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Social Security Contributions and the Business Cycle

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ABSTRACT

We investigate business cycle dynamics of social security contributions (SSC), by far the largest labor tax distortion in the OECD. In most countries, we find a negative covariation of SSC tax burdens with levels and growth of GDP at business cycle frequencies and lower. In detrended data, a decline of GDP of 1% is associated with a 0.05-0.2 percentage point increase in the aggregate SSC burden, measured as a fraction of the wage bill. For most countries, average marginal SSC rates exceed, but track average rates. Changes in average SSC tax burdens are largely due to adjustments in statutory tax schedules rather than cyclical shifts in earnings distributions. Our findings are consistent with Esping-Andersen's (1990) typology of social welfare states. In some countries, SSC rates co-move with measures of the "labor wedge" (Chari et al. 2007, Brinca et al. 2016).

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 national income. Most financing for this redistribution comes from dedicated payroll taxes, also known as social security contributions (SSC). SSC represent more than half of total labor income taxation in OECD member states, and thus dominate the difference between employers' costs of labor and monetary benefit received directly by workers. In 2017, total SSC in OECD countries amounted to about $4.4 trillion, or 9.2% of GDP; in many economies, social security contributions represent more than a third of total labor compensation. Even if workers perceive these contributions as payment for social benefits, SSC represent a significant potential distortion in the worker-firm relationship.[1]

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[1] Gruber, (1997) argues that labor supply may be higher despite lower take-home pay and offset the distortion, if workers link SSC taxes with other forms of compensation (e.g. health insurance, pension benefits, unemployment and disability insurance). Yet there is no reason to expect this offset to be complete, and subjective perception of SSC by workers can deviate from actual compensation, especially in the short run. Anderson and Meyer, (1997,2000) cannot reject full shifting of payroll taxes onto workers in the US, while Adam et al. (2019) find evidence of only partial incidence in the short to medium run.

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This paper investigates the cyclical behavior of social security contributions in 25 OECD countries over the period 1960-2015. To our knowledge, the dynamics of 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 total gross labor compensation) vary countercyclically 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 where social security budgets are cross-subsidized by other revenue sources. Because SSC represents a large part of the average burden of a worker-job match in a frictional labor market, this cyclicality has potentially important implications for labor market dynamics over the business cycle. Below, we show that this distortion co-moves with output and employment movements at business cycle frequencies as a "labor wedge" (Chari et al. 2007).[3]

Average SSC tax rates can vary over time for two reasons. First, holding tax schedules constant, cyclical shifts in the distribution of gross labor earnings can increase or decrease the SSC burden relative to the wage bill, due to different tax rates applying to different income brackets. Second, social security systems are mandated in many countries to run balanced or near-balanced budgets, requiring tax schedule adjustments to meet revenue shortfalls in recessions or to trim surpluses in periods of economic expansion. This "Bismarckian principle" originates in political constraints to regulate, or even minimize the degree of redistribution between capital and labor. In contrast, balanced budget requirements are typically absent in social insurance systems in which redistribution plays a larger role and cross-subsidy of social security funds is more common, in the spirit of Beveridge (Beveridge, 1944). Esping-Andersen (1990) distinguishes between corporatist welfare systems that dominate Continental Europe, reinforce traditional society and protect individuals from the "logic of class opposition" from those that emphasize the "decommodification of labor," either in a liberal laissez-faire or social welfare state context (Esping-Andersen 1990, p.40).

To quantify the relative importance of exogenous changes in SSC tax rates versus endogenous changes in the structure of earnings, we propose an accounting framework for decomposing movements in average SSC rates. We find that the lion's share of observed changes in annual average contribution rates originates in adjustments to statutory tax schedules. In the spirit of Barro and Redlick (2011), we show that these average tax burdens co-vary with average marginal tax rates, with the latter exceeding the former in almost all cases. Our estimates of average SSC rates are also correlated in many countries with measures of the "labor wedge," the reduced form labor market distortion described by Chari et al. (2007) and Brinca et al. (2016) in their business cycle accounting framework.

In Section 2 we present the data and descriptive statistics that motivate our interest in SSC. Section 3 discusses long-run features of social security contributions in our sample. Section 4 presents more empirical findings on cyclical properties of contribution rates and evaluates sources of this behavior at cyclical and lower frequencies. Section 5 examines the behavior of the SSC tax burden in the context of the business cycle accounting framework of Chari et al. (2007). Section 6 concludes.

2. Data description and trends

2.1. Measuring social security contributions as average tax burden

Because of the special nature of social security contributions as a dedicated payroll tax, we focus on the sum of employer and employee contributions to the exclusion of personal income taxes and indirect taxation affecting household income from market activities in general (e.g. value-added taxes). In particular, we are interested in the behavior of the wedge between the cost of labor to firms and the net payment to households for labor supplied. Our central indicator is τ_t^A, the average SSC rate on the total cost of labor in year t, defined as the ratio of total social security contributions to the total wage bill, or "total compensation of employees," including employers' and employees' contributions to social insurance:[4]

$$\tau_t^A = SSC_t / wage\ bill_t \tag{1}$$

We employ two annual time series published by the OECD for 25 member countries over the period 1960-2015.[5] The first, "Social Security Contributions Received by the General Government," includes payments by both firms and workers to pension funds,

[2] Burda and Weder (2016) report similar regularities in a smaller group of countries; see also Gali et al. (2007), Frankel et al. (2013) and Vegh and Vuletin, (2015).

[3] Distortionary effects of tax systems change nonlinearly with tax rates (Auerbach and Hines, 2002), so a comprehensive analysis of the labor taxation should examine labor income taxes, social security contributions and other taxes levied on labor together. However, most of existing macroeconomic and especially DSGE literature (in the spirit of Smets and Wouters, 2007) focuses on the labor income tax in isolation and ignores dynamics of the SSC, which behaves differently from general income taxation. Burda and Weder (2016) show that a countercyclical SSC tax burden can account for the Hall-Shimer anomaly in a model with search and matching frictions. In this paper, we sidestep the normative issue of optimality of countercyclical payroll taxation, stressing instead a robust aggregate characterization of their cyclical and trend behavior.

[4] The OECD computes two similar indicators: "average rate of employees' social security contributions" and "average rate of employers' social security contributions". While their measure is computed for eight different household types, ours aggregates over all households and includes both employer and employee SSC payments. In addition, the OECD indicators are calculated starting from year 2000, while our series begins in 1960 for the majority of countries. See: http://stats.oecd.org/Index.aspx?DataSetCode=AWCOMP#.

[5] *OECD Economic Outlook 95* (2015). For details on these and other data used in this paper, see Appendix A.

disability and health insurance, as well as unemployment insurance and related programs.[6] The second series is "Compensation of Employees", defined as the sum of wages, salaries and social security contributions paid by employers directly or on behalf of their employees. For workers and firms that take such payments into account when entering into an employment contract, τ^A is the (unconditional) expected distortionary burden on the value of a firm-worker match.

Table 1 displays the size of total social security contributions, relative both to GDP and total labor compensation, in 2017. In most European countries, social contributions comprise 10-20% of GDP and as much as 30% and more of total labor compensation, but less than 5% of GDP or 10% of total labor compensation in the US, Canada and New Zealand.[7] The first and second columns of the table summarize the size of the SSC wedge and the magnitude of the potential distortion, while the third captures the overall significance of SSC in each country.

In Appendix B (available online), Figure A1 displays τ_t^A for all countries in our sample and reveals sizeable heterogeneity across the OECD in levels, trend and cyclical behavior. Table 2 provides a compact summary of these features. The first two columns show that SSC rates can exhibit stability over time, with little long-run change in Canada, Denmark, the Netherlands, Sweden, United Kingdom, and the United States over the past half-century, or significant increases in Finland, France, Germany, Italy, Japan and South Korea. We will argue that these differences are not accidental, but rather are a function of the way social security systems are financed.

