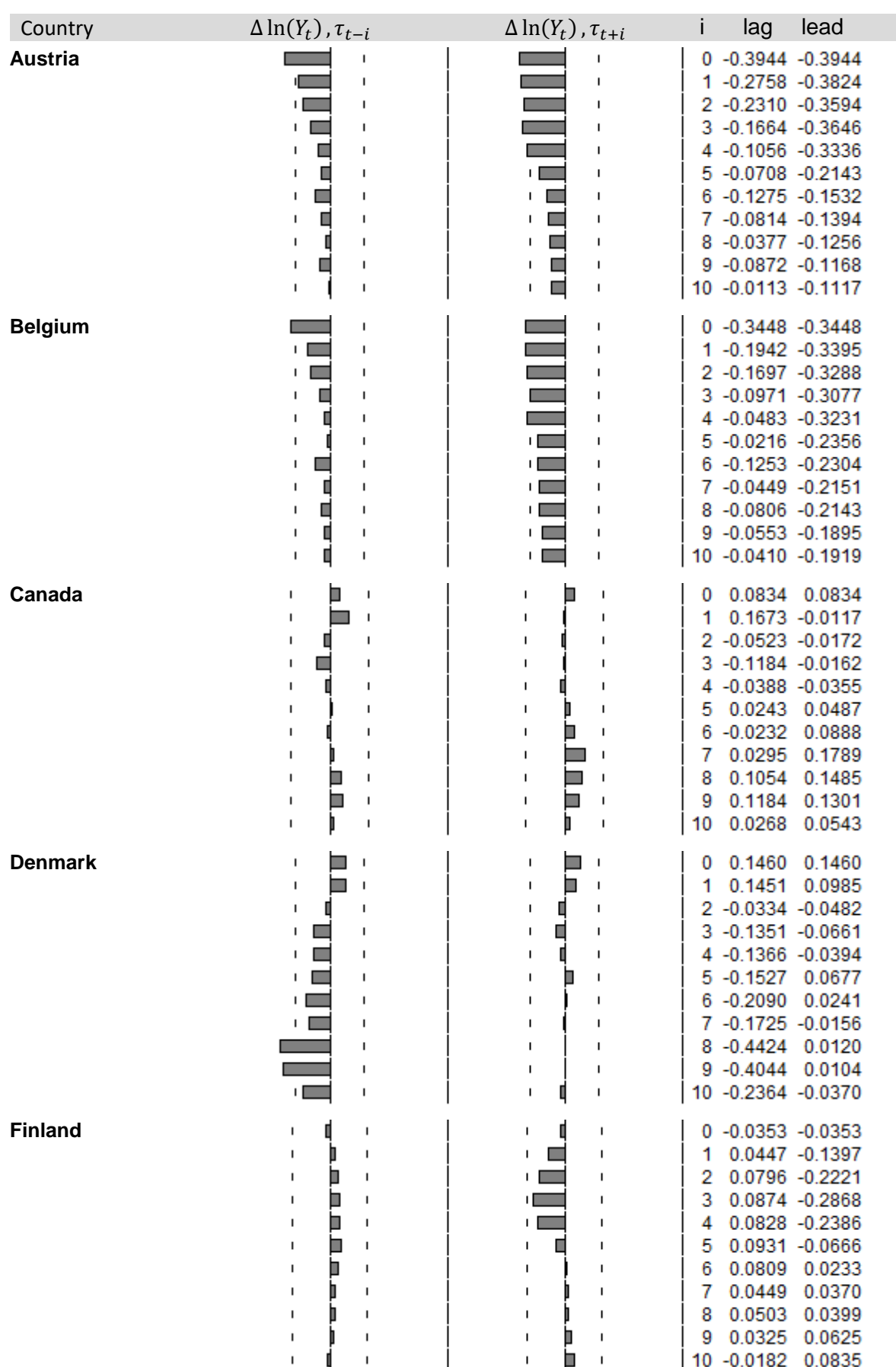


Figure 4: Total payroll taxes as a fraction of total compensation, Germany, 1970-2015



