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On the spread of social protection systems

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Abstract This paper undertakes an empirical analysis of the adoption of contributory social security systems and effective and specific contribution rates. Conditional on country-(time-)specific economic determinants of the setting of these components, the empirical analysis focuses on the role of contagion for policy adoption. Specifically, the paper assesses to which extent a country's integration into the international network of economic and political cooperation, the similarity of political systems, and economic interdependence facilitate the adoption of a social security system, its components, and its contributions across economies. The findings suggest that proximity through common policy, geographical neighborhood, and common culture is important for the diffusion of any type of social security scheme among proximate countries. Further,

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contagion matters for the adoption probability of specific contribution systems as such, as well as for the setting of contribution rates for both employers and employees.

Keywords Social security systems · Taxation · International comparisons · Panel data analysis

JEL Classification H55 · H2 · C22 · F42

1 Introduction

Social security is a major aspect of economic development. Modern states protect their citizens by means of different social security programs against potential life adversities and risks. Social security has an outstanding role in promoting growth and political as well as human development (see Collier and Messick 1975). Given its tantamount importance for securing minimum living standards and its relevance as a policy strategy against poverty and low levels of wellbeing, especially in developing countries, a systematic analysis of the fundamentals determining the adoption of different aspects of social security systems appears important. Such fundamentals may be domestic or foreign, pertaining to contagion.

The responsiveness to contagion is likely heterogeneous across types of countries (developing, transition, and developed) as well as across types of components of social security systems (the range of aforementioned provisions covered and the scale and scope of protection). With this research interest, the present paper is concerned with understanding the cross-country progression and clustering of the adoption of social security standards. In particular, this research agenda is interested in isolating economic and political fundamentals, whose change might have specifically large impacts on the cross-country pattern of the adoption of such systems and the expansion of welfare programs around the world.

As will become clearer below, the adoption of social security systems in general and of particular aspects thereof is well understood on the basis of earlier research (see Collier and Messick 1975; Caucutt et al. 2013; Schmitt 2015). However, the empirical nature of the forces of contagion in specific aspects of the systems—in particular, with regard to contribution rates for employers and employees—is relatively unknown territory. The findings in Collier and Messick (1975) and Schmitt (2015) do suggest that the adoption of social security systems at large follows a hierarchy from peer countries (typically colonizers) to followers (often their colonies).[1] However, these works do not allude to the specifics of systems—employer- versus employee-borne aspects—or to the scope of the contributions and coverage, which is at the heart of the present paper.

[1] Notice that the spread of social security systems in this way is often simply linked to the historical emergence of new countries (former colonies) upon becoming independent. Conceptually, this notion of diffusion is mechanical and, eventually, gives an erroneous impression of wider coverage, as citizens of the "newly adopting" countries were covered by their colonizer's social security system prior to the country's independence.

The present paper alludes to the role of contagion through three channels—proximity in policy, geography, and culture—for the adoption of specific aspects of contributions to social security systems (employer-borne versus employee-borne contributions) and of average general and specific (for pension, health, and unemployment insurance) contribution rates. Covering up to 144 countries and 33 years, the evidence provided below can be summarized as follows. We find evidence of contagion both in the adoption of employer- and employee-borne contributions, as well as in the adjustment of average general and specific contribution rates. Contagion happens through all three channels of interdependence considered—policy, geography, and culture. In particular, employer-borne contribution systems and rates abroad and at home react akin to strategic complements (affecting each other positively), which is, to a somewhat lesser extent, also the case for employee-borne aspects and rates. With regard to specific contributions to pension, unemployment, and health insurance contributions, we detect a complex interrelationship of contagion across issues.

The remainder of the paper is structured as follows. The subsequent section provides a brief overview of the history of social security systems at large and their major components and the development of contributory systems in particular. Section 3 summarizes earlier work providing guidance for the empirical analysis in the paper. Section 4 presents the data employed, the construction of variables used in the empirical analysis, and the estimation strategy. Section 5 reports on the main empirical results, and the last section concludes with a brief summary.

2 The history and nature of social security systems

From a historical perspective, the political concept of modern social insurance can be traced as far back as 1883–1889 to the German government at the time of Chancellor Bismarck, while the concept of mutual aid can be traced back even further to ancient-Greek times (Collier and Messick 1975). Generally, the first type of insurance was sickness insurance, followed by work injury insurance, and, later on, by invalidity and old age provisions. It was financed by contributions and was compulsory for all wage earners.

Following Germany's lead, several countries started introducing similar systems. By the 1930s, the USA, Canada, and several Latin American countries had implemented different types of social insurance schemes (see ILO 1984). A second wave in social security adoption occurred after the Second World War. Many countries achieved independence from their former colonizers at that time and social security programs spread to Asia and Africa. Between the end of the 1940s and the beginning of the 1980s, the number of countries that had introduced social security programs more than doubled from 58 to 139 (see US-SSA 1981; ILO 1984). This increase is partly due to the growth in the number of independent countries,[2] apart from the spread of adoption to preexisting countries.

[2] E.g., upon becoming independent, former colonies typically adopted the social security system implemented by their former colonizers.

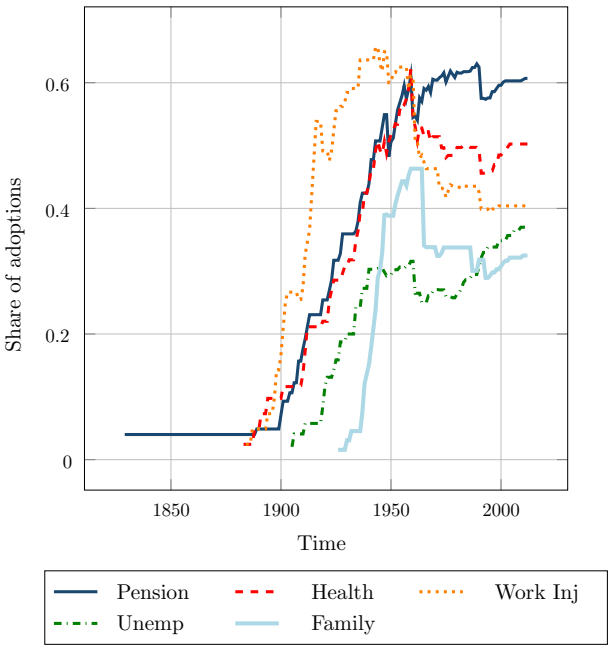

Fig. 1 Independent adoption of social security programs by type (Pre-1900 to 2012) in sovereign countries

It is useful to distinguish among five broad social insurance categories or components, name coverage for (i) old age, disability, and survivors, (ii) sickness and maternity, (iii) work injury, (iv) unemployment, and, lastly, (v) family allowances. The data underlying Fig. 1 are based on information from the US Social Security Administration—Social Security Programs Around the World publications. Combined with the dates of national sovereignty, we can calculate the share of sovereign countries that have independently adopted one of the respective social security components. Figure 1 shows that a majority of countries introduced coverage for old age and health provisions by 2012, presenting the share of countries that have independently adopted social security system components, excluding countries who merely adopted the components of their former colonizers upon achieving sovereignty. While the shares of pension schemes have increased consistently, the share of sovereign countries that have a system of work injury peaked around the 1940s at around 65% and now only 40% of sovereign countries apply a separate work injury program. Similar to pension provisions, the prevalence of unemployment insurance has been increasing around the world since the first program (in France); however, it is only present in around 35% of countries—more prevalent than only family assistance schemes. Health insurance has been independently adopted by around half of all independent countries by 2012, having followed a similar trajectory to pension provisions until around 1960. At present, 122 and 100 countries have independently implemented pension and health insurance schemes, respectively, whereas only 74 economies provide for unemployment relief. 80 and 65 economies run independently adopted work injury and family allowance programs, respectively.