The second two columns of Table 2 report standard deviations as a measure of variation in the two sub-periods and show significant differences in the variation of SSC rates across countries. The variability of SSC taxation is comparable to or exceeds levels associated with many macroeconomic variables of interest, such as output, employment, and interest rates, and its standard deviation is as high as 5 percentage points in some countries and for some periods. This variability appears to be time-varying, reflecting changing patterns of economic growth and social security budgets over time.

The last six columns report simple regression coefficients of SSC rates on a measure of cyclical economic activity over time. We consider deviations of both series from respective HP-trend values and both contemporaneous and lagged values of τ^A for robustness. The overwhelming majority of the countries exhibit average SSC rates that are countercyclical, rising in periods of depressed economic activity and falling when output is above trend. The estimated regression coefficients on current output gaps associate a 1% decline of real GDP from trend with a 0.05 to 0.2 percentage point increase in the current SSC tax rate. Naturally, the predominance of negative coefficients reveals nothing about causation: Economic activity may lead to lower SSC tax rates, fluctuation of tax rates may affect GDP, or factors causal to both may be simultaneously at work. In the next section we examine more closely the structure of social security taxation for evidence on the direction of causality.

2.2. Closer examination of SSC schedules and marginal tax rates

Average SSC rates displayed in the first column of Table 1 and characterized in Table 2 do not provide a complete picture of the distortionary impact of labor taxes, as they do not represent the true *marginal* tax burden on a worker-firm-match arising from social security contributions. Before constructing a measure of the average marginal tax rate attributable to SSC (Barro and Sahasakul 1983, 1986), we first consider SSC tax schedules in more detail, and highlight their regressivity in most countries. The OECD database "Taxing Wages 2016," covers 32 countries from 1981 to 2015 and provides annual information on each country's SSC tax schedule, including tax brackets and respective rates for non-linear schedules.[8] Almost all countries in our sample have separate tax schemes for employers and employees; for our purposes, marginal rates for tax brackets on either side are simply added together, resulting in a consolidated SSC tax schedule for a worker-firm match.[9] SSC schedules differ considerably across OECD countries in our sample: In 2015, Belgium, Hungary, Greece, Finland, New Zealand and Slovenia had a flat (constant) SSC rate, while the remaining countries in the sample had either progressive or regressive tax schemes with different marginal SSC rates applied to different levels of earnings. Iceland, Denmark and Spain also imposed lump-sum payments or fixed minimum contributions for all workers. In 2015, 9 of 25 countries in our dataset capped social security contributions at some earnings level above which the marginal SSC rate is zero: Austria, Canada, Germany, Greece, Israel, Italy, Netherlands, Slovakia and Spain.[10]

Figure 1 displays SSC tax schedules for six representative countries in 2015, with the level of labor compensation (expressed in Euro) subject to social security contributions on the horizontal axis, and the corresponding marginal SSC rate on the vertical axis. Germany, Netherlands and Spain exhibit a low SSC threshold above which the marginal tax rate declines to zero, while Finland, France and the United States are examples of social security systems in which relatively high incomes are subject to SSC at the

[6] 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 that varies significantly across 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 in Appendix A). We repeated our analysis for several countries using social security payments by households and obtained similar results.

[7] Because we only analyze contributions to social security systems and not payments that employees receive from social security funds, our measures in Table 1 may understate the size of the social security system (in Canada or Denmark, for example).

[8] Data, including further details on social security contribution rates and aggregated tax schedules, are available at https://www.wiwi.hu-berlin.de/de/professuren/vwl/wtm2/mitarbeiter/burda/ssc_schedules_data.zip.

[9] This procedure ignores lump-sum payments and fixed minimum contributions. These payments are independent of the business cycle and, presumably do not distort the labor supply margin. We also ignore the fact that in some countries tax schedules vary depending on family status. For this reason, some countries (e.g. Norway) were excluded from our dataset.

[10] In the United States, a tax ceiling applies to all social security contributions except those for Medicare, which are currently unlimited. In 2017, this ceiling was $127,200.

Table 1
Dimension of social security systems in 2017
Source: OECD Economic Outlook 95, OECD revenue statistics and authors' calculations. Values for Japan are from 2016.

Country	SSC as % of GDP	SSC as % of wage bill (SSC rate, τ^A)	SSC as % of total tax revenues
USA	6.2	11.7	23.0
Canada	4.6	9.2	14.1
New Zealand	1.1	2.2	3.4
Germany	14.2	27.5	37.9
Sweden	9.7	20.4	21.8
France	16.8	32.2	36.4
Netherlands	13.8	28.8	35.7
United Kingdom	6.4	13.0	19.2
Denmark	0.9	1.8	3.9
Greece	11.5	35.3	29.6
Finland	12.1	25.8	27.8
Hungary	12.3	29.7	32.1
Japan	12.5	24.4	39.9
Belgium	13.6	27.5	30.5
Italy	12.8	32.5	30.3
Ireland	3.9	13.2	17.1
Austria	14.6	30.6	34.9
Switzerland	6.7	11.3	23.6
Norway	10.3	21.7	26.6
Poland	12.8	33.4	35.7
Slovak Republic	14.5	35.8	43.9
Czech Republic	15.0	36.2	43.0
South Korea	6.9	15.6	25.7
Iceland	3.4	6.3	9.1
Spain	11.5	24.5	34.0

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

Country	Average SSC tax rate (τ^A) (p.p.)		Standard deviation of τ^A (p.p.)		Regression coefficients, contemporaneous output gap			Regression coefficients, lagged output gap		
	1960-1990	1991-2015	1960-1990	1991-2015	1960-1990	1991-2015	1960-2015	1960-1990	1991-2015	1960-2015
USA	9.1	12.3	2.3	0.4	0.04	-0.05	0.02	0.04	0.00	0.03
Germany	28.3	33.7	2.3	1.5	-0.18*	-0.14*	-0.15*	-0.18*	-0.14*	-0.15*
Sweden	9.5	10.2	2.9	2.5	-0.09*	0.02	-0.02	-0.05	0.01	-0.01
France	31.1	36.1	4.9	1.9	-0.08	-0.16	-0.11	-0.08	0.00	-0.06
Netherlands	29.8	29.5	4.2	1.9	-0.47*	0.16	-0.06	-0.56*	-0.18	-0.31*
United Kingdom	13.1	14.5	1.6	0.8	-0.10*	0.04	-0.06	-0.13*	0.02	-0.09*
Denmark	2.5	3.0	0.6	0.7	-0.02	0.06	0.01	-0.03	-0.03	-0.03
Greece	-	37.4	-	2.0	-	-0.10	-0.10	-	-0.19*	-0.19*
Finland	15.2	25.9	5.4	1.8	-0.18*	-0.04	-0.12*	-0.03	-0.13*	-0.10*
Hungary	-	30.2	-	1.6	-	0.20*	0.20*	-	0.21	0.21
Japan	11.5	20.5	2.9	3.2	-0.05	0.04	-0.02	-0.07*	0.00	-0.03
Belgium	26.4	31.7	3.3	0.6	-0.24*	-0.12*	-0.19*	-0.10	-0.05	-0.08
Italy	28.7	33.5	2.1	1.6	0.03	-0.04	0.00	-0.01	0.10	0.03
Ireland	14.4	13.7	0.0	0.8	-	-0.02	-0.02	-	0.00	0.00
Austria	25.2	31.7	2.8	1.1	-0.08	-0.11*	-0.10*	0.01	-0.10*	-0.06
Switzerland	10.3	11.6	0.0	0.5	-	-0.03	-0.01	-	0.02	0.00
Norway	22.5	21.2	1.4	0.5	0.13	-0.04	0.07	0.17	-0.09	0.07
Poland	-	33.4	-	2.3	-	-0.14	-0.14	-	-0.17	-0.17
Slovak Republic	-	35.2	-	1.7	-	-0.10	-0.10	-	-0.06	-0.06
Canada	6.8	9.2	0.8	0.3	-0.04	-0.03	-0.04	-0.07	-0.01	-0.05*
Czech Republic	-	36.8	-	0.7	-	0.07	0.07	-	-0.05	-0.05
New Zealand	2.0	2.7	0.9	0.5	-0.49	-0.01	-0.02	-0.96*	0.00	-0.06
South Korea	3.0	12.4	2.1	4.0	0.00	-0.13*	0.00	0.00	-0.04	0.00
Iceland	1.5	657	0.2	1.0	-0.05	-0.11*	-0.09*	-0.03	-0.08*	-0.06*
Spain	20.5	26.2	5.0	0.6	-0.21*	-0.12*	-0.16*	-0.06	-0.03	-0.06

Data series start in 1960 or from the earliest available year and asterisks indicate 5% significance level. *Source*: OECD Economic Outlook 95 and authors' calculations
Notes: - = not available. HP-detrending with λ=6.25.

margin. In addition, SSC tax schedules change over time. Figure 2, which tracks their evolution for France and Germany, shows a combination of both trend and fluctuations, the latter occurring mostly at business cycle frequencies.