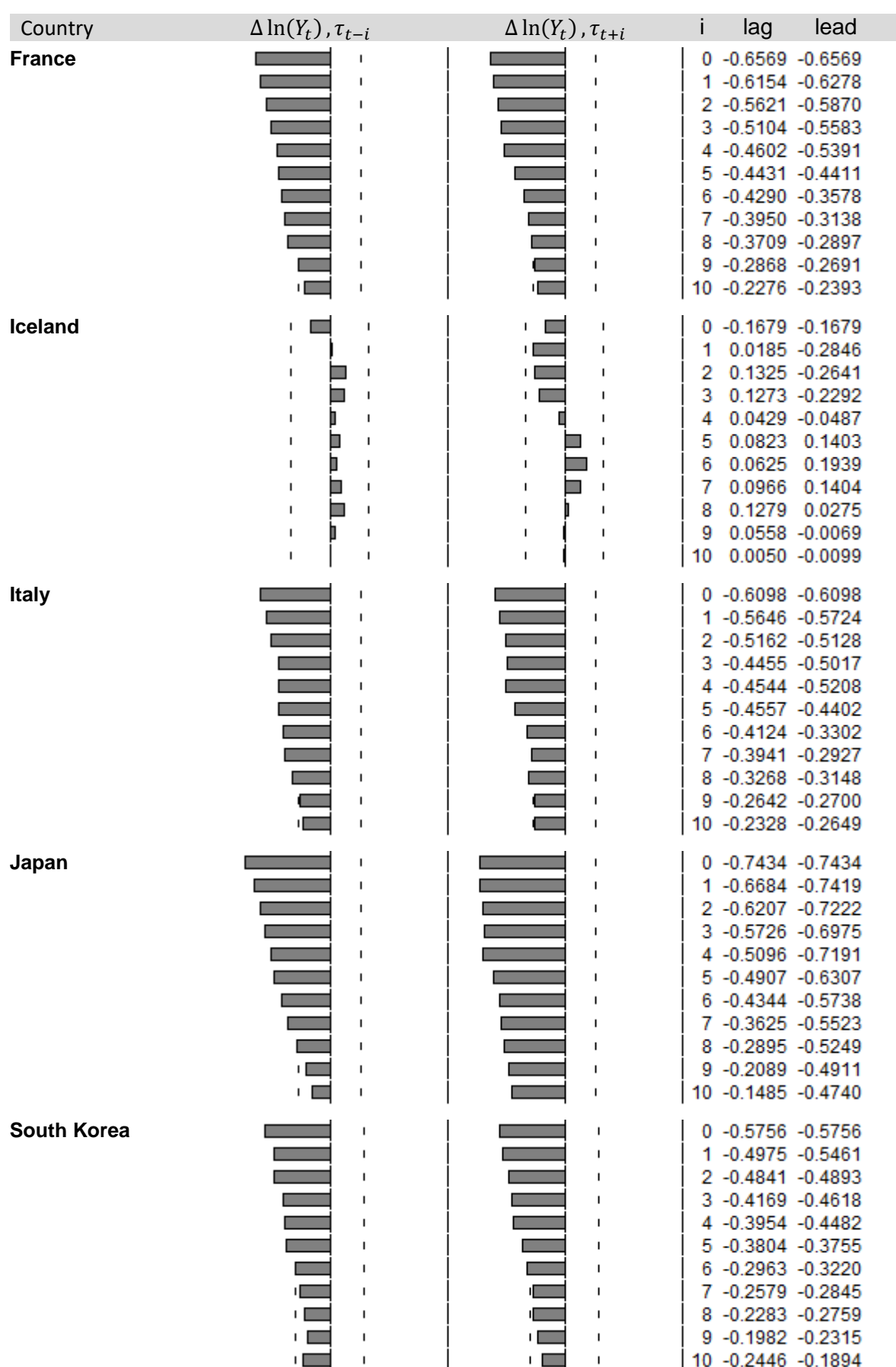
Note: Data for 1970-1990 are for West Germany only