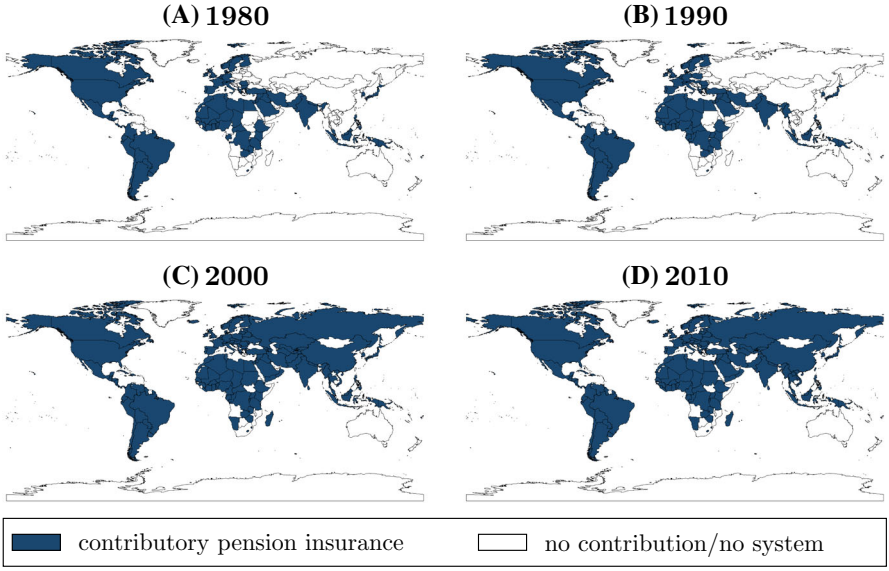

Fig. 2 Geographical spread of contributory pension programs

However, Fig. 1 is unable to depict how the different social security systems are financed. While a number of countries rely on general tax revenue to finance expenditures on social protections, the general trend leans toward contributory systems—out of the 144 countries in our regression sample, the use of employee-borne contributions increased from two-thirds in 1980 to over 90% in 2012. Similarly, the use of employer-borne contributions expanded from 75% in 1980 to 94% in 2012. For our empirical analysis in Sect. 4 we only employ data for the years 1980–2012 for which we have detailed information on the different social security program contribution rates as well as the domestic and contagion control variables.

The following maps depict the spatial distribution of each particular contributory social security program between 1980 and 2012. Figure 2 presents the spread of contributory pension programs, which in the 1980s and 1990s were largely limited to Europe, North and South America, and some African countries. During the first 10 years of the new millennium, pension contributions were also charged in large parts of Eastern Europe, Russia, the Middle East, and Asia.

Figure 3 presents the spread of contributory health insurance programs. During the 1980s, only some European and Central and South American countries had implemented contributory health programs. During the 1990s Australia, India, and China followed, with North America, Russia, Eastern European economies and countries in northwestern Africa introducing these contributions only since the beginning of the 2000s. Many African countries still lack any form of contributory health program.

A different picture emerges for compulsory contributory work injury programs in Fig. 4. A larger number of African countries implemented such contributions, but neither the USA nor former member countries of the Soviet Union did so. We should note here, that, at the beginning of the 2000s the former members of the Soviet Union imple-

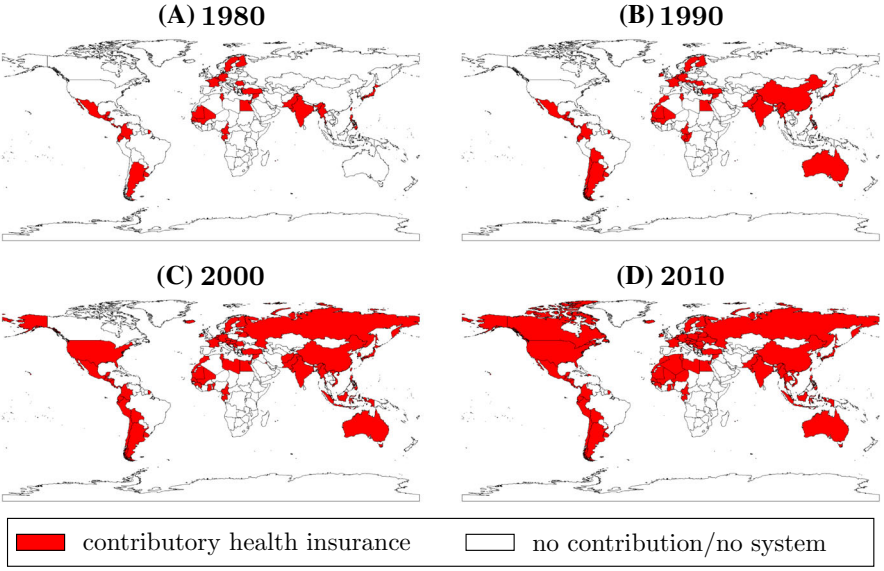

Fig. 3 Geographical spread of contributory health programs

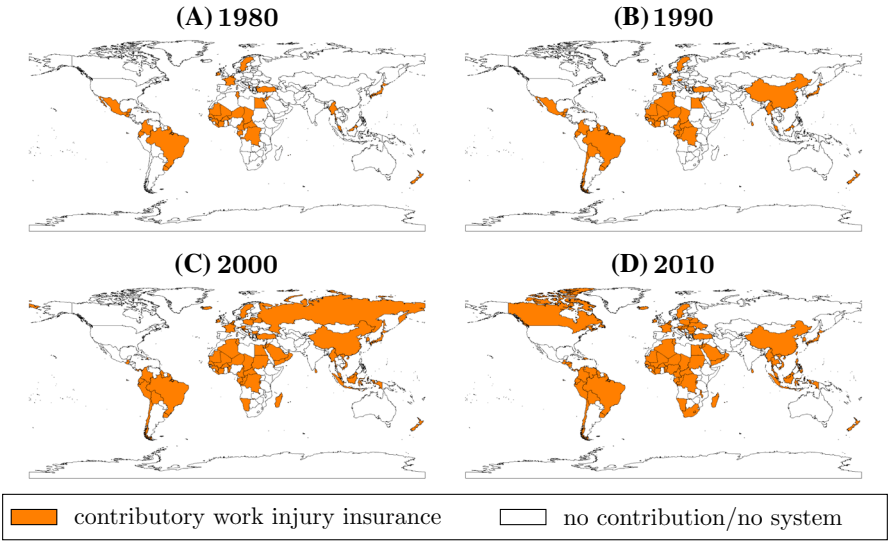

Fig. 4 Geographical spread of contributory work injury programs

mented separate work injury, unemployment and family programs, but they mostly aggregated these programs and associated contributions into a single contribution by 2010.

Figure 5 shows that contributory unemployment insurance experienced very little spread between 1980 and 2012. It remains mainly limited to North America, Europe,

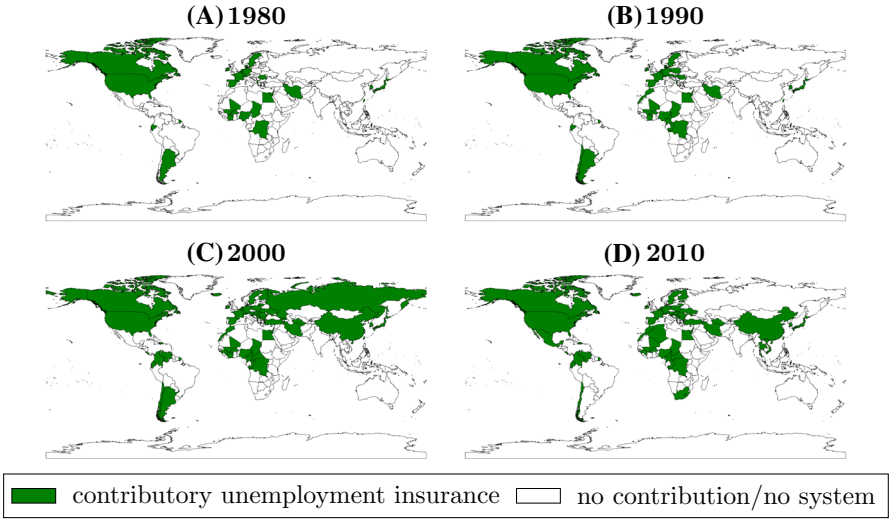

Fig. 5 Geographical spread of contributory unemployment programs

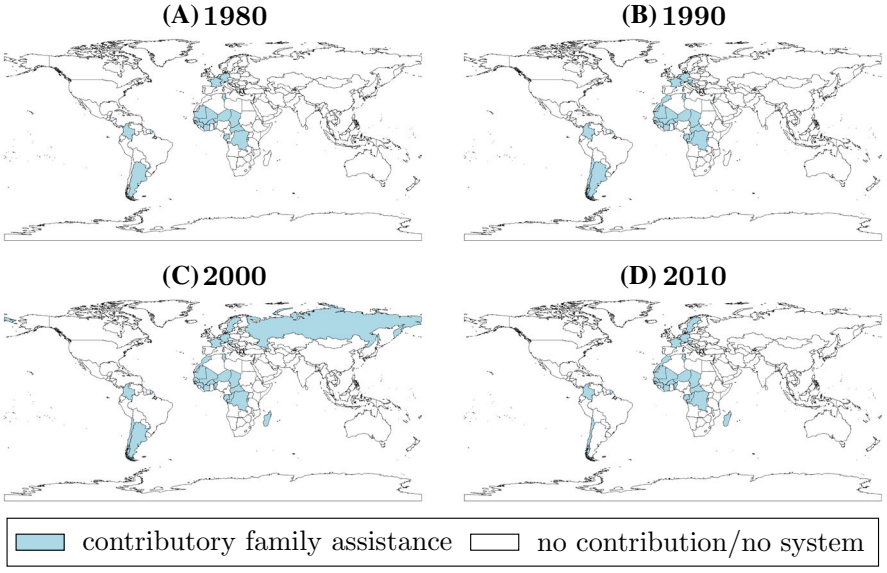

Fig. 6 Geographical spread of contributory family allowance programs

and former French colonies, expanding to China and parts of Asia only in the 2000s. This goes hand in hand with the low amount of unemployment system uptake in Fig. 1.