Using available OECD information for each country, we construct an indicator of the average marginal distortion embodied in the system of social security contributions. We follow Barro and Sahasakul (1983, 1986) and Barro and Redlick (2011) who construct average marginal tax rate series for US workers (see also Joines 1981 and Seater 1982). Their measure represents a weighted central tendency of marginal payroll taxation for individuals over various points of the labor earnings distribution, with weights corresponding to a measure of the relative importance of a particular individual.[11] Not having access to individual data in all countries, we construct average marginal SSC rates $\bar{\tau}_t$ by combining SSC schedules scraped from the database "Taxing Wages 2016" with gross wage earnings distributions taken from the database "Distribution of gross earnings of full-time employees."[12] These data consist of annual observations for nine deciles of gross wage earnings of full-time employees in 27 OECD countries over the period 1975-2010 (hourly, weekly, monthly or annual wages depending on the country). First, we compute the relevant marginal rate for each of nine representative earners at the respective nine deciles of the gross earnings distribution. By applying the schedules of statutory contribution rates to annualized earnings at the deciles $i \in \{1,2,\ldots 9\}$, we arrive at nine marginal SSC rates τ_{it} applicable to an additional unit of gross compensation at the i^{th} decile. The original earnings data excludes employers' contributions, which are part of the tax base for the consolidated SSC schedules for worker-firm matches. We therefore use data on employer SSC rates to infer their contributions paid on behalf of each representative earner, and add them to the earnings data before computing τ_{it}. Our "average marginal tax rate" measure $\bar{\tau}_t$ is simply an unweighted average of the nine marginal rates, i.e. $\bar{\tau}_t = \frac{1}{9}\sum_1^9 \tau_{it}$. For a given year and country, this measure can be constructed only if data for both the tax schedule and wage distribution are available. In 10 countries in our OECD sample, this requirement is met for 10 or more years.

Figure 3 displays the time series of average marginal rates $\bar{\tau}_t$ (red lines), as well as average SSC rates τ_t^A already described in Section 1 (blue lines). Remarkably, average marginal rates exceed the overall average SSC tax burden in all countries except Canada and Japan. Because SSC tax schedules in most countries are regressive as in Figure 1, a large number of low-income workers tend to face the highest marginal rates. Due to the regressive feature of the SSC tax systems, average rates can understate the distortionary effect of SSC, especially for low wage earners. The following simple example illustrates how this is possible. A population consists of three families, with gross labor earnings of 20,000, 60,000, and 200,000 respectively. These families face a truncated SSC schedule that levies a uniform 30% tax on gross labor income up to 61,000, but 0% on income exceeding that amount. The average SSC tax rate τ^A equals $(0.3*20{,}000 + 0.3*60{,}000 + 0.3*61{,}000) \div (20{,}000 + 60{,}000 + 200{,}000) = 15.1\%$, which is significantly below the average marginal rate $\bar{\tau}$ of $(0.3 + 0.3 + 0)/3 = 20\%$. The uniform weighting of the different representative earners plays a key role in explaining high average marginal rates. If earners were weighted with their earnings, those at the lower end of the distribution – who face the highest marginal rates when the tax schedule is regressive – would have a relatively smaller weight compared to high-income earners who tend to face lower marginal rates.

Figure 3 also shows that in most countries, the average SSC tax rate τ^A closely tracks changes of our measure of the average marginal tax burden $\bar{\tau}_t$, the relevant marginal burden on worker-firm matches. For that reason, the rest of our analysis will focus on the average SSC, which is available for many more OECD countries and for longer time periods.

3. Trend and cyclical properties of SSC rates

3.1. Long run trends

Studying the series presented in Section 2 can inform about longer-term, low frequency movements of social security tax burdens in the OECD. They can also allow us to explore sources of variation in τ^A over time. Before considering business cycle frequency properties of our constructed time series, we study medium to long-term trends in average SSC rates. Figure A2 in Appendix B reports cross-correlograms for all countries with sufficient observations of τ_{t+j}^A with annual GDP (Y) growth (approximated as $\Delta \ln Y_t$) for j = -10, -9,… 0,… + 9, + 10. In Figure 4, we group results for four representative countries in each of the three categories of the social welfare state as identified by Esping-Andersen (1990): (1) liberal/Anglo-Saxon (Canada, New Zealand, UK and the US), (2) conservative continental European (France, Italy, Japan, and South Korea), and (3) social democratic/Scandinavian (Denmark, Iceland, Norway, Sweden).

The most salient finding is robust negative correlation of current $\Delta \ln Y_t$ with τ_{t+j}^A for $j > 0$ (future tax rates) of the continental European countries Austria, Belgium, France, Italy, Spain, and Sweden as well as their "Bismarckian offshoots" Japan, and South Korea. The United States is a borderline case, resembling continental Europe only marginally.[13] The correlation of SSC rates with future output is generally weaker and less consistent. In contrast, countries with social insurance programs in the tradition of Beveridge (Australia, Canada, New Zealand, UK) tend to show little or no covariation.[14] As discussed in detail below, SSC rates in

[11] Barro and Sahasakul (1983) use consumption shares as weights.

[12] Available under http://www.oecd.org/els/emp/39606921.xls .

[13] For a similar finding, see Burda and Weder (2016). Using data from Barro and Redlick (2011) over the period 1951-2006 we find an increasingly negative correlation of HP-detrended GDP with average marginal social security tax rates, with the most significantly negative correlation arising in the last two decades of the sample. This shift is not evident in other series they report (average marginal federal income tax, state income tax, state income tax). In fact, the overall marginal and the federal individual average marginal tax rates are significantly procyclical (positively correlated with GDP).

[14] Several economies seem to have undergone regime shifts over the last half-century. Burda and Weder (2016) find that over the period 1970-2010, the Netherlands and Sweden switched from a Bismarck-style regime to a Beveridge one, while the US moved in the opposite direction after the 1980s.

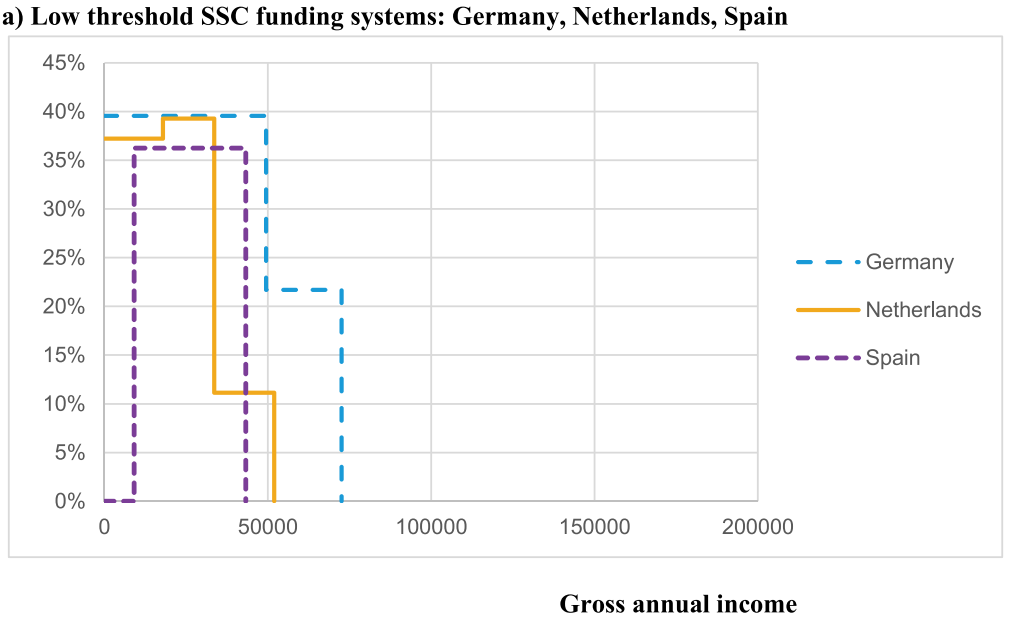

Figure 1. SSC schedules in 2015, six countries

many OECD countries appear to be driven by economic conditions. In particular, procyclical wage bills induce governments to cut payroll tax rates in times of expansion and to raise them in recessions.