Figure 5: Cross correlations of real growth and SSC rates



Source: Authors' calculations

Figure 5 (continued): Cross correlations of real growth and SSC rates















































Source: Authors' calculations

Figure 5 (continued): Cross correlations of real growth and SSC rates

Country	$\Delta \ln(Y_t), \tau_{t-i}$	$\Delta \ln(Y_t), \tau_{t+i}$	i	lag	lead
Netherlands			0	0.2347	0.2347
			1	0.2918	0.0133
			2	0.4095	-0.1162
			3	0.4025	-0.2009
			4	0.4091	-0.2290
			5	0.3922	-0.1750
			6	0.4295	-0.1797
			7	0.3955	-0.1127
			8	0.2544	-0.0840
			9	0.1441	-0.0649
			10	0.2206	-0.1381
New Zealand			0	0.2783	0.2783
			1	0.3825	0.0314
			2	0.0455	0.0475
			3	-0.0391	0.1304
			4	0.1653	0.1181
			5	0.5158	-0.1430
			6	0.4247	-0.4346
			7	0.2318	-0.4513
			8	0.0477	-0.3054
			9	-0.0598	-0.2431
			10	-0.1404	-0.2125
Norway			0	0.1026	0.1026
			1	-0.0440	0.1578
			2	0.0379	0.2143
			3	0.1292	0.1550
			4	0.1850	0.0632
			5	0.1522	0.0071
			6	0.1035	0.1135
			7	0.1146	0.2341
			8	0.1227	0.2420
			9	0.1716	0.1873
			10	0.3223	0.1949
Spain			0	-0.5931	-0.5931
			1	-0.5273	-0.5617
			2	-0.4708	-0.4947
			3	-0.4099	-0.4353
			4	-0.3680	-0.3831
			5	-0.2916	-0.2873
			6	-0.2117	-0.2238
			7	-0.1982	-0.1881
			8	-0.1670	-0.1729
			9	-0.0496	-0.1349
			10	0.0410	-0.0999
Sweden			0	-0.2927	-0.2927
			1	-0.2448	-0.3236
			2	-0.2240	-0.3089
			3	-0.1790	-0.2941
			4	-0.1172	-0.2587
			5	-0.0832	-0.3323
			6	-0.0707	-0.3265
			7	-0.0860	-0.2891
			8	-0.1056	-0.2360
			9	-0.0743	-0.2050
			10	0.0236	-0.1567

Source: Authors' calculations

Figure 5 (continued): Cross correlations of real growth and SSC rates

Country	$\Delta \ln(Y_t), \tau_{t-i}$	$\Delta \ln(Y_t), \tau_{t+i}$	i	lag	lead
United Kingdom			0	-0.0456	-0.0456
			1	-0.0107	-0.1090
			2	-0.0306	-0.1854
			3	-0.0744	-0.1651
			4	-0.0147	-0.1193
			5	-0.0795	-0.0316
			6	-0.0766	-0.0102
			7	-0.0192	-0.0058
			8	0.0045	0.0370
			9	0.1020	0.1046
			10	0.1789	0.1750
USA			0	-0.2883	-0.2883
			1	-0.3311	-0.2662
			2	-0.2425	-0.2406
			3	-0.2298	-0.2194
			4	-0.1916	-0.2319
			5	-0.1254	-0.2123
			6	-0.0874	-0.2140
			7	-0.1101	-0.1492
			8	-0.0638	-0.0965
			9	-0.0279	-0.0604
			10	-0.0564	-0.0272

Source: Authors' calculations

Figure 6: Decomposition of changes in average SSC rates (%)