A scant geographical coverage is encountered in Fig. 6 for compulsory contributory family allowance programs, including child allowances and maternity benefits confirming the pattern we saw in the adoption of such programs in the course of time. At the moment, only a small number of countries worldwide have implemented such mandatory contributory family programs as was presented in Fig. 1.

3 Determinants of the adoption of social security systems in the literature

3.1 Domestic factors

Earlier work on social security systems suggests that their adoption is more likely in richer countries with a better informed public. For instance, the analysis in Collier and Messick (1975), Tang (1996), Mulligan and Sala-i-Martin (1999), Kim (2001), Mulligan et al. (2002), Perotti and Schwienbacher (2009) and Schmitt (2015) suggests that richer countries—in terms of per-capita income—and countries with a better educated population adopt social security systems with greater likelihood and earlier in time. Moreover, the work by Collier and Messick (1975), Mulligan et al. (2002) and Attanasio and Brugiavini (2003) suggests that countries with a larger population and a greater dependency ratio adopt social security systems with greater likelihood and earlier in time. Finally, the work by Becker and Mulligan (1998), Kim (2001) and Mulligan et al. (2002) indicates that political freedom and the efficiency of the political and institutional system in a country affect the probability of an adoption of social security systems.

3.2 Contagion in policy setting

The literature on the diffusion of economic policies at large is vast (see Gilardi 2016, for a review), with one of the first contributions being the one of Cooper (1968). According to Gilardi (2016), the literature distinguishes between three categories of diffusion mechanisms, namely learning, competition, and emulation. The first channel assumes that countries are influenced by the repercussions of similar policies in other countries and adopt and adapt policies tailored to their respective economic and political environment.[3] The second mechanism attributes diffusion to the mutual reaction between states in order to attract scarce and mobile resources. Third, emulation, in contrast to learning, does not require that decision makers objectively assess the consequences of policy but posits that states conform to normative perceptions. Hence, whereas some reforms do not receive support even though they might have positive effects, others benefit from strong endorsement regardless of their success probability (Gilardi 2016). Simmons and Elkins (2004) reveal an additional channel of policy diffusion through globalization and the liberalization of cross-border transactions, leading to the spatial or temporal clustering of policy adoption. The reason for contagion in space and time is that the adoption of economic policy changes the economic environment in an adopting country as well as in *economically connected* ones; furthermore, it changes the information set for future potential adopters about the policy. Other reasons for contagion are yardstick competition and standard competition for mobile agents (individuals, firms, etc.), which are the general standpoint in the literature on tax competition (see Besley and Case 1995; Wilson 1999, for an

[3] Gilardi (2010) highlights the importance of differentiating between the policy and political repercussions of policy change. His findings reveal a heterogeneity in the effect of new information on policy makers. This different sensitivity can be attributed to different ideological positions and prior beliefs. Furthermore, he shows that policy makers react to both the political as well as the policy consequences of reforms.

overview). Beyond tax competition, there is additional evidence on the adoption of environmental standards and policies along similar lines. Among others, Beron et al. (2003) examine the correlation between the decisions of different sovereign states to ratify the Montreal Protocol, and Lovely and Popp (2011) and Perkins and Neumeyer (2012) study the determinants of environmental regulation diffusion, such as economic integration among countries, political economy factors, or international market power.

However, apart from the notion of a hierarchical spreading of the adoption of social security systems as, e.g., in Collier and Messick (1975) or Schmitt (2015), no systematic analysis of the diffusion of or contagion in the specific aspects of social security systems or contribution rates exists to date.

4 Data, variable construction, and descriptive statistics

The data utilized in this paper cover (depending on the year, up to) 144 countries[4] and the years 1980–2012. Since there are a large number of entries of politically independent countries within the covered time span, the available panel data on the dependent and explanatory variables are generally unbalanced.

4.1 Characteristics of social security systems

All of the information on social security systems employed in this paper is collected from the US *Social Security Administration's Social Security Programs Throughout the World* (see US-SSA 2016), which provides information on the year of the introduction of each program and aspect in each country as well as the employee and employer contribution rates for the specific programs. Additionally, we use information from the OECD's *Taxing Wages* publications, such as OECD (2016), for specific details on the social security contributions of OECD countries, as well as a wide array of country-specific sources.[5]

[4] The following countries are included in our analysis: Afghanistan, Albania, Algeria, Argentina, Armenia, Australia, Austria, Bahrain, Bangladesh, Barbados, Belgium, Belize, Benin, Bolivia, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burundi, Cambodia, Cameroon, Canada, Central African Republic, Chile, China, Colombia, Congo, Costa Rica, Côte d'Ivoire, Croatia, Cuba, Cyprus, Czech Republic, Czechoslovakia, Democratic Republic of the Congo, Denmark, Dominican Republic, Ecuador, Egypt, El Salvador, Estonia, Fiji, Finland, France, Gabon, Gambia, Germany, Ghana, Greece, Guatemala, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Latvia, Lesotho, Liberia, Libya, Lithuania, Luxembourg, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russian Federation, Rwanda, Saudi Arabia, Senegal, Serbia, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, Soviet Union, Spain, Sri Lanka, Sudan, Swaziland, Sweden, Switzerland, Syrian Arab Republic, Tajikistan, Tanzania, Thailand, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Uganda, Ukraine, United Arab Emirates, UK, USA, Uruguay, Venezuela, Viet Nam, Yemen, Yugoslavia, Zambia, and Zimbabwe.

[5] See Egger and Strecker (2017) and Strecker (2017) for additional information on the data collected, as well as for a complete list of sources underlying the data, respectively.

Table 1 Summary statistics: dependent variables

Variable	Mean	SD	Median	Min.	Max.	Obs.
Contributory systems						
$CONT - ER_{it}$	0.887	0.317	1	0	1	4259
$CONT - EE_{it}$	0.848	0.359	1	0	1	4259
Effective average contribution rates						
$EACR50\% - ER_{it}$	0.108	0.084	0.094	0.000	0.385	4259
$EACR100\% - ER_{it}$	0.111	0.084	0.096	0.000	0.385	4259
$EACR500\% - ER_{it}$	0.092	0.083	0.074	0.000	0.435	4259
$EACR50\% - EE_{it}$	0.055	0.056	0.045	0.000	0.385	4259
$EACR100\% - EE_{it}$	0.056	0.054	0.046	0.000	0.354	4259
$EACR500\% - EE_{it}$	0.043	0.044	0.032	0.000	0.288	4259
Specific contribution rates[a]						
$PENSION - ER_{it}$	0.070	0.057	0.051	0.000	0.600	3382
$HEALTH - ER_{it}$	0.037	0.034	0.030	0.000	0.250	1349
$UNEMP - ER_{it}$	0.012	0.013	0.009	0.000	0.065	707
$PENSION - EE_{it}$	0.143	0.509	0.089	0.000	8.346	3496
$HEALTH - EE_{it}$	0.054	0.037	0.048	0.000	0.180	1612
$UNEMP - EE_{it}$	0.034	0.032	0.020	0.000	0.139	1233

[a] Measures greater than 1 are possible due to flat-rate contributions

We explore the complexities of contributory social security systems in three distinct ways. First, two binary variables are introduced to reflect whether a contributory system involving employers ($CONT - ER_{it}$) or employees ($CONT - EE_{it}$) as contributors was in place in country i at time t (then being unity) or not (then being zero).