Policies that reinforce distortions in downturns have potentially severe consequences for allocative efficiency. Daveri and Tabellini (2000) present evidence that labor taxation is associated with high unemployment in OECD economies at low frequencies; SSC are the dominant candidate for a driver of the labor wedge in the sense of Chari et al. (2007), Brinca et al. (2016), and represent a concrete link between the labor wedge and business cycle dynamics. A severe or persistent recession that reduces social security contributions and raises expenditures is likely to lead to higher distortionary taxes and a worsening of business conditions. Such a "death spiral" characterizes the particularly pronounced low frequency trajectories of SSC rates in Figure A2 for France, Italy, South Korea, and Spain. They can also help account for virtuous cycle cases such as Belgium, Germany, the Netherlands, and Ireland. Naturally, findings presented in Figure 4 may be confounded by lower-frequency movements resulting from social security reforms, stagnant growth, or structural change. In next section, we study the relationship between SSC rates and GDP at business-cycle periodicities in detrended data and examine the robustness of correlations over the sample for signs of potential sub-sample instability.

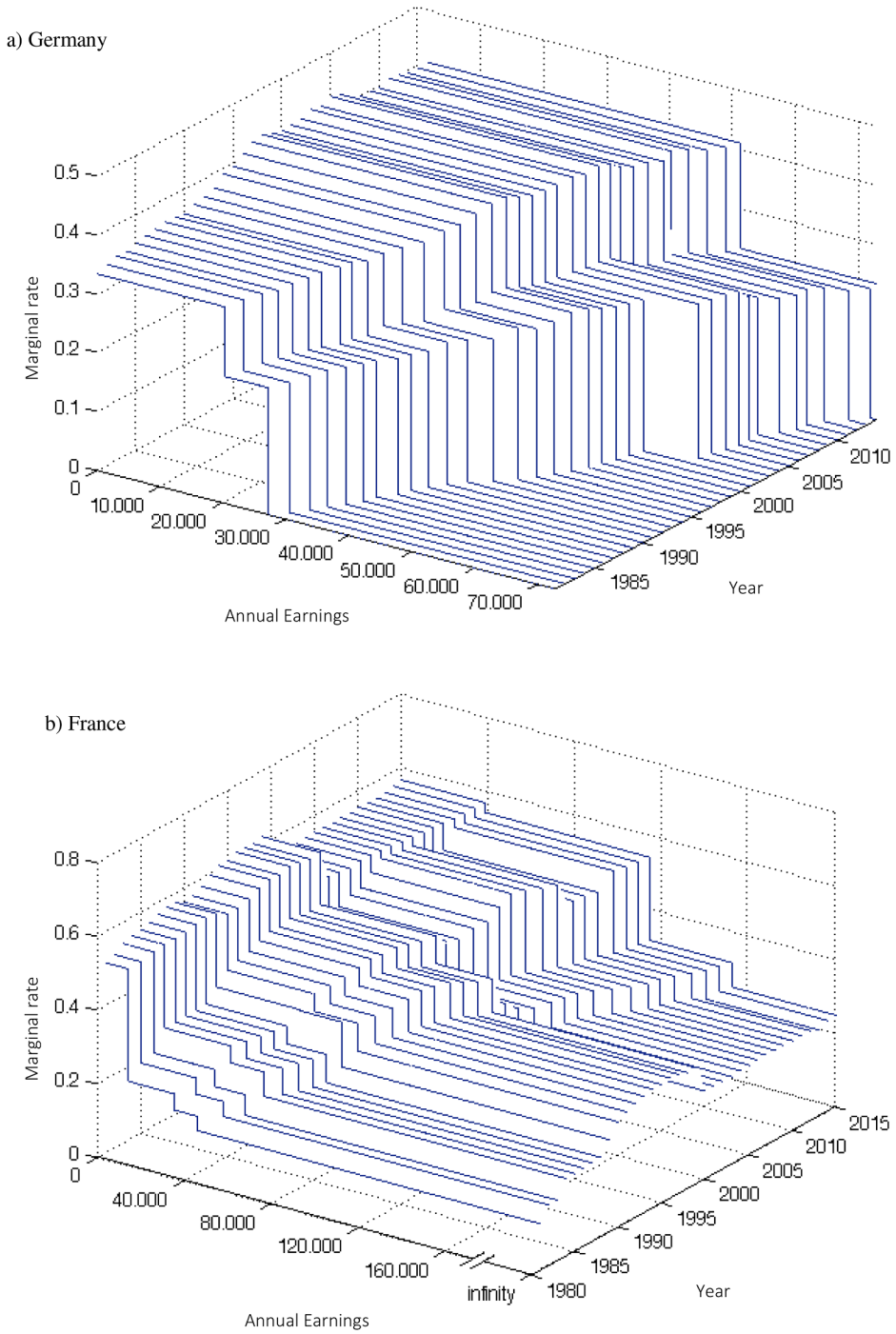

Figure 2. Two SSC schedules over time: Germany and France

3.2. Cyclical properties of SSC rates

As noted in Section 1, the average tax burden will shift if tax schedules change, as movements in marginal rates, tax brackets or contribution ceilings can have large effects on total contributions. Second, the distribution of earnings itself may change. In the case of nonlinear tax schedules documented in Section 2, marginal income can move into a different tax bracket or above a threshold, implying changes in contributions as a share of total earnings. This shift need not only involve the first moment of the distribution, because changes in variance or higher moments can affect the overall tax burden. Recalling the previous example, suppose all individuals experience earnings growth of 10%, with incomes of the three families rising to 22,000, 66,000, and 220,000