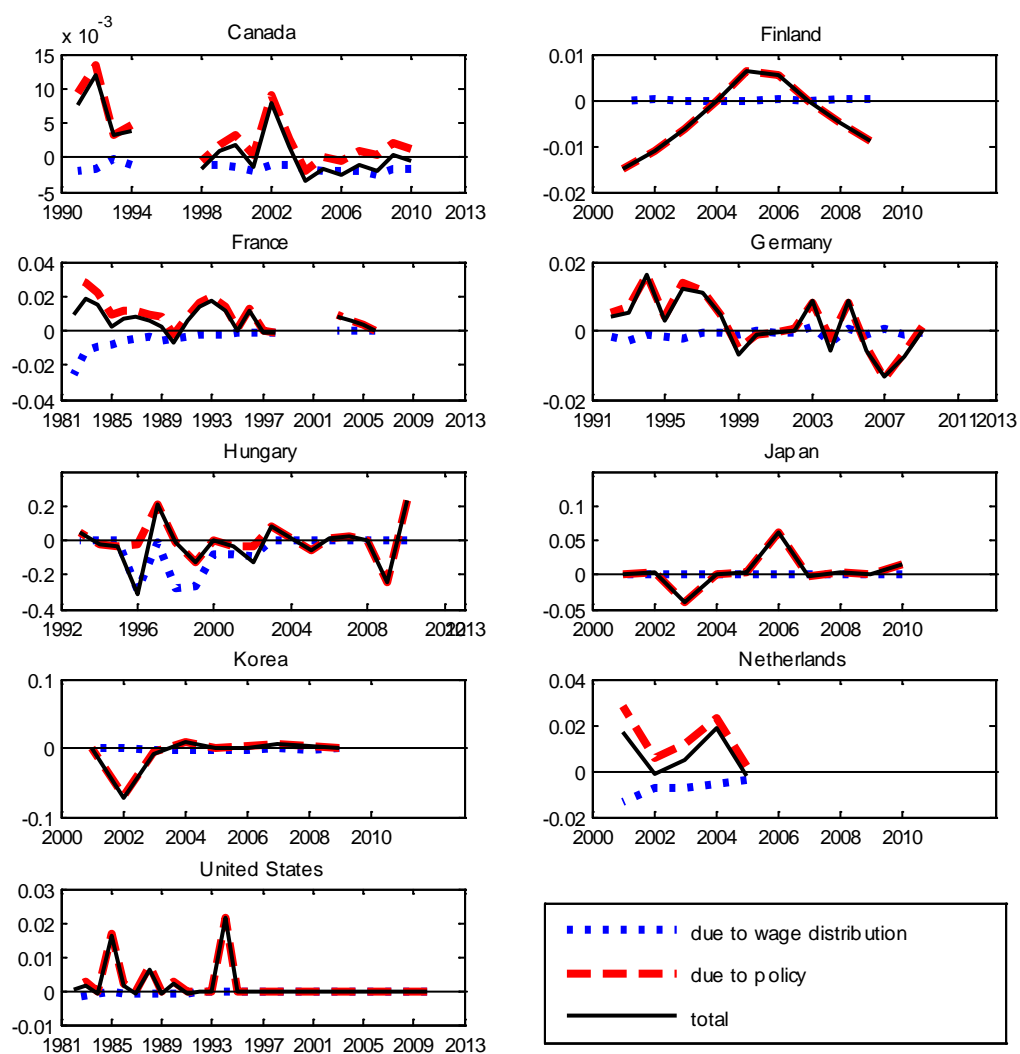


Table 1: Dimension of social security systems in 2015 (%)

Country	SSC/GDP	SSC/compensation (SSC rate, τ)	SSC/total taxation
USA	7.4	12.5	23.7
Canada	5.4	9.4	15.3
New Zealand	1.1	2.2	0.0
Germany	18.0	32.6	37.9
Sweden	3.7	7.8	22.5
France	19.7	36.3	37.1
Netherlands	15.2	30.0	37.7
United Kingdom	8.0	15.7	18.6
Denmark	1.1	1.9	0.1
Greece	13.2	41.4	29.0
Finland	14.4	26.3	29.0
Hungary	18.4	32.0	33.3
Japan	12.5	25.9	n.a.
Belgium	16.7	32.8	31.9
Italy	14.1	33.6	30.2
Ireland	4.7	14.5	9.7
Austria	16.8	32.0	34.0
Switzerland	6.8	11.5	24.6
Norway	10.2	21.9	27.4
Poland	14.5	36.6	n.a.
Slovak Republic	14.5	36.5	42.8
Czech Republic	15.5	36.5	43.3
South Korea	8.2	18.5	n.a.
Iceland	6.3	6.9	16.6
Spain	12.4	25.9	33.7

Source: OECD Economic Outlook 95, OECD revenue statistics and authors calculations.