Second, we define three fractional variables each for employers (denoted by $-ER$) and employees (denoted by $-EE$) reflecting effective average general contribution rates to the social security system at an income of 50, 100 and 500% of the average income. We denote these variables by $\{EACR50\% - ER_{it}, EACR100\% - ER_{it}, EACR500\% - ER_{it}\}$ and $\{EACR50\% - EE_{it}, EACR100\% - EE_{it}, EACR - EE500\% - EE_{it}\}$, respectively.

Finally, we introduce three fractional measures each for employers (denoted by $-ER$) and employees (denoted by $-EE$) reflecting the top marginal, specific contribution rates on pension, health, and unemployment insurance. We denote the latter variables by $\{PENSION - ER_{it}, HEALTH - ER_{it}, UNEMP - ER_{it}\}$ and $\{PENSION - EE_{it}, HEALTH - EE_{it}, UNEMP - EE_{it}\}$, respectively.

Table 1 summarizes these corresponding variables in the data sample. In the table, we provide information on the mean, the standard deviation (SD), the median, the minimum (Min.), and the maximum (Max.) sample value for each considered characteristic of social security systems. Moreover, we give the number of observations for which the corresponding variables exist (Obs.). The data suggest that there is little variation in the binary contributory system variables, as most of the countries existing at any moment already held such a system for both employers and employees during

the sample period. However, there is a large degree of variability in the *EACR* general contribution rates as well as the *PENSION*-, *HEALTH*-, and *UNEMP*-specific contribution rates, as the standard deviation for these measures is about as large as the mean, the minimum value for all of these rates is zero, and the maximum value is much larger than twice the standard deviation.

In the subsequent analysis, we will refer to these dependent variables generically by Y_{it}.

4.2 Contagion and its channels

Contagion in the setting of the aforementioned characteristics of social security systems is at the heart of this paper's interest. Contagion means that the setting of the characteristics elsewhere (say, in a given country j in the previous year) affects the setting in country i (say, in year t). We know from earlier work on the adoption of policy at large (fiscal spending, taxation, etc.) that "elsewhere" does not mean "everywhere," but *proximity* or *similarity* matters (in a positive or negative way) for the adoption of policy across countries.

In this paper, we use three metrics of *proximity*, pertaining to policy, geography, and culture, which we generically index by $h \in \{\underline{p}olicy; \underline{g}eography; \underline{c}ulture\}$. Specifically, let us denote the metric of proximity in category h between countries i and j in year t by w^h_{ijt}, which is zero whenever $i = j$ and is normalized such that it adds to unity for all countries i in any year t, $\sum_{j=1}^{N_t} w^h_{ijt} = 1$ with N_t being the number of countries in the sample in year t. Depending on the metric type h, we may define for any country-year tuple it the corresponding third-country characteristics, $\overline{Y}^h_{it}$. For instance, with $Y = CONT - EE$ and $h = g$, $\overline{Y}^h_{it} = \overline{CONT - EE}^g_{it}$ reflects the relative prevalence (a ratio) of a contributory social security system regarding employees for country i and year t in geographically close countries. Similarly, with $Y = EACR100\% - ER$ and $h = p$, $\overline{Y}^h_{it} = \overline{EACR100\% - ER}^p_{it}$ reflects the weighted average of the effective average general contribution rate of employers (a fraction) in countries with similar economic policy for country i and year t. Each metric w^h_{ijt} is based on several measures of proximity itself, and we combine those measures by principal component analysis (*PCA*), where we focus on the first principal component in dimension h. For a single principal component of similarity in h for country pair ij and year t, PCA^h_{ijt}, we obtain the proximity weight as $w^h_{ijt} = \frac{PCA^h_{ijt}}{\sum_{j \neq i} PCA^h_{ijt}}$ for $i \neq j$ and $w^h_{iit} = 0$, which ensures that w^h_{ijt} sums up to unity over j.

Specifically, the three metrics of proximity involve the following measures:

- *Proximity through policy* The measure w^p_{ijt} and the underlying first principal component PCA^p_{ijt} are based on five binary indicator variables which capture whether in year t two countries i and j were members of a common bilateral trade agreement, a bilateral investment agreement, a bilateral tax treaty, jointly members of the WTO and its predecessors, and a common currency or currency union. The data on the just-mentioned policy variables are taken from Egger and Wamser 2013).

- *Proximity through geography* The measure w^g_{ijt} and the underlying first principal component PCA^g_{ijt} involve the log of inverse bilateral distance and a bilateral land adjacency indicator between countries i and j. Notice that even though the underlying characteristics are time-invariant, the metric of geographical proximity, w^g_{ijt}, may vary over time as the number of countries changes between years. The data informing on geographical proximity are taken from the gravity database of the Centre d'Études Prospectives et d'Informations Internationales (see Head et al. 2010).
- *Proximity through common culture, history, and institutions* The measure w^c_{ijt} and the underlying first principal component PCA^c_{ijt} involve time-invariant binary indicators on common official language, common ethnic language, common law system, colonial relationship (current, at any point in time, and post-1945), common colonizer, and if countries were ever part of the same country. Hence, the metric of cultural proximity is time-invariant. For the same reasons as w^g_{ijt}, w^c_{ijt} is time-variant even though the underlying measures of proximity are not. The data on cultural proximity are also taken from the gravity database of the Centre d'Études Prospectives et d'Informations Internationales (see Head et al. 2010).

In general, we use the contagion variables with one annual lag in the regressions so that a regression of Y^h_{it} will always involve some $\overline{Y}^h_{it-1}$. We will generally collect the contagion or third-country variables into the vector $\overline{Z}^Y_{it-1}$. That vector may for instance include only $\overline{Y}^p_{it-1}$ or $\overline{Y}^g_{it-1}$ or $\overline{Y}^c_{it-1}$. Alternatively, it could include $\overline{Y}^p_{it-1}$ along with $\overline{Y}^g_{it-1}$ and $\overline{Y}^c_{it-1}$. This is done to inform the analysis about the relative importance of different channels of contagion for policy setting. Moreover, if Y was $CONT-ER$, $\overline{Z}^Y_{it-1}$ could even include all elements in ($CONT-ER^p_{it}$, $CONT-ER^g_{it}$, $CONT-ER^c_{it}$, $CONT-EE^p_{it}$, $CONT-EE^g_{it}$, $CONT-EE^c_{it}$) together. The latter is done to consider some spillovers across particular policy instruments. However, since the combinations across instruments (of which there are 14 in Table 1) and channels of contagion (of which there are three) are too many, we are selective in terms of considerations of possible configurations of $\overline{Z}^Y_{it-1}$ below.

4.3 Control variables

Most of the earlier work on the determinants of social security systems is on the adoption of such a system in general or the adoption of specific components and its timing. The analysis of the present paper is, with the exception of the distinction between employer- and employee-borne aspects in the binary $CONT-ER$ and $CONT-EE$ indicators, much more focused on quantitative aspects of social security systems. However, we let the earlier literature as summarized in Sect. 3.1 inform the set of country-time-specific control variables for these measures.

In order to address the insights from the literature reviewed in Sect. 3.1, we generally control for log per-capita income, log population, the dependency ratio of the population (as one minus the fraction of the population between 15 and 65 years of age), the primary, secondary and tertiary completion shares in the population, and

three variables capturing the political system of a country, namely the Polity score of political freedom, an indicator variable for a federal system, and an indicator variable for a finite-term system of a country's government. While the three political variables stem from Dahlberg et al. (2015), who edit and compile the University of Gothenburg's Quality of Governance Dataset, the education shares are from Barro and Lee (2010), with intermittent observations interpolated via regression on a polynomial of the year variable, and all other control variables are constructed based on information in the World Bank's World Development Indicators (see World Bank 2014).

Formally, we will collect the aforementioned control variables into the vector X_{it}. We relegate brief summary statistics to the Appendix.

4.4 Empirical specification

After introducing a country-specific fixed effect μ_i, a time-specific fixed effect λ_t, and a remainder disturbance term u_{it}, we may specify the following linear fixed effects model for dependent variable Y_{it}:

$$Y_{it} = \overline{Z}_{it-1}^{YS}\alpha^{YS} + X_{it-1}\beta^{YS} + \mu_i^{YS} + \lambda_t^{YS} + u_{it}^{YS}, \tag{1}$$

where α^{YS} and β^{YS} are conformable parameter vectors whose size and values will depend on outcome Y and the configuration S of $\overline{Z}$. In the interest of brevity, we will suppress the parameters on the control variables, β^{YS}, in the subsequent tables and focus on estimates of α^{YS}.