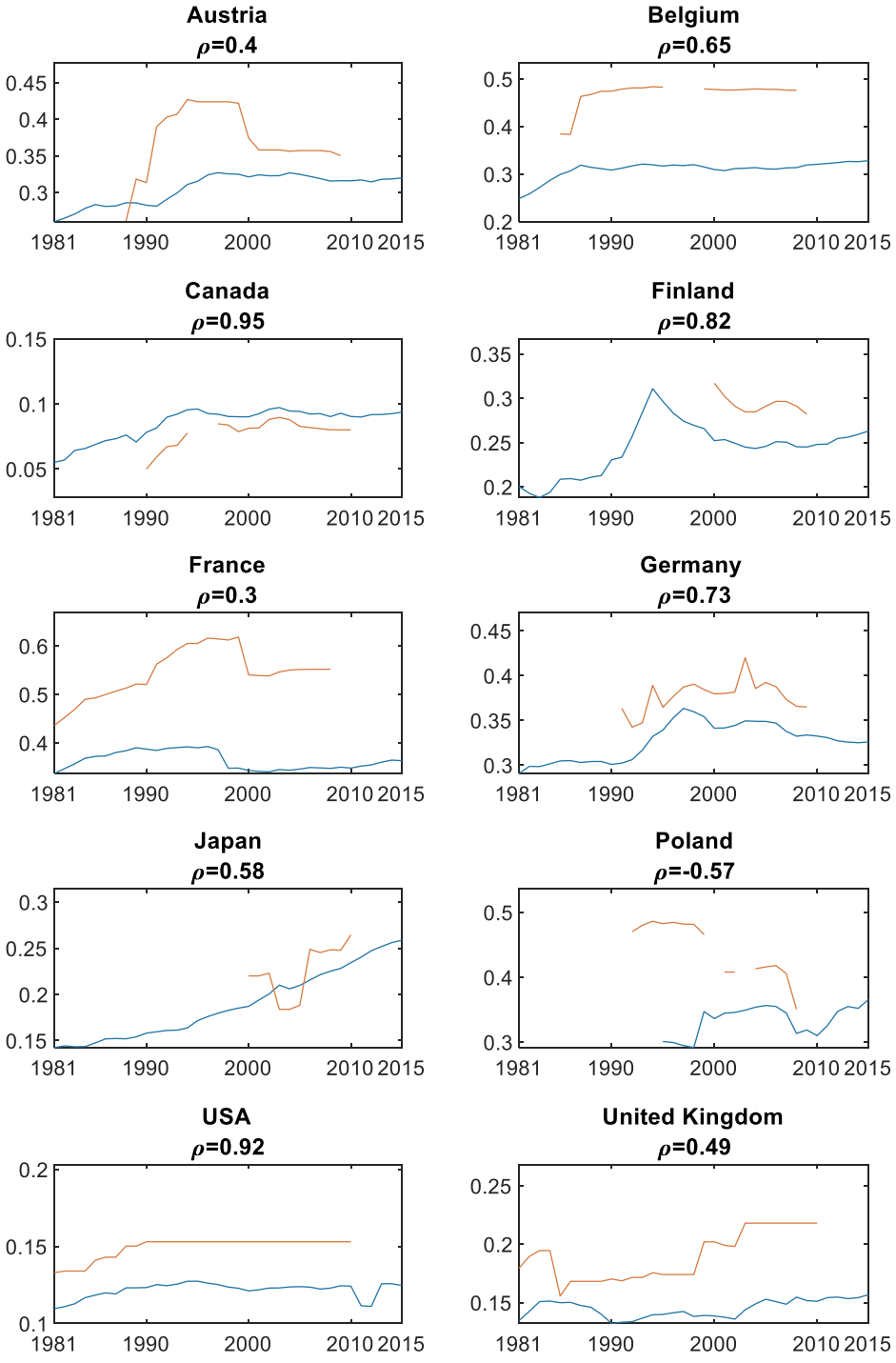

Figure 3. Average SSC (blue lines) and average marginal SSC (red lines) rates (%)

respectively.[15] At unchanged SSC rates, the average rate declines from 15.1% to (0.3*22,000 + 0.3*61,000 + 0.3*61,000) ÷ (22,000 + 66,000 + 220,000) ≈ 14%, while the average marginal rate plummets from 20% to (0.3 + 0 + 0)/3 = 10%. It follows that, given the generally regressive structure of SSC taxation, business cycle fluctuations should naturally generate a labor tax burden that rises in recessions and declines in expansions. This contrasts sharply with the general tendency of average and marginal income taxes

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

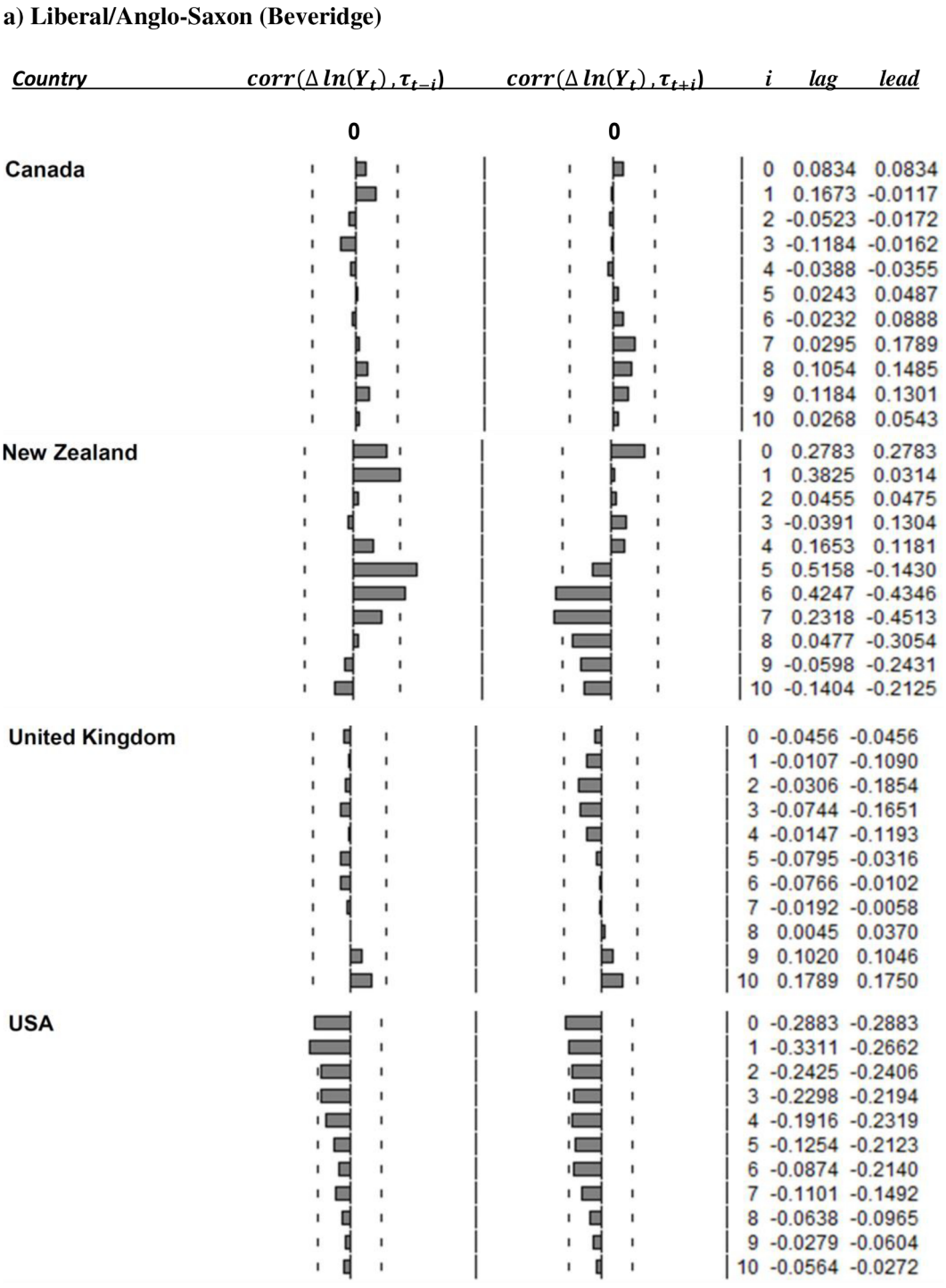

Figure 4. Cross-correlograms of real GDP growth and SSC rates by welfare system type

to behave procyclically.