**Table 2: Average SSC rates: Means, standard deviations
and cyclical correlations, 1960-2015***

Country	Average SSC tax rate (τ)		Standard deviation of τ (%)		Correlation of HP-filtered τ with HP-filtered GDP*		
	1960-90	1991-2015	1960-1990	1991-2015	1960-1990	1991-2015	1960-2015
USA	0.09	0.12	2.3	0.4	0.31	-0.20	0.10
Germany	0.28	0.34	2.3	1.5	-0.61	-0.48	-0.53
Sweden	0.09	0.10	2.9	2.5	-0.38	0.07	-0.06
France	0.31	0.36	4.9	1.9	-0.19	-0.28	-0.23
Netherlands	0.30	0.30	4.2	1.9	-0.50	0.22	-0.06
United Kingdom	0.13	0.15	1.6	0.8	-0.47	0.22	-0.27
Denmark	0.02	0.03	0.6	0.7	-0.11	0.25	0.07
Greece	n.a.	0.37	n.a.	2.0	n.a.	-0.32	-0.32
Finland	0.15	0.26	5.4	1.8	-0.45	-0.11	-0.31
Hungary	n.a.	0.30	n.a.	1.6	n.a.	0.43	0.43
Japan	0.11	0.21	2.9	3.2	-0.28	0.27	-0.08
Belgium	0.26	0.32	3.3	0.6	-0.72	-0.60	-0.66
Italy	0.29	0.34	2.1	1.6	0.07	-0.07	0.01
Ireland	n.a.	0.14	0.0	0.8	n.a.	-0.28	-0.30
Austria	0.25	0.32	2.8	1.1	-0.38	-0.50	-0.44
Switzerland	n.a.	0.12	0.0	0.5	n.a.	-0.10	-0.10
Norway	0.23	0.21	1.4	0.5	0.24	-0.19	0.15
Poland	n.a.	0.33	n.a.	2.3	n.a.	-0.15	-0.15
Slovak Republic	n.a.	0.35	n.a.	1.7	n.a.	-0.27	-0.27
Canada	0.07	0.09	0.8	0.3	-0.28	-0.26	-0.28
Czech Republic	n.a.	0.37	n.a.	0.7	n.a.	0.29	0.29
New Zealand	0.02	0.03	0.9	0.5	-0.41	-0.08	-0.09
South Korea	0.03	0.12	2.1	4.0	-0.12	-0.82	-0.47
Iceland	0.02	0.06	0.2	1.0	-0.39	-0.62	-0.57
Spain	0.21	0.26	5.0	0.5	-0.50	-0.47	-0.47

Source: OECD Economic Outlook 95 and authors' calculations

Note: Data series start from 1960 or from the earliest available year.

* HP-filter with $\lambda=6.25$ (see Ravn and Uhlig, 2002).

Table 3: Correlation between average SSC rates and log-output 1960*-2015

Country	Correlation coefficients				Range			
	HP	Diff	BP	BP	HP	Diff	BP(2,8)	BP(3,7)
			(2,8)	(3,7)				
USA	0.10	0.20	0.07	0.02				
Germany	-0.52	-0.19	-0.50	-0.52				
Sweden	-0.06	-0.08	-0.04	-0.05				
France	-0.23	0.02	-0.01	0.01				
Netherlands	-0.06	-0.06	0.17	0.03				
United Kingdom	-0.27	-0.17	-0.32	-0.22				
Denmark	0.07	0.06	0.26	0.13				
Greece	-0.32	-0.37	-0.05	-0.12				
Finland	-0.31	-0.26	-0.01	0.11				
Hungary	0.43	0.10	0.54	0.63				
Japan	-0.08	-0.21	-0.05	-0.15				
Belgium	-0.66	-0.50	-0.56	-0.56				
Italy	0.01	0.01	0.09	0.12				
Ireland	-0.30	-0.30	0.09	0.36				
Austria	-0.44	-0.29	-0.34	-0.27				
Switzerland	-0.10	-0.36	0.22	0.44				
Norway	0.15	0.17	0.32	0.42				
Poland	-0.15	-0.22	0.10	0.29				
Slovak Republic	-0.27	-0.28	-0.01	0.03				
Canada	-0.28	-0.21	-0.16	-0.48				
Czech Republic	0.29	0.21	0.33	0.34				
New Zealand	-0.09	-0.23	-0.17	-0.43				
South Korea	-0.47	-0.42	-0.50	-0.69				
Iceland	-0.57	-0.51	-0.47	-0.46				
Spain	-0.47	-0.16	-0.25	-0.32				

Notes: HP=data detrended using Hodrick Prescott filter; diff: =first differenced data; BP= data detrended using the band-pass filter with lower and upper periodicity parameters (x,y).