The use of a linear model formulation ensures a relatively greater stability of the estimation procedure than nonlinear models would, and it provides for a straightforward interpretation of the parameters. With the adopted form, an estimated parameter value of $\widehat{\alpha}^{CONT-ER,S} = 0.5$ means that the probability of adopting a system of $CONT - ER$ for any country i in year t was higher by 0.05% points if a random set of 10% of its neighbors had such a system in place in year $t-1$ than if none of the countries had done so, ceteris paribus. Similarly, an estimated parameter value of $\widehat{\alpha}^{EACR100\%-EE,S} = 0.5$ means that $EACR100\% - EE$ rate for any country i in year t was higher by 0.05% points if all of its neighbors ceteris paribus had had such a rate of 10% in year $t-1$ than if they had a rate of zero.

The linear treatment of the considered dependent variables in a regression leads to an associated heteroskedasticity of the disturbances, but this can be guarded against by using an Eicker–White sandwich estimator of the variance–covariance matrix of the parameters.

5 Empirical results

Tables 2, 3, 4, 5, 6, 7 and 8 summarize the regression results by focussing on the parameters on the contagion variables. Each table is devoted to another aspect of the social security system. All tables have the same principal structure. They are organized in nine columns, where the first one contains the acronyms of the respective contagion

Table 2 Fixed effects regressions: contributory social security systems

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: CONT − ER$_{it}$								
$\overline{CONT-ER}^{p}_{it-1}$	0.286***			1.002***			0.066	0.696***
	(0.087)			(0.154)			(0.087)	(0.158)
$\overline{CONT-ER}^{g}_{it-1}$		0.579***			0.972***		0.555***	0.932***
		(0.046)			(0.070)		(0.051)	(0.076)
$\overline{CONT-ER}^{c}_{it-1}$			0.434***			0.318***	0.068	−0.177*
			(0.075)			(0.095)	(0.081)	(0.099)
$\overline{CONT-EE}^{p}_{it-1}$				−0.890***				−0.654***
				(0.159)				(0.166)
$\overline{CONT-EE}^{g}_{it-1}$					−0.447***			−0.471***
					(0.061)			(0.067)
$\overline{CONT-EE}^{c}_{it-1}$						0.134**		0.312***
						(0.067)		(0.071)
R^2	0.147	0.176	0.151	0.153	0.187	0.152	0.177	0.194
Dependent variable: *CONT − EE$_{it}$*								
$\overline{CONT-ER}^{p}_{it-1}$				0.976***				0.497***
				(0.180)				(0.185)
$\overline{CONT-ER}^{g}_{it-1}$					1.164***			1.082***
					(0.082)			(0.089)
$\overline{CONT-ER}^{c}_{it-1}$						0.477***		−0.024
						(0.112)		(0.116)
$\overline{CONT-EE}^{p}_{it-1}$	−0.452***			−1.287***			−0.541***	−0.811***
	(0.104)			(0.186)			(0.109)	(0.195)
$\overline{CONT-EE}^{g}_{it-1}$		0.048			−0.714***		0.089*	−0.641***
		(0.047)			(0.071)		(0.053)	(0.078)
$\overline{CONT-EE}^{c}_{it-1}$			0.106*			−0.100	0.110	0.141*
			(0.062)			(0.079)	(0.068)	(0.083)
R^2	0.164	0.160	0.161	0.170	0.200	0.165	0.166	0.204
Observations	4259	4259	4259	4259	4259	4259	4259	4259
Countries	144	144	144	144	144	144	144	144

All regressions include country- and year-fixed effects along with the control variables listed in Sect. 4.3. Standard errors in parentheses are robust to an unknown form of heteroscedasticity and autocorrelation
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

variables and eight numbered columns pertain to estimates based on alternative model specifications. Columns (1)–(3) always refer to the most parsimonious specifications (containing the fewest parameters), and column (8) refers to the least parsimonious specification. While all columns together in a table are interesting to look at, we should consider that there is some collinearity between the contagion variables so that the results in columns (1)–(3) are easiest to interpret. In case that significance levels

Table 3 Fixed effects regressions: effective average contribution rates—50% of average wage

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: $EACR50\% - ER_{it}$								
$\overline{EACR50\% - ER}^{p}_{it-1}$	−0.090			−0.204**			−0.126**	−0.232***
	(0.059)			(0.079)			(0.060)	(0.082)
$\overline{EACR50\% - ER}^{g}_{it-1}$		0.103**			0.140***		0.073	0.107**
		(0.044)			(0.047)		(0.048)	(0.050)
$\overline{EACR50\% - ER}^{c}_{it-1}$			0.149***			0.140**	0.135**	0.145**
			(0.055)			(0.056)	(0.060)	(0.061)
$\overline{EACR50\% - EE}^{p}_{it-1}$				0.257**				0.322**
				(0.121)				(0.126)
$\overline{EACR50\% - EE}^{g}_{it-1}$					−0.190**			−0.246***
					(0.076)			(0.082)
$\overline{EACR50\% - EE}^{c}_{it-1}$						0.073		0.086
						(0.073)		(0.080)
R^2	0.063	0.064	0.064	0.064	0.065	0.064	0.066	0.069
Dependent variable: $EACR50\% - EE_{it}$								
$\overline{EACR50\% - ER}^{p}_{it-1}$				0.007				−0.044
				(0.045)				(0.046)
$\overline{EACR50\% - ER}^{g}_{it-1}$					0.120***			0.092***
					(0.027)			(0.028)
$\overline{EACR50\% - ER}^{c}_{it-1}$						0.167***		0.115***
						(0.032)		(0.035)
$\overline{EACR50\% - EE}^{p}_{it-1}$	0.309***			0.302***			0.222***	0.277***
	(0.051)			(0.069)			(0.054)	(0.072)
$\overline{EACR50\% - EE}^{g}_{it-1}$		0.261***			0.201***		0.187***	0.127***
		(0.041)			(0.043)		(0.045)	(0.047)
$\overline{EACR50\% - EE}^{c}_{it-1}$			0.171***			0.134***	0.061	0.022
			(0.041)			(0.042)	(0.044)	(0.045)
R^2	0.091	0.092	0.087	0.091	0.097	0.093	0.097	0.104
Observations	4259	4259	4259	4259	4259	4259	4259	4259
Countries	144	144	144	144	144	144	144	144

All regressions include country- and year-fixed effects along with the control variables listed in Sect. 4.3. Standard errors in parentheses are robust to an unknown form of heteroscedasticity and autocorrelation
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

and parameter signs change in other columns relative to columns (1)–(3) this accrues due to collinearity of the regressors. Each table is split into two vertical blocks, one pertaining to employer-borne contributions (at the top) and the other pertaining to employee-borne contributions (at the bottom). Within each of the two vertical blocks, we report parameter point estimates and (in parentheses) standard errors as well as the R^2 and the number of observations and countries covered with the concept at stake.

Table 4 Fixed effects regressions: effective average contribution rates—100% of average wage

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: $EACR100\% - ER_{it}$								
$\overline{EACR100\% - ER}^{p}_{it-1}$	−0.097*			−0.167**			−0.125**	−0.193**
	(0.056)			(0.075)			(0.057)	(0.077)
$\overline{EACR100\% - ER}^{g}_{it-1}$		0.075*			0.140***		0.048	0.110**
		(0.043)			(0.046)		(0.048)	(0.050)
$\overline{EACR100\% - ER}^{c}_{it-1}$			0.113**			0.122**	0.109*	0.135**
			(0.052)			(0.053)	(0.058)	(0.059)
$\overline{EACR100\% - EE}^{p}_{it-1}$				0.158				0.257**
				(0.113)				(0.117)
$\overline{EACR100\% - EE}^{g}_{it-1}$					−0.293***			−0.324***
					(0.071)			(0.078)
$\overline{EACR100\% - EE}^{c}_{it-1}$						−0.046		0.012
						(0.072)		(0.079)
R^2	0.084	0.084	0.084	0.084	0.088	0.084	0.085	0.090
Dependent variable: $EACR100\% - EE_{it}$								
$\overline{EACR100\% - ER}^{p}_{it-1}$				0.075*				0.034
				(0.043)				(0.044)
$\overline{EACR100\% - ER}^{g}_{it-1}$					0.091***			0.066**
					(0.026)			(0.028)
$\overline{EACR100\% - ER}^{c}_{it-1}$						0.141***		0.090***
						(0.031)		(0.034)
$\overline{EACR100\% - EE}^{p}_{it-1}$	0.326***			0.251***			0.272***	0.246***
	(0.048)			(0.064)			(0.050)	(0.067)
$\overline{EACR100\% - EE}^{g}_{it-1}$		0.207***			0.157***		0.138***	0.079*
		(0.038)			(0.041)		(0.042)	(0.045)
$\overline{EACR100\% - EE}^{c}_{it-1}$			0.143***			0.098**	0.034	0.009
			(0.040)			(0.041)	(0.044)	(0.045)
R^2	0.137	0.133	0.129	0.137	0.135	0.134	0.140	0.144
Observations	4259	4259	4259	4259	4259	4259	4259	4259
Countries	144	144	144	144	144	144	144	144