Table 3 summarizes these dynamics. The first column presents correlations of HP-filtered trend deviations of average SSC rates and HP-filtered trend deviations of log GDP. 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, the Netherlands, Italy).[16]

The HP filter has been criticized for inducing spurious cyclicality (e.g. King and Rebelo, 1993, Cogley and Nason, 1995). To

b) Conservative continental European (Bismarck)

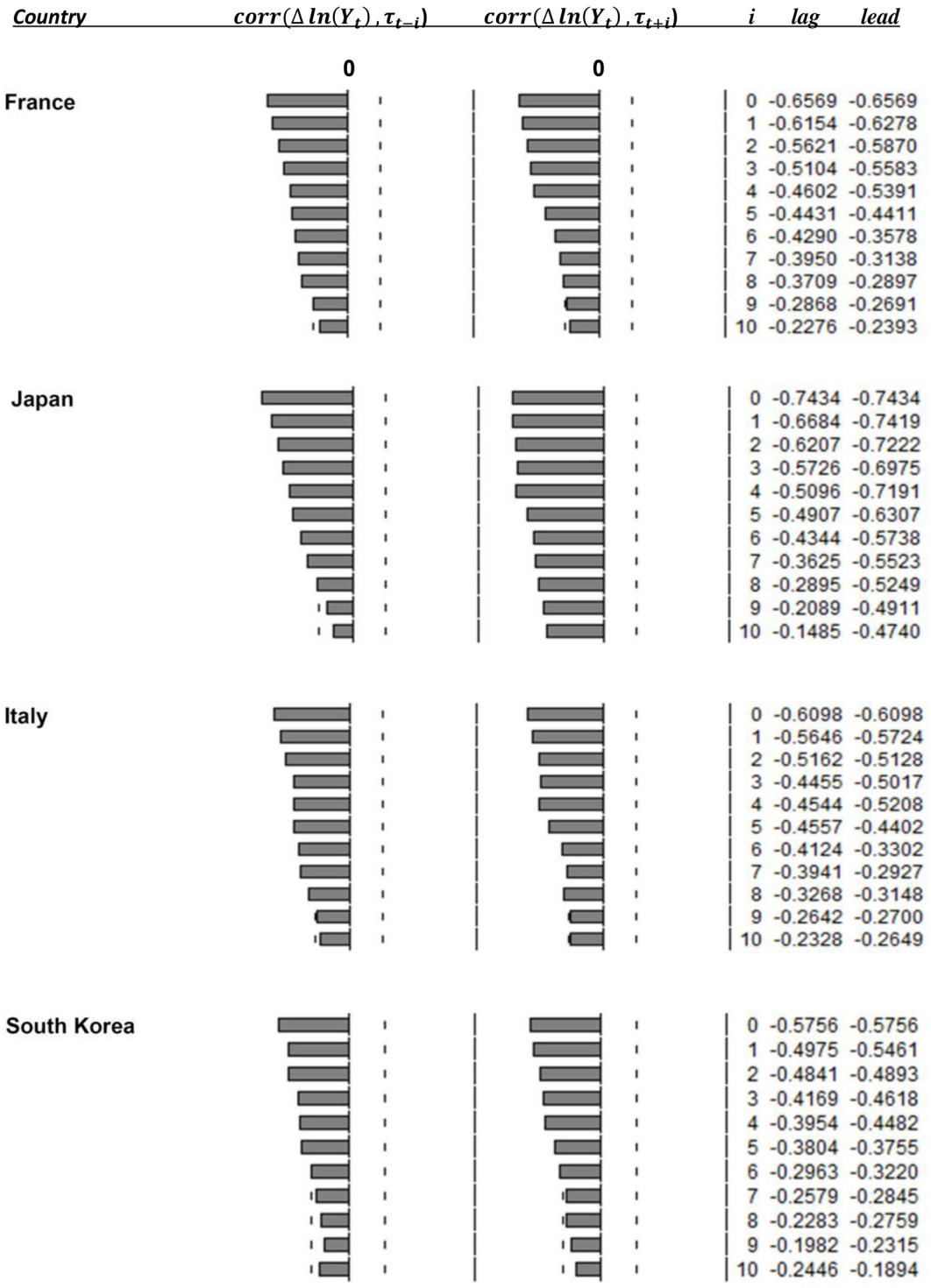

Figure 4. (*continued*)

[16] The subperiod correlations for 1960-1990 and 1991-2015 are suggestive of regime changes in 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 has moved in the opposite direction over the same interval.

c) Social democratic/Scandinavian (Beveridge welfare state)

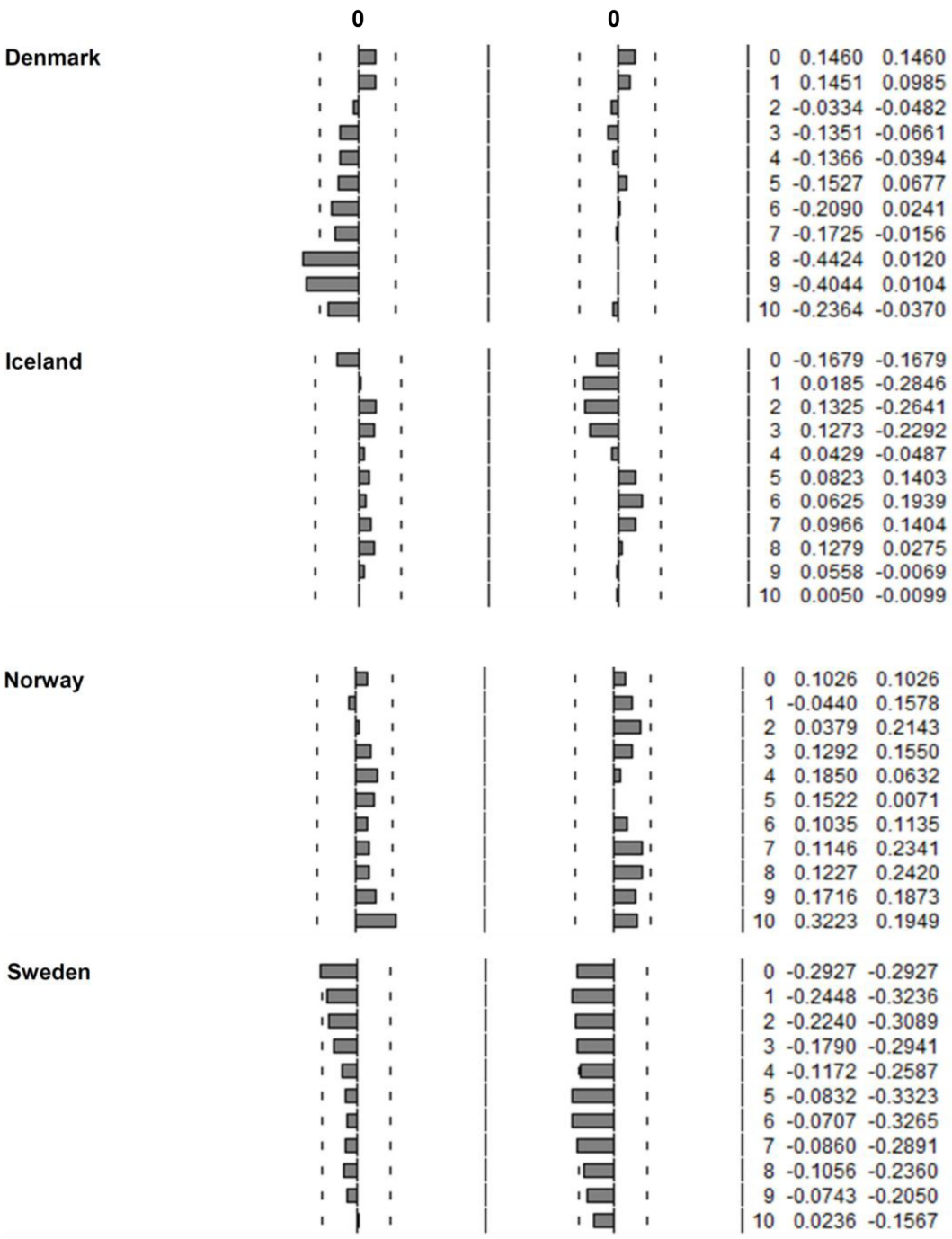

Figure 4. (*continued*)

Table 3
Covariation of SSC rates and GDP, 1960-2015 (correlation coefficients)
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).

Country	HP	Difference	BP (2,8)	BP (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

examine the robustness of our findings to detrending method, we compute the correlations using first differences and the band-pass filter (Christiano and 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 presented in second to fourth columns of Table 3.