Source: OECD, authors' calculations

Table 4: Dynamic correlation between average SSC rates and log-output 1960*-2015

<i>Country</i>	HP-Filter, lambda=6.25		First Differences		Band-Pass Filter, l=2, u=8 years	
	$\rho(\tau_{t-1}, y_t)$	$\rho(\tau_{t+1}, y_t)$	$\rho(\tau_{t-1}, y_t)$	$\rho(\tau_{t+1}, y_t)$	$\rho(\tau_{t-1}, y_t)$	$\rho(\tau_{t+1}, y_t)$
USA	-0.26	0.17	-0.16	0.14	-0.38	0.24
Germany	-0.08	-0.54	0.11	-0.21	0.02	-0.53
Sweden	-0.06	-0.02	-0.08	-0.06	-0.11	0.08
France	-0.01	-0.14	0.15	0.08	0.02	0.14
Netherlands	0.08	-0.39	-0.09	-0.35	0.23	-0.25
United Kingdom	0.08	-0.45	-0.01	-0.28	0.06	-0.46
Denmark	0.29	-0.15	0.31	-0.04	0.48	-0.05
Greece	0.09	-0.52	-0.22	-0.52	0.40	-0.52
Finland	-0.23	-0.29	-0.22	-0.23	-0.05	-0.01
Hungary	-0.24	0.42	-0.38	0.08	-0.30	0.45
Japan	0.06	-0.20	-0.14	-0.32	-0.01	-0.07
Belgium	-0.05	-0.29	0.09	-0.15	0.21	-0.03
Italy	-0.08	0.06	-0.01	0.03	-0.13	0.23
Ireland	-0.20	-0.08	-0.25	-0.24	0.16	0.06
Austria	0.10	-0.30	0.11	-0.06	0.24	-0.11
Switzerland	-0.17	-0.02	-0.25	-0.10	0.06	0.33
Norway	-0.15	0.20	0.00	0.15	-0.14	0.42
Poland	-0.03	-0.17	-0.09	-0.16	0.22	-0.04
Slovak Republic	-0.26	-0.19	-0.29	-0.30	-0.24	0.17
Canada	0.04	-0.40	0.04	-0.32	0.12	-0.17
Czech Republic	0.42	-0.22	0.36	-0.34	0.48	-0.32
New Zealand	0.42	-0.12	0.24	-0.17	0.58	-0.56
South Korea	-0.08	-0.05	-0.28	-0.21	-0.15	0.12
Iceland	-0.29	-0.40	-0.32	-0.36	0.02	-0.44
Spain	-0.07	-0.26	0.01	0.04	0.26	-0.09

Source: OECD Economic Outlook 95 and authors' calculations

Note: SSC rates and log of real GDP were HP-filtered with smoothing parameter 6.25. Data starts from 1960 or from the earliest available year.

Table 5: Decomposition of annual changes in average SSC rates (%)

Country	Mean. change	Mean change due to policy	Mean change due to wage distribution.
Austria (1988-2009)	3.47	3.53	-0.08
Belgium 1984-2008)	0.58	0.58	0.00
Canada (1990-2010)	0.31	0.33	-0.02
Czech Rep (1996-2009)	1.92	1.92	0.00
Finland (200-2009)	0.65	0.65	0.00
France (1982-2006)	0.74	1.08	-0.34
Germany (1991-2009)	0.64	0.64	0.00
Italy (1986-2008)	6.06	6.06	0.00
Japan 2000-2010)	1.31	1.31	0.00
Poland (1992-2008)	2.25	2.25	0.00
UK (1982-2010)	1.21	1.37	-0.26
USA (1982-2010)	0.19	0.19	0.00

Table 6: Correlation of the average SSC rate with wedges

Country	Labor wedge	Gov. consumption wedge	Efficiency wedge
USA	0.03	0.27	0.05
Germany	0.42	-0.07	-0.34
Sweden	0.10	-0.17	-0.08
France	0.11	0.19	-0.14
Netherlands	0.44	0.30	0.23
United Kingdom	0.36	0.24	0.04
Denmark	0.40	0.50	0.25
Greece	0.30	-0.35	0.11
Finland	0.14	0.02	-0.17
Hungary	-0.22	-0.12	0.31
Japan	0.26	0.10	-0.02
Belgium	0.35	0.22	-0.43
Italy	0.35	0.23	-0.09
Ireland	0.12	0.09	-0.07
Austria	0.00	-0.18	-0.23
Switzerland	-0.17	-0.28	-0.14
Norway	-0.21	0.11	0.21
Poland	0.43	0.27	0.32
Slovak Republic	-0.13	-0.05	-0.23
Canada	0.26	0.32	0.06
Czech Republic	-0.13	0.20	0.38
New Zealand	-0.19	-0.06	-0.09
South Korea	0.43	0.55	n.a.
Iceland	0.17	-0.05	-0.27
Spain	0.32	0.14	0.05

Source: Authors calculations. *Note:* All series are computed for 1960*-2015 and HP detrended