All regressions include country- and year-fixed effects along with the control variables listed in Sect. 4.3. Standard errors in parentheses are robust to an unknown form of heteroscedasticity and autocorrelation
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table 2 refers to the binary contribution system (employer versus employee) indicators as dependent variables, and Tables 3, 4 and 5 employ effective average contribution rates for earners of 50, 100, and 500% of the average income in a country and year. In these tables, we consider effects of contagion in the employer-borne as well as the employee-borne weighted dependent variable abroad on either employer-borne or employee-borne outcome. With three channels of interdependence (policy, geography,

Table 5 Fixed effects regressions: effective average contribution rates—500% of average wage

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: $EACR500\% - ER_{it}$								
$\overline{EACR500\% - ER}^{p}_{it-1}$	−0.273***			−0.262***			−0.308***	−0.308***
	(0.062)			(0.077)			(0.063)	(0.079)
$\overline{EACR500\% - ER}^{g}_{it-1}$		0.068			0.184***		0.041	0.138***
		(0.047)			(0.049)		(0.051)	(0.053)
$\overline{EACR500\% - ER}^{c}_{it-1}$			0.120**			0.181***	0.139***	0.206***
			(0.048)			(0.050)	(0.053)	(0.054)
$\overline{EACR500\% - EE}^{p}_{it-1}$				−0.037				0.284*
				(0.145)				(0.151)
$\overline{EACR500\% - EE}^{g}_{it-1}$					−0.628***			−0.586***
					(0.078)			(0.088)
$\overline{EACR500\% - EE}^{c}_{it-1}$						−0.333***		−0.139
						(0.078)		(0.086)
R^2	0.066	0.062	0.063	0.066	0.076	0.067	0.068	0.082
Dependent variable: $EACR500\% - EE_{it}$								
$\overline{EACR500\% - ER}^{p}_{it-1}$				0.029				0.004
				(0.042)				(0.043)
$\overline{EACR500\% - ER}^{g}_{it-1}$					0.046*			0.047
					(0.027)			(0.029)
$\overline{EACR500\% - ER}^{c}_{it-1}$						0.044		0.017
						(0.027)		(0.030)
$\overline{EACR500\% - EE}^{p}_{it-1}$	0.199***			0.168**			0.153**	0.162*
	(0.064)			(0.079)			(0.067)	(0.083)
$\overline{EACR500\% - EE}^{g}_{it-1}$		0.135***			0.112***		0.105**	0.077
		(0.041)			(0.043)		(0.046)	(0.049)
$\overline{EACR500\% - EE}^{c}_{it-1}$			0.077*			0.058	0.009	0.000
			(0.041)			(0.042)	(0.046)	(0.047)
R^2	0.062	0.062	0.061	0.062	0.063	0.061	0.064	0.065
Observations	4259	4259	4259	4259	4259	4259	4259	4259
Countries	144	144	144	144	144	144	144	144

All regressions include country- and year-fixed effects along with the control variables listed in Sect. 4.3. Standard errors in parentheses are robust to an unknown form of heteroscedasticity and autocorrelation
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

and culture) and employer-borne and employee-borne outcomes, there are up to six regressors in each of the Tables 2, 3, 4, and 5. Notice that with this setup, we do account for some effects of contagion in social security aspects but not in all of them: while we consider effects of, e.g., the existence of the employer-borne *EACR* for earners of 50% of the average income in proximate countries on a country's employer- as well

as its employee-borne *EACR* for earners of 50% of the average income, we do not consider effects of the employer-borne *EACR* for earners of 100% or of 500% of the average income. Clearly, these three aspects of social security contribution are highly correlated with each other and considering cross-aspect effects for different earners would have led to a very high degree of collinearity. With this in mind, we should not expect too different results between Tables 3, 4 and 5.

Tables 6, 7 and 8 focus on component-specific contribution rates—pensions, health insurance, and unemployment insurance—and consider not only effects of, say, pension contributions abroad on pension contributions at home but also of contributions for health insurance and unemployment insurance on pension contributions. With three concepts and three channels of contagion this leads to nine contagion parameters within the domains of employer and employee contributions. Due to the large number of effects, unlike in Tables 2, 3, 4, and 5, we decided against considering effects of employee contributions on employer contributions and vice versa in those respective tables.

In what follows, we will summarize the results in the tables for contributory systems in Table 2, jointly for effective average contribution rates for different earner types in Tables 3, 4 and 5, and jointly for different specific contribution rates on pensions, health insurance, and unemployment insurance in Tables 6, 7 and 8.

Table 2 suggests the following insights about the spreading of social security systems with employer- and/or employee-borne contributions. First, the regression parameters in columns (1)–(3), which are based on 144 countries and 4259 observations, suggest that there is a relatively stronger and clearer pattern of cross-country adoption for employer-type than for employee-type contributions. An earlier adoption abroad of employer-type contributions tends to spread particularly likely to countries which are linked by economic policy, geography or culture.

However, the contagion variables are highly collinear and when including them together the effects offset each other; compare column (7) with columns (1)–(3). However, if proximate countries adopt employee-borne contributions abroad this appears to reduce the propensity at home to adopt an employer- and even an employee-borne contribution. An introduction of employer-borne contributions abroad not only makes an adoption of such a contribution at home more likely but also increases the probability of adopting an employee-borne contributions.

The evidence in Tables 3, 4, and 5 is again based on 144 countries and 4259 observations. Columns (1)–(3) in those tables suggest that there are positive spillovers in the setting of effective average contribution rates in almost all dimensions of proximity and at any level of income earned. Only policy-proximate neighbors tend to set lower employer-borne contribution rates if their peers set higher ones (which may point to some element of strategic substitution in that domain). Geographically and culturally proximate countries tend to raise employer-borne contribution rates if their peers raised them. While higher employer-borne rates abroad tend to lead to higher employee-borne ones at home, if anything, countries tend to reduce their employer-borne rates at home if employee-borne rates increased abroad. Again, if some of the incidence of higher employee-borne rates was falling on employers abroad, this could be interpreted as implicit evidence of some element of strategic substitution in the domain of average contribution rates.

Table 6 Fixed effects regressions: specific contribution rate—pension provisions

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: $PENSION - ER_{it}$								
$\overline{PENSION - ER}^{p}_{it-1}$	0.060			−0.107			0.028	−0.139
	(0.072)			(0.089)			(0.074)	(0.092)
$\overline{PENSION - ER}^{g}_{it-1}$		0.000			−0.029		−0.080	−0.078
		(0.052)			(0.053)		(0.057)	(0.058)
$\overline{PENSION - ER}^{c}_{it-1}$			0.218***			0.283***	0.253***	0.345***
			(0.068)			(0.076)	(0.074)	(0.082)
$\overline{HEALTH - ER}^{p}_{it-1}$				0.545***				0.792***
				(0.186)				(0.195)
$\overline{HEALTH - ER}^{g}_{it-1}$					−0.153			−0.256**
					(0.112)			(0.124)
$\overline{HEALTH - ER}^{c}_{it-1}$						−0.450***		−0.394**
						(0.144)		(0.153)
$\overline{UNEMP - ER}^{p}_{it-1}$				0.462				−0.160
				(0.415)				(0.440)
$\overline{UNEMP - ER}^{g}_{it-1}$					1.734***			1.765***
					(0.400)			(0.438)
$\overline{UNEMP - ER}^{c}_{it-1}$						1.094**		0.324
						(0.495)		(0.519)
R^2	0.088	0.088	0.091	0.091	0.093	0.094	0.091	0.103
Observations	3382	3382	3382	3382	3382	3382	3382	3382
Countries	127	127	127	127	127	127	127	127
Dependent variable: $PENSION - EE_{it}$								
$\overline{PENSION - EE}^{p}_{it-1}$	−0.707***			−0.668***			−0.646***	−0.519**
	(0.248)			(0.249)			(0.248)	(0.247)
$\overline{PENSION - EE}^{g}_{it-1}$		−0.061			−0.088		0.061	−0.006
		(0.065)			(0.065)		(0.069)	(0.069)
$\overline{PENSION - EE}^{c}_{it-1}$			−1.123***			−1.132***	−1.161***	−1.224***
			(0.219)			(0.219)	(0.232)	(0.232)
$\overline{HEALTH - EE}^{p}_{it-1}$				−0.603				2.056
				(2.076)				(2.175)
$\overline{HEALTH - EE}^{g}_{it-1}$					−10.830***			−13.511***
					(1.396)			(1.586)
$\overline{HEALTH - EE}^{c}_{it-1}$						−0.931		5.940***
						(1.863)		(2.128)
$\overline{UNEMP - EE}^{p}_{it-1}$				8.767**				6.403
				(4.347)				(4.619)