Average SSC rates are countercyclical for most, but not all OECD countries. This dynamic pattern of social security contributions implies that the distortionary wedge between labor costs of a firm and the net wage received by a worker worsens in business cycle downturns.[17] The social security system has the potential to amplify business cycle shocks throughout the economy. This potential is weakly associated with the type of the welfare state. An informal classification of countries in Table 3 into Bismarck versus Beveridge systems based on Krieger and Traub (2013) is informative with respect to business cycle correlation with the SSC rate in the first column of Table 3: a χ^2 test of the two-way classification of Bismarck versus Beveridge is significant at the 1% level. Regardless of the social welfare system, there is a marked tendency for average SSC rates to move countercyclically, i.e. to rise in recessions and to fall in expansions.[18]

4. Deconstructing the Mechanism: Determinants of cyclical SSC rates

Time variation in average SSC burdens can arise from two sources. First, a government can adjust statutory tax schedules to meet current revenue requirements or to trim surpluses. It can do this by changing a single tax rate in the case of a flat tax schedule, piecewise tax rates or tax brackets, or maximal compensation subject to contributions (max tax). Note that adjustments of maximum taxable income need not be discretionary, and might in fact result from automatic indexation based on average income, wages, or the price level. In what follows, we will assign such automatic adjustments to economic policy, as opposed to endogenous changes in the

[17] In Appendix B Table A1, we report results for lags and leads of τ^A. In most countries, the leads remain strongly countercyclical, and this finding is robust to detrending method employed. In 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.

[18] Austria, Belgium, Finland, France, Germany, Greece, Japan, Iceland, Italy, Poland, Slovakia, South Korea and Spain were classified as Bismarckian; Canada, Czech Republic, Denmark, Hungary, Ireland, Netherlands, New Zealand, Norway, Sweden, Switzerland, UK, and the USA as Beveridgean. The cutoff value of the correlation coefficient was -0.27.

distribution of wages or total earnings.

Second, holding tax brackets and cutoffs constant, the distribution of labor earnings can change over the cycle, altering tax revenues in the process. To see how variability in the wage distribution affects the average SSC rate, consider a regressive tax schedule as found in Germany, France or Spain, displayed in Figure 1. An overall increase in gross earnings during an expansion moves a larger fraction of taxable income into brackets with lower tax rates, so the average tax rate declines. Furthermore, if the tax schedule features a cut-off or upper threshold value of taxable income (as in Germany, Netherlands or Spain), increases in gross earnings can increase the fraction of gross compensation that is exempt. Similarly, a decline in earnings during a downturn means that a larger fraction of gross labor income falls into lower tax brackets that tend to have higher marginal rates, raising the average SSC rate. Since tax schedules are not strictly linear in most countries, variability in the wage distribution is a potentially important driver for observed variability in average SSC rates.

We now assess the relative importance of variation of these two sources of variability and decompose changes in average SSC rates into two components: the first captures changes due to statutory tax schedule adjustments, and the second summarizes changes due to shifts in earnings distributions. We first construct synthetic series of social security contributions using tax schedules and gross labor earnings distributions. We consider once again nine representative earners $i \in \{1,2,\ldots,9\}$ associated with the nine deciles of the gross earnings distribution as reported by the OECD. Social security contributions are levied according to a piecewise linear function, that aptly describes almost all of the systems in the OECD.[19] SSC paid by the representative worker in decile i with gross labor earnings in period t, $W_{i,t}$, is given by

$$SSC_{i,t} = \sum_{k=1}^{K} I(W_{i,t} - \overline{W}_{k,t} > 0)\tau_{k,t}[\min(\overline{W}_{i,t}) - \overline{W}_{k-1,t}] \tag{2}$$

where $k \in 1,\ldots,K$ indexes tax brackets of the SSC schedule $\{\tau_{k,t}, W_{k,t}\}$ which applies tax rate $\tau_{k,t}$ to gross labor income greater than $W_{k\text{-}1,t}$ but less than $W_{k,t}$ (with $W_{0,t} = 0$), and where $I(.)$ is the indicator function. The average SSC rate for this earner, $\tau^{A}_{i,t}$ is thus given by $SSC_{i,t}/W_{i,t}$. We define the economy-wide synthetic indicator $\tau^{A}*$ of average SSC taxation as the unweighted average of nine average rates taken over the nine deciles:

$$\tau^{A*}_{t} = \frac{1}{9}\sum_{i=1}^{9} \tau^{A}_{i,t} \tag{3}$$

In contrast to the average SSC rate τ^{A} computed in Section 2, $\tau^{A}*$ is a synthetic average tax burden constructed from tax schedules and gross earnings data. Differences between the two are due to the computation procedure and more importantly due to aggregation of wage distribution information into deciles and a missing top decile.

As the two measures track each other fairly well, we can track year-to-year changes $\Delta\tau^{A*}_{t}$ as the sum of two components. The first component, $\Delta\tau^{S}_{t}$ (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,

$$\begin{aligned}
\Delta\tau^{S}_{t} &= \frac{1}{9}\sum_{i=1}^{9}\frac{\Delta SSC_{i,t}}{W_{i,t-1}} \\
&= \frac{1}{9}\sum_{i=1}^{9}\left\{\sum_{k=1}^{K}\frac{I(W_{i,t-1} - \overline{W}_{k,t} > 0)\tau_{k,t}\left[\min\left(\overline{W}_{k,t}, W_{i,t-1}\right) - \overline{W}_{k-1,t}\right]}{W_{i,t-1}}\right. \\
&\quad \left. - \sum_{k=1}^{K}\frac{I(W_{i,t-1} - \overline{W}_{k,t-1} > 0)\tau_{k,t-1}\left[\min\left(\overline{W}_{k,t-1}, W_{i,t-1}\right) - \overline{W}_{k-1,t-1}\right]}{W_{i,t-1}}\right\}
\end{aligned} \tag{4}$$

A second component $\Delta\tau^{D}_{t}$ (D for "distribution") can be defined as a residual, comprised of changes in the earnings distribution at the tax structure from period t-1 to t, plus second order effects due to interaction of tax schedules and earnings changes: $\Delta\tau^{D}_{t} \equiv \Delta\tau^{A*}_{t} - \Delta\tau^{S}_{t}$.

Table 4 decomposes average absolute changes of the synthetic average marginal SSC rates into a component due to statutory SSC schedule changes ($\Delta\tau^{S}_{t}$) and a residual due to changes in the structure of earnings ($\Delta\tau^{D}_{t}$) for 10 countries with sufficient data. The results show that changes in average SSC are remarkably close to changes in the components directly related to rates and caps. Evidently, adjustments in contribution schedules, either discretionary or automatic, are the dominant source of year-to-year changes in average SSC rates.[20]

The finding that planned changes in the tax schedules drive macroeconomic correlations we report for τ^{A} merits further discussion. Changes in tax schedules can be due to balanced budget considerations à la Bismarck, or simply due to indexation of SSC rates and caps designed to reduce bracket creep. Of all the countries in Table 4, only the US has a positive correlation of τ^{A} with the business cycle, and it is statistically insignificant. Our detailed analysis shows that since 1990, this correlation has become more

[19] We ignore lump-sum payments to social insurance funds as implemented in Switzerland, which are relatively rare.

[20] This claim is corroborated by individual regressions of changes in overall average SSC rates (Δ^{A}) on $\Delta^{S}$and Δ^{D} respectively, in the spirit of columns (3) and (5) in Table 4. R^{2}'s for statutory rate changes are lower, sometimes significantly so, but with the exception of Austria always exceed the fraction of variance that can be accounted for by shifts in the earnings distribution.

Table 4
Decomposition of annual changes in synthetic average SSC rates ($\Delta\tau_t^{A*}$)
Source: Authors' calculations

Country (period)	Mean absolute value of ($\Delta\tau_t^{A*}$) over period	(2) Mean absolute value of $\Delta\tau_t^{S}$ over period	(3) % of var ($\Delta\tau_t^{A*}$) accounted for by $\Delta\tau_t^{S}$	(4) Mean absolute value of $\Delta\tau_t^{D}$ over period	(5) % of var($\Delta\tau_t^{A*}$) accounted for by $\Delta\tau_t^{D}$
Austria (1988-2009)	0.73	0.70	96.3	0.13	3.9
Belgium (1984-2008)	0.58	0.58	100.0	0.00	0.0
Canada (1990-2010)	0.31	0.33	98.6	0.15	8.5
Finland (2000-2009)	0.65	0.65	100.0	0.00	0.0
France (1982-2006)	0.91	1.06	98.2	0.20	3.3
Germany (1991-2009)	0.66	0.67	98.3	0.11	0.2
Japan (2000-2010)	1.31	1.31	100.0	0.00	0.0
Poland (1992-2008)	2.25	2.25	100.0	0.00	0.0
UK (1982-2010)	0.90	1.02	91.9	0.43	6.9
USA (1982-2010)	0.19	0.19	99.7	0.04	0.2

negative.[21] For all the other countries, this correlation is stronger or weaker but always negative for all filters considered. While the US social security system does not follow a balanced budget principle, the largest part of the variation of the average marginal SSC rate in the US is still explained by changes in rates and caps due to indexation.[22]

5. Interpreting SSC rates as a labor wedge

We have demonstrated a significant association of our SSC tax burden measure with output, both at business cycle and lower frequencies in a number of important OECD economies. Naturally, correlation is not causation, and common third factors might lie behind these co-movements. Yet any plausible explanation for countercyclical behavior of SSC rates must appeal to some combination of 1) procyclical variations in employment and/or the wage bill, 2) countercyclical proportion of the wage bill subject to SSC, and 3) countercyclical behavior of SSC rates. The role of the last channel is confirmed by our analysis of average statutory marginal tax rates, which also rise in recessions.

Evidence presented above suggests that the SSC rate is a wedge that may lead to long run underemployment (Daveri and Tabellini 2000). At business cycle frequencies, SSC rates should aggravate cyclical fluctuations in the sense of prolonging departures from a steady state growth path, and should be associated at least partially with Chari et al.'s (2007) measure of the labor wedge in their "business cycle accounting" framework. This decomposition attributes components of deviations of GDP to four distortions from an ideal path implied by a theoretical Ramsey-Cass-Koopmans growth model. Chari et al. (2007) show that several broad classes of macroeconomic models can be mapped into these four deviations from an assumed steady state path. While the method itself is not uncontroversial, it would seem that our measure of SSC rates should correspond, conceptually at least, to the labor market distortion described by Chari et al. (2007) and Brinca et al. (2016) as the "labor wedge".

Table 5 presents correlations of our average SSC rates and the labor wedge, which we compute using the business cycle accounting procedure (Chari, et al. 2007) and which represents the discrepancy between the marginal product of labor and a marginal rate of substitution of consumption for leisure.[23] The first column shows correlation coefficients between average SSC rates and labor wedges computed with our data directly from the first order condition for labor in a neoclassical growth model. For most of the countries examined, the correlation is positive and significant. This is especially true for the countries with countercyclical SSC rates: Germany, UK, 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[24]. The second column presents correlation coefficients between our measure of average SSC rates and labor wedges taken from Brinca et al. (2016). A different method for computing the labor wedge as well as a different time span leads to slightly different results, but in the UK, Finland, Belgium, South Korea, Iceland and Spain the high positive correlation persists. The evidence supports the notion that SSC taxes reflect one obvious labor market distortion of the type described by Chari et al. (2007) and Brinca et al. (2016).

6. Conclusion

We have documented that social security contributions (SSC) represent a significant and time-varying burden on employment in the OECD, ranging as high as one-third of total labor costs. This SSC labor tax wedge is countercyclical in most economies, at both business cycle and lower frequencies. In many continental European countries, the rise in SSC has coincided with chronic labor market malaise, especially in those associated with Esping-Andersen's (1990) "conservative continental European system." This form of the social welfare system was promoted by Bismarck in the industrial revolution (for historical context, see Eichengreen 2018, chapter 4) and is based on the equivalence principle (entitlements based on contributions). We estimate that a 1% negative output gap, measured as deviation from HP-trend, is associated with a 0.05 to 0.20 percentage point increase in the SSC rate. The relationship accounts for a significant component of the variance of SSC rates in many countries we examine.

A decomposition of changes in SSC rates across the OECD attributes most of the change to purposeful legislative changes as opposed to shifts of the earnings distribution. To the extent that the business accounting framework has economic content, it should be possible to identify empirical counterparts to the distortions or "wedges" that move a representative agent away from an idealized path associated with the neoclassical growth model. We have established that social security contributions are one highly salient and

[21] Correlations of average marginal federal, state, and social security taxes computed Barro and Redlick (2011) with HP-detrended GDP yielded a correlation of SSC revenues and the cycle of 0.067 over the entire period 1960-2006, -0.649 for the interval 1990-2006.

[22] We are grateful to a referee for pointing out that since legislation in 1972, maximum taxable income in US is indexed by the average nationwide wage level. See https://www.ssa.gov/oact/cola/cbb.html .

[23] We employ the same underlying model and parameter values for all countries. More precisely, production is Cobb-Douglas production with capital share equal to one third, time-separable period utility is logarithmic with isoelastic disutility of labor and the usual aggregate macroeconomic identities. Country-specific macroeconomic variables that were used for calculations: population, total employment, average annual hours worked per employee, government final consumption, export and import of goods and services, sales tax, real GDP, GDP deflator, gross capital formation and net capital stock, investment and consumption of durables were taken from the OECD databases.

[24] We also computed a simplified version of the "government consumption wedge" and "efficiency wedge" (Chari, et al. 2007). Average SSC rates are negatively correlated with the efficiency wedge and positively correlated with the government spending wedge. Similar correlations for Sweden are reported by Brinca (2013). Gali et al. (2007) and Hall (1997) discuss the countercyclical nature of labor wedge, while Mulligan (1998, 2002) presents evidence that federal labor tax and labor wedge are highly correlated at low frequencies.

Table 5
Correlation of first difference in average SSC rate with first differences of two labor wedge measures
Source: Authors' calculations and Brinca et at. (2016). *Note:* Data are annual averages for quarterly indices (2008Q1 = 100). All data series were detrended by taking first differences. Authors' data series are for 1960-2015 and the data series from Brinca et al. (2016) are for 1981-2015.

Country	Authors' estimate	Brinca et al. (2016) measure
USA	-0.07	0.06
Germany	0.52	0.02
Sweden	0.18	-0.11
France	0.29	0.25
Netherlands	0.46	0.26
United Kingdom	0.32	0.32
Denmark	0.39	0.40
Greece	0.29	n.a.
Finland	0.24	0.54
Hungary	0.05	n.a.
Japan	0.14	-0.05
Belgium	0.28	0.26
Italy	0.39	0.40
Ireland	0.10	-0.06
Austria	0.04	0.32
Switzerland	-0.15	0.21
Norway	-0.21	-0.34
Poland	0.48	n.a.
Slovak Republic	-0.09	n.a.
Canada	0.30	0.05
Czech Republic	-0.11	n.a.
New Zealand	-0.03	0.10
South Korea	0.34	0.31
Iceland	0.23	0.25
Spain	0.47	0.32

measurable distortion in the labor market that qualifies as an empirical counterpart of the labor market "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 according to balanced-budget (Bismarckian) principles. In good times when social insurance funds are flush with cash, contribution rates are cut; in bad times, rates are increased.

We have uncovered a robust statistical regularity in OECD countries that, while consistent with many theories of the causes and persistence of business cycles, has received relatively little attention in the empirical study of macroeconomic fluctuations. The presence of balance budget social security funding rule in the Bismarckian tradition has the potential to contribute to labor market volatility and increased business cycle persistence (Burda and Weder 2016). As unemployment in the OECD reaches new lows, it will be important to gain more understanding of these propagation mechanisms going forward, especially those that are determined by policy rules and balanced budget considerations.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jmacro.2020.103209.

Appendix A. 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

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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

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