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RESEARCH ARTICLE

Onward and upward? Occupational upgrading, social inclusion and collective skill formation in the transition to the knowledge economy

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Abstract
Collective skill formation systems were central to sustaining a high-road to economic development while upholding social inclusion in industrial societies. But can they still deliver on both economic and social grounds in knowledge-based societies? The article argues that the transition to the knowledge economy may in fact strengthen the 'traditional' advantage of collective skill formation systems over other skill formation systems on both economic and social grounds while simultaneously, however, exerting pressure on them to recalibrate some of their underlying policy arrangements. It is argued that this dual relationship has to do with the institutional architecture of collective skill formation systems, in particular, their 'shared governance' between employers, unions and governments, and with the nature of technological change in the transition to the knowledge economy, in particular the bias toward complex cognitive skills that it produces. Quantitative and qualitative evidence lends overall support for the argument. Regression analysis shows that collective skill formation systems are still positively associated with a range of socio-economic outcomes also in the new knowledge economy, although conditional analyses suggest that they may be subject to 'diminishing returns' on social inclusion grounds, i.e., their ability to effectively perform a social policy function is confronted with greater challenges at high levels of technological intensity. Case studies of Austria, Germany, and Switzerland show how collective skill formation systems have adapted to the knowledge economy following country-specific patterns.

Keywords: Knowledge economy; skill formation; varieties of capitalism; comparative political economy

Introduction

Many countries in North-Western Europe – often referred to as coordinated market economies in the comparative political economy (CPE) literature – historically combined a high road to economic development with high levels of equality (Hall and Gingerich, 2009; Hall and Soskice, 2001; Soskice, 1994). Skill formation has often been singled out as playing a particularly prominent role in this respect. In several countries, skill formation systems have been historically organized around tight relationships between and strong commitment by employers, unions and governments, leading to the establishment of *collective* skill formation systems (Busemeyer and Trampusch, 2012; Culpepper, 2003; Estevez-Abe, Iversen, and Soskice, 2001; Thelen, 2004). These systems were simultaneously performing an *economic* and *social* policy function: they provided high-quality skills that helped firms move 'up-market' and engage in product market strategies premised on quality over cost (Streeck, 1997), while also catering for pupils in the bottom half of the academic ability distribution and offering them smooth school-to-work transitions

(Busemeyer, 2015; Iversen, 2005; Soskice, 1994). Yet, these systems thrived in industrial societies and were particularly well-suited to create 'intermediate' skills with a strong practical inclination (Durazzi and Geyer, 2020, 2021). In today's knowledge economies, these are precisely the skills that are more likely to be automatized (Anderson and Hassel, 2013; Baethge and Wolter, 2015; Müller and Jacob, 2008).

Against this backdrop, we ask the following question: can collective skill formation systems still be an effective vehicle of economic *and* social policy in today's knowledge economies? Building on recent literature on the topic (see e.g., contributions in Bonoli and Emmenegger, 2022), we hypothesize that the transition to the knowledge economy may strengthen the 'traditional' advantage of collective skill formation systems over other skill formation systems on both economic and social grounds while simultaneously exerting pressure on them to recalibrate some of their underlying policy arrangements. We contend that this dual relationship has to do with the institutional architecture of collective skill formation systems, in particular, their 'shared governance' between employers, unions and governments, and with the nature of technological change in the transition to the knowledge economy, in particular the bias toward complex cognitive skills that it produces. Quantitative and qualitative evidence lends overall support for the argument. Regression analysis shows that collective skill formation systems are still positively associated with a range of socio-economic outcomes also in the new knowledge economy, although conditional analyses suggest that they may be subject to 'diminishing returns' on social inclusion grounds, i.e., their ability to effectively perform a social policy function is confronted with greater challenges at high levels of technological intensity. Case studies of Austria, Germany, and Switzerland show how collective skill formation systems have adapted to the knowledge economy following country-specific patterns. The rest of the paper proceeds as follows: Section 2 reviews the literature; Section 3 outlines the theoretical argument; Sections 4 and 5 presents, respectively, the findings from the quantitative and qualitative analyses; Finally, Section 6 discusses the results of our study in light of the broader CPE literature and offers some concluding thoughts.