Table 6 continued

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\overline{UNEMP - EE}^{g}_{it-1}$					5.116**			4.403
					(2.390)			(2.678)
$\overline{UNEMP - EE}^{c}_{it-1}$						2.218		−3.418
						(3.034)		(3.293)
R^2	0.088	0.086	0.093	0.089	0.103	0.093	0.095	0.117
Observations	3496	3496	3496	3496	3496	3496	3496	3496
Countries	127	127	127	127	127	127	127	127

All regressions include country- and year-fixed effects along with the control variables listed in Sect. 4.3. Standard errors in parentheses are robust to an unknown form of heteroscedasticity and autocorrelation
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Table 7 Fixed effects regressions: maximum specific marginal contribution rate—health insurance

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: $HEALTH - ER_{it}$								
$\overline{PENSION - ER}^{p}_{it-1}$				−0.248***				−0.197**
				(0.076)				(0.077)
$\overline{PENSION - ER}^{g}_{it-1}$					0.037			0.104*
					(0.055)			(0.062)
$\overline{PENSION - ER}^{c}_{it-1}$						0.018		−0.036
						(0.070)		(0.078)
$\overline{HEALTH - ER}^{p}_{it-1}$	0.010			0.066			−0.287*	−0.310*
	(0.158)			(0.167)			(0.161)	(0.171)
$\overline{HEALTH - ER}^{g}_{it-1}$		0.591***			0.586***		0.586***	0.551***
		(0.094)			(0.094)		(0.104)	(0.103)
$\overline{HEALTH - ER}^{c}_{it-1}$			0.315***			0.149	0.136	−0.013
			(0.091)			(0.100)	(0.096)	(0.106)
$\overline{UNEMP - ER}^{p}_{it-1}$				0.916***				0.483
				(0.333)				(0.363)
$\overline{UNEMP - ER}^{g}_{it-1}$					−0.002			−0.916***
					(0.300)			(0.338)
$\overline{UNEMP - ER}^{c}_{it-1}$						2.550***		2.911***
						(0.439)		(0.476)
R^2	0.046	0.076	0.055	0.057	0.076	0.081	0.079	0.114
Observations	1349	1349	1349	1349	1349	1349	1349	1349
Countries	59	59	59	59	59	59	59	59
Dependent variable: $HEALTH - EE_{it}$								
$\overline{PENSION - EE}^{p}_{it-1}$				−0.032				−0.032
				(0.026)				(0.025)

Table 7 continued

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\overline{PENSION - EE}^{g}_{it-1}$					-0.021^{***}			-0.023^{***}
					(0.003)			(0.003)
$\overline{PENSION - EE}^{c}_{it-1}$						-0.048^{***}		0.002
						(0.012)		(0.013)
$\overline{HEALTH - EE}^{p}_{it-1}$	0.506^{***}			0.510^{***}			0.514^{***}	0.637^{***}
	(0.110)			(0.121)			(0.115)	(0.125)
$\overline{HEALTH - EE}^{g}_{it-1}$		0.278^{***}			0.148^{**}		0.319^{***}	0.118
		(0.069)			(0.069)		(0.078)	(0.081)
$\overline{HEALTH - EE}^{c}_{it-1}$			0.048			0.005	-0.262^{***}	-0.147
			(0.082)			(0.085)	(0.096)	(0.098)
$\overline{UNEMP - EE}^{p}_{it-1}$				-0.021				-0.044
				(0.240)				(0.244)
$\overline{UNEMP - EE}^{g}_{it-1}$					0.470^{***}			0.414^{***}
					(0.128)			(0.147)
$\overline{UNEMP - EE}^{c}_{it-1}$						0.573^{**}		0.173
						(0.222)		(0.251)
R^2	0.047	0.044	0.033	0.048	0.095	0.046	0.058	0.114
Observations	1612	1612	1612	1612	1612	1612	1612	1612
Countries	69	69	69	69	69	69	69	69

All regressions include country- and year-fixed effects along with the control variables listed in Sect. 4.3. Standard errors in parentheses are robust to an unknown form of heteroscedasticity and autocorrelation
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

The results in Tables 6, 7, and 8 are obtained from substantially fewer observations than the ones in Tables 2, 3, 4, and 5, since specific contributions exist in far fewer economies. Columns (1)–(3) in those tables indicate that higher employer-borne contribution rates elsewhere tend to lead to higher ones at home within pension, health, and unemployment. This is similar for employee-borne health insurance contributions but different for employee-borne pension and unemployment insurance contributions. There is evidence of some cross-issue effects: in particular higher employer- and employee-borne unemployment insurance contributions abroad tend to lead to higher pension and health insurance contributions of employers and employees, respectively. Higher pension contributions abroad tend to reduce health insurance contribution rates at home.

Altogether the findings in this paper suggest that there are significant effects of positive and negative contagion in different aspects of social security systems. Such effects materialize for proximate countries with a similar economic policy setting, in a geographical neighborhood, and with a similar cultural heritage. There tends to be positive contagion of employer-type contribution aspects abroad on the same employer-type aspects at home. Such contagion exists also for employee-type aspects abroad and at home, but it is not always positive. Moreover, results for specific contribution rates suggest that policy setting happens in a complex connected system, where

Table 8 Fixed effects regressions: maximum specific marginal contribution rate—unemployment insurance

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable: $UNEMP - ER_{it}$								
$\overline{PENSION - ER}^{p}_{it-1}$				0.142***				0.140***
				(0.043)				(0.044)
$\overline{PENSION - ER}^{g}_{it-1}$					0.094***			0.018
					(0.036)			(0.040)
$\overline{PENSION - ER}^{c}_{it-1}$						0.143***		0.117**
						(0.043)		(0.049)
$\overline{HEALTH - ER}^{p}_{it-1}$				−0.138				−0.153
				(0.098)				(0.101)
$\overline{HEALTH - ER}^{g}_{it-1}$					−0.074			−0.118*
					(0.059)			(0.065)
$\overline{HEALTH - ER}^{c}_{it-1}$						0.043		0.037
						(0.063)		(0.065)
$\overline{UNEMP - ER}^{p}_{it-1}$	0.327**			0.093			0.522***	0.183
	(0.164)			(0.183)			(0.176)	(0.195)
$\overline{UNEMP - ER}^{g}_{it-1}$		−0.488***			−0.586***		−0.961***	−1.082***
		(0.185)			(0.193)		(0.217)	(0.222)
$\overline{UNEMP - ER}^{c}_{it-1}$			0.277			0.107	0.640**	0.820***
			(0.224)			(0.242)	(0.252)	(0.274)
R^2	0.075	0.079	0.071	0.092	0.090	0.091	0.104	0.145
Observations	707	707	707	707	707	707	707	707
Countries	41	41	41	41	41	41	41	41
Dependent variable: $UNEMP - EE_{it}$								
$\overline{PENSION - EE}^{p}_{it-1}$				0.002				0.001
				(0.011)				(0.011)
$\overline{PENSION - EE}^{g}_{it-1}$					−0.005			−0.019
					(0.019)			(0.023)
$\overline{PENSION - EE}^{c}_{it-1}$						0.017		0.023
						(0.013)		(0.015)
$\overline{HEALTH - EE}^{p}_{it-1}$				0.144				0.093
				(0.123)				(0.130)
$\overline{HEALTH - EE}^{g}_{it-1}$					−0.036			0.092
					(0.076)			(0.091)
$\overline{HEALTH - EE}^{c}_{it-1}$						−0.173**		−0.232**
						(0.080)		(0.096)
$\overline{UNEMP - EE}^{p}_{it-1}$	−0.865***			−1.039***			−0.515**	−0.599**
	(0.222)			(0.272)			(0.231)	(0.294)

Table 8 continued

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\overline{UNEMP - EE}^{g}_{it-1}$		−0.669***			−0.659***		−0.486***	−0.488***
		(0.120)			(0.122)		(0.136)	(0.140)
$\overline{UNEMP - EE}^{c}_{it-1}$			−0.941***			−0.851***	−0.466*	−0.356
			(0.232)			(0.238)	(0.252)	(0.262)
R^2	0.099	0.111	0.100	0.100	0.111	0.105	0.118	0.125
Observations	1233	1233	1233	1233	1233	1233	1233	1233
Countries	58	58	58	58	58	58	58	58

All regressions include country- and year-fixed effects along with the control variables listed in Sect. 4.3. Standard errors in parentheses are robust to an unknown form of heteroscedasticity and autocorrelation
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

specific contributions across domains (e.g., for pension, health, and unemployment) affect each other at home and abroad in a complex way.

6 Conclusions

Social security promotes economic and social development by ensuring income security, access to health care, and the provision of additional services which safeguard the population against life risks. Even if most countries by now operate a social security system of some kind, the effective coverage still varies to a large degree. Given the relevance of social security for poverty alleviation and a guarantee of minimum living standards, a systematic analysis of the fundamentals determining the adoption of various aspects of such social security systems appears important.

This paper has attempted to contribute to this line of interest by focussing on the forces of cross-country contagion—in terms of policy, geographical, and cultural proximity—on the legal adoption of aspects of social security systems worldwide. The findings suggest that especially employer-borne aspects of social security systems change in a way that is consistent with a notion of strategic complementarity—an increase in the adoption of a system and the setting of respective contribution rates abroad tends to lead to subsequently higher rates in a country. To some—though weaker—extent, we also find such evidence for employee-borne aspects of contributions. The analysis of special contribution rates for pensions, as well as health and unemployment insurance contributions suggests that there is complex pattern of cross-country and cross-issue interrelation.

The results suggest that cross-country spillovers in aspects of social security systems are important. For instance, the findings suggest that if the maximum specific marginal employer-borne contribution rate on health insurance would be increased by one percentage point everywhere abroad, the average country would subsequently raise its own rate by almost 0.6% point due to its geographical proximity and by about 0.3% points due to its cultural connectedness. Other spillover effects are of a similar economic importance.

Let us conclude with a message to policy makers. The results in the present paper suggest that policy appears to react to foreign countries for the reasons of learning, competition, and emulation across economies. Apparently, these channels of cross-country interdependence limit the scope of what policy makers could do with regard to the structure of social security systems independently. However, there is one aspect of interdependence which is itself policy-induced, namely policy diffusion within the context of social security contribution systems, types, and rates among countries that are more interconnected geographically, culturally, or economically. This suggests that since integration policies for trade and investment induce feedback effects across other policy domains and toward the design of optimal country-specific policies, we should pay attention to the interdependence of different policy domains, which had not been done in the past.

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Appendix: Additional control variables

See Table 9.

Table 9 Summary statistics: additional control variables

Variable	Mean	SD	Median	Min.	Max.	Obs.
ln(GDPc)	7.821	1.606	7.719	4.171	11.637	4259
ln(Pop)	15.956	1.705	15.962	11.433	21.019	4259
Dependency	0.683	0.199	0.649	0.163	1.188	4259
PrimEd	0.278	0.161	0.260	0.000	0.822	4259
SecEd	0.314	0.211	0.284	0.000	0.920	4259
TertEd	0.085	0.080	0.062	0.000	0.480	4259
Polity	2.745	7.136	6	−10	10	4259
Federal	0.143	0.350	0	0	1	4259
FiniteTerm	0.833	0.373	1	0	1	4259

References

Attanasio, O. P., & Brugiavini, A. (2003). Social security and households' saving. *The Quarterly Journal of Economics*, *118*, 1075–1119.

Barro, R., & Lee, J. (2010). A new data set of educational attainment in the world, 1950–2010. *Journal of Development Economics*, *104*(C), 184–198.

Becker, G. S., & Mulligan, C. B. (1998). Deadweight costs and the size of government. *NBER Working Paper* 6789.
Beron, K. J., Murdoch, J. C., & Vijverberg, W. P. M. (2003). Why cooperate? Public goods, economic power, and the Montreal protocol. *Review of Economics and Statistics*, *85*(2), 286–297.
Besley, T. J., & Case, A. C. (1995). Incumbent behaviour: Vote seeking, tax setting and yardstick competition. *American Economic Review*, *85*, 25–45.
Collier, D., & Messick, R. E. (1975). Prerequisites versus diffusion: Testing alternative explanations of social security adoption. *The American Political Science Review*, *69*(4), 1299–1315.
Caucutt, E. M., Cooley, T. F., & Guner, N. (2013). The farm, the city, and the emergence of social security. *Journal of Economic Growth*, *18*, 1–32.
Cooper, N. (1968). *The Economics of Interdependence: Economic Policy in the Atlantic Community*. New York, NY: Mc-Graw Hill for the Council on Foreign Relations.
Dahlberg, S., Holmberg, S., Rothstein, B., Hartmann, F., & Svensson, R. (2015). *The quality of government basic dataset, version Jan 15*. The Quality of Government Institute, University of Gothenburg.
Egger, P. H., & Strecker, N. M. (2017). A tour of labor income tax in the world, 1980–2012. *Mimeo*.
Egger, P. H., & Wamser, G. (2013). Multiple faces of preferential market access: Their causes and consequences. *Economic Policy*, *28*(73), 143–187.
Gilardi, F. (2010). Who learns what in policy diffusion processes? *American Journal of Political Science*, *54*(3), 650–666.
Gilardi, F. (2016). Four ways we can improve policy diffusion research. *State Politics and Policy Quarterly*, *16*(1), 8–21.
Head, K., Mayer, T., & Ries, J. (2010). The erosion of colonial trade linkages after independence. *Journal of International Economics*, *81*(1), 1–14.
International Labour Organization (ILO). (1984). *Introduction to social security*. Washington, DC: International Labour Organization.
Kim, K. S. (2001). Determinants of the timing of social insurance legislation among 18 OECD countries. *International Journal of Social Welfare*, *10*, 2–13.
Lovely, M., & Popp, D. (2011). Trade, technology, and the environment: Does access to technology promote environmental regulation? *Journal of Environmental Economics and Management*, *61*, 16–35.
Mulligan, C. B., Gil, R., & Sala-i-Martin, X. (2002). Social security and democracy. *NBER working paper* 8958.
Mulligan, C. B., & Sala-i-Martin, X. (1999). Gerontocracy, retirement and social security. *NBER working paper* 7117.
OECD. (2016). *Taxing wages*. Paris: OECD.
Perkins, R., & Neumeyer, E. (2012). Does the "California effect" operate across borders? Trading- and investing-up in automobile emission standards. *Journal of European Public Policy*, *19*(2), 217–237.
Perotti, E., & Schwienbacher, A. (2009). The political origin of pension funding. *Journal of Financial Intermediation*, *18*, 384–404.
Schmitt, C. (2015). Social security development and the colonial legacy. *World Development*, *70*, 332–342.
Simmons, B. A., & Elkins, Z. (2004). The globalization of liberalization: Policy diffusion in the international political economy. *American Political Science Review*, *98*(1), 171–189.
Strecker, N. M. (2017). Labor income taxation in a globalizing world: 1980–2012. *KOF dissertation series* 27.
Tang, K. L. (1996). The determinants of social policy in developing countries: A comparative analysis. *International Social Work*, *39*, 377–393.
United States Department of Health and Human Services, Social Security Administration. (1981). Social security programs around the world. *US-SSA research report* 58.
United States Department of Health and Human Services, Social Security Administration. (2016). *Social security programs around the world*. Washington, DC: US-SSA.
Wilson, J. (1999). Theories of tax competition. *National Tax Journal*, *52*, 269–304.
World Bank. (2014). *World development indicators*. Washington, DC: World Bank Group.