Collective skill formation systems and the transition to the knowledge economy

A breakthrough in contemporary CPE research has been the identification of a 'coordinated' model of capitalism combining economic success with social inclusion. Such a combination rested on several mutually reinforcing institutions found in (primarily) Continental and Nordic European countries (Hall and Soskice, 2001; Iversen, 2005; Martin and Thelen, 2007). Within them, a crucial role has been traditionally assigned to the 'collective' skill formation system – the 'crown jewel' of coordinated capitalism (Thelen, 2007). Collective skill formation systems are a product of (pre-) industrial societies (Martin, 2012; Thelen, 2004) and are characterized by a strong element of work-based learning alongside a school-based component, famously captured through the notion of *dual* apprenticeships. In post-World War II, these were organized around tight relationships between unions and business in the definition of training profiles, skill content and curricula, with governments playing a facilitating role (Busemeyer and Trampusch, 2012; Culpepper, 2003). Contributions on both economic and social grounds were essentially built into the system. From an economic standpoint, high-quality training formed 'polyvalent' workers (Streeck, 2012), which were consequential to target high-quality market segments (Streeck, 1997). In parallel, the system produced socially inclusive outcomes by providing high-quality training to pupils who were not academically gifted (Soskice, 1994, 55).

Yet, the ability to perform an economic and social policy function was contingent on the configuration of labour markets in industrial societies, which were characterized by large industrial sectors fuelling demand for intermediate skills (Durazzi and Geyer, 2020, 2021). Over the last 30 years, that world morphed into something very different as advanced capitalist

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countries entered the knowledge economy (Diessner, Durazzi, and Hope, 2022; Hall, 2021; Thelen, 2019). The extent and pace of technological change underpinned much of this transformation in that it is precisely those industrial jobs in the middle of the skill distribution that were traditionally linked with collective skill formation systems that have been more subject to the risk of automation (Acemoglu, 2002; Goos, Manning, and Salomons, 2009). As technology replaced workers in the middle of the skill distribution, scholars have painted a rather bleak picture for collective skill formation systems (Anderson and Hassel, 2013; Baethge and Wolter, 2015). In short, this view holds that collective skill formation systems would be under pressure from both the supply and demand sides: young people and their families would be increasingly attracted toward general-academic paths, while firms would increasingly look for high-cognitive skills typically found in higher education graduates.

Yet, more recent contributions have challenged the earlier assessments on the unviability of collective skill formation systems in the knowledge economy (Emmenegger and Haslberger, 2023). The changing socio-economic context undoubtedly poses a challenge for collective skill formation systems. However, standing still in the face of such challenges and letting them 'drift' (Streeck and Thelen, 2005) is not the only option. Actors might instead seek to adjust skill formation systems to the new knowledge economy. Scholars have documented the pursuit of this route, pointing at active political-coalitional work (Emmenegger, 2021) carried out by social partners and governments to adapt collective skill formation systems to the knowledge economy on both economic (Busemeyer and Thelen, 2022; Carstensen and Lyhne Ibsen, 2021; Durazzi and Benassi, 2020; Emmenegger, Bajka, and Ivardi, 2023) and social grounds (Bonoli and Emmenegger, 2020; Carstensen, Emmenegger, and Unterweger, 2022; Carstensen and Lyhne Ibsen, 2021; Durazzi and Geyer, 2020). Why and how is it plausible to assume that collective skill formation systems are still able to deliver economically efficient and socially inclusive outcomes in today's knowledge economies? We now turn to this question.

Theorizing continuity in socio-economic outcomes and change of policy arrangements

Our core argument is that the transition to the knowledge economy contains seeds of both continuity and change for collective skill formation systems: it strengthens their 'traditional' advantage on both economic and social grounds while simultaneously exerting pressure on them to adjust some of their underlying policy arrangements. We contend that this dual relationship has to do with the institutional architecture of collective skill formation systems, in particular, their 'shared governance' between employers, unions and governments, and with the nature of technological change in the transition to the knowledge economy, in particular the bias toward complex cognitive skills that it produces. In the remainder of this section, we unpack this argument and outline a set of five stylized theoretical propositions that stem from it.

Firstly, the transition to the knowledge economy, particularly the technological change that underpins it, biases skill needs in important ways: it triggers demand for more complex skill sets while making cognitive skills more important vis-à-vis manual ones (Acemoglu, 2002; Goos, Manning, and Salomons, 2009). While these two trends have been traditionally seen as militating against collective skill formation systems because of their historical affinity with intermediate and practice-oriented training, we suggest that collective skill formation systems should not be expected to be intrinsically in an inferior position compared to other types of education and training systems. In fact, they may be even better placed to meet the skill demands of fast-changing labour markets as they are re-shaped by technological change: a traditional strength of collective skill formation systems was their responsiveness to skills needs, given the proximity of social partners to the labour market and their institutionalized ability to shape training systems accordingly (Thelen and Culpepper, 2007). In the context of the knowledge economy, this feature may, in fact, turn to the advantage of collective skill formation systems. As skill requirements change more often and more quickly than ever before, it is plausible to expect that the ability of

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employers and/or unions to directly 'translate' such requirements into training programmes is greater compared to that of the two other models of skill formation that are predominant in Europe, namely the statist model (which features a strong role of governments but weak involvement of non-state actors) and the liberal model (characterized by a strong role of private training providers but weak state involvement) (Busemeyer and Trampusch, 2012). The former might need – at the very least – to gather adequate information from social partners on how skill requirements are changing, thereby being slower at reacting compared to collective skill formation systems (Busemeyer and Thelen, 2022; Carstensen and Lyhne Ibsen, 2021). The latter are characterized instead by private actors' attempts to maximize their profits from providing training. Therefore, they face a disincentive to update training profiles, especially when designing more complex training – and are therefore more expensive and less lucrative (Benassi, Durazzi, and Fortwengel, 2022). Collective skill formation systems are expected to be not only agile in responding to more complex skill requirements but also to be able to accommodate increasingly theoretically oriented training. Indeed, the strength of the theoretical learning that takes place in dual systems is an often overlooked yet crucial part of the system, as pointed out by Streeck in a seminal contribution: employers and unions have been pursuing 'a strengthening of the 'theoretical' content of training as provided above all by vocational schools [. . .]. While employers were seeking high skills [. . .] unions strived to maximize their members' employment and earning opportunities by enhancing the portability of their personal work skills [. . .]' (Streeck, 2012, 327). If the arguments presented thus far are correct, it follows that collective skill formation systems can provide complex and theoretically oriented skills feeding into occupations crucial in today's knowledge economy. As such, the destiny of collective skill formation systems may not be tied to that of occupations in the middle of the skill distribution that are being progressively wiped out by technological change. The first theoretical proposition is, therefore, as follows: *Collective skill formation systems are better able relative to other skill formation systems to produce high-level cognitive skills*.

Moreover, they are expected still to confer such skills to pupils from relatively disadvantaged backgrounds. It has been amply demonstrated that the expansion of higher education has proceeded with a strong socio-economic gradient (Bonoli, Cantillon, and Lancker, 2017, 72). The logical complement of the socio-economically uneven expansion of higher education is that pupils from disadvantaged backgrounds are still a core constituency of vocational training systems today. Hence, the possibility for pupils from disadvantaged backgrounds to acquire skills valued in the labour market that can act as a vehicle for their inclusion in society depends on the *quality* of the vocational training system. To the extent that collective skill formation systems offer superior training relative to other training systems, we expect that they also retain their social inclusion function, leading us to formulate a second theoretical proposition: *Collective skill formation systems are better able relative to other skill formation systems to produce socially inclusive outcomes for young people*.

We have argued thus far that there are theoretical reasons to expect collective skill formation systems to 'outperform' other skill formation systems on both economic and social grounds because the tight relationships between businesses, unions and governments serve as an in-built system of adjustment to the rapid changes that stem from the knowledge economy. At the same time, we argue that such changes sharpen differences in actors' preferences, leading to country-specific patterns in how collective skill formation systems adjust to the knowledge economy depending on the relative distribution of power within the business camp, between business and unions and on the relationship between the government and social partners. We turn to this part of the argument in the remainder of this section. To begin with, the ability of collective skill formation systems to offer more complex and theoretically oriented training is likely to be affected by political tensions within the employer camp (Busemeyer, 2012; Culpepper, 2007; Trampusch, 2010). At the core of such inter-employer cleavage lie differences in the demand for skills and in the use of apprenticeships made by SMEs and large firms. The former traditionally think of

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apprenticeships not only as skill formation but also as a source of cheap labour. As such, they seek highly standardized apprenticeships and are reluctant to step up the theoretical (school-based) component, which would come to the detriment of the practical (work-based) component. Large firms, on the other hand, are more likely to pursue sophisticated and complex skill profiles, often with a stronger theoretical component, and they will seek to 'de-standardise' training programmes to adapt training more flexibly to their needs, seeking so-called 'segmentalist' solutions (Thelen and Busemeyer, 2012). This leads us to formulate a third theoretical proposition: *Where large employers are politically powerful relative to other actors, collective skill formation systems turn to a greater extent to the provision of complex and theoretical skills while also undergoing a process of de-standardization of training.*

Similarly to small employers, unions are expected to oppose de-standardization, fearing that differentiation in training would reverberate in wage differentials in the labour market (Durazzi and Geyer, 2020). But in line with large businesses, they favour more theoretically oriented training as that would enhance workers' portability of skills (Streeck, 2012). This makes the emergence of a cross-class coalition difficult in that unions' preferences do not overlap either with those of large employers or with those of small employers. Given that the structural weakness of labour vis-à-vis capital in post-Fordist societies (Baccaro and Pontusson, 2022) makes it unlikely for unions to unilaterally impose their preferences, their ability to influence policy rests on the willingness of unions and governments to cooperate to sidestep business opposition, leading to the fourth theoretical proposition: *Where unions and government are aligned and politically powerful relative to other actors, collective skill formation systems turn to a greater extent to the provision of complex and theoretical skills, without undergoing de-standardization.*[1]

The process of adjustment is politically mediated also as far as social inclusion is concerned. Again, the type of skills required in the knowledge economy is central to understanding why political tensions would emerge on this dimension, too. As general cognitive abilities tend to be increasingly important, firms might be more reluctant to offer apprenticeship places to low-achieving pupils – a challenge not overly problematic in the industrial age, as cognitive skills were not central. In this context, a particular conflict might emerge between unions and firms – the former would want to push for employers to take on young people and, where appropriate, offer them the support they need to succeed in apprenticeships for ever more complex occupations (Durazzi and Geyer, 2020, 2021). We expect unions to find an ally in governments who have an obvious interest in keeping social exclusion at bay, and training opportunities are important to that end, in particular, if they are led by centre-left parties (Geyer and Durazzi, 2022). On the other hand, employers might think of this scenario as one where costs outweigh benefits and would not offer an apprenticeship place to academically low achievers, resulting in these pupils being excluded from the training system and, therefore, struggling to acquire relevant skills and transition into good jobs. Our fifth and final theoretical proposition is, therefore, the following: *Where unions and government are aligned and politically powerful relative to other actors, collective skill formation systems more explicitly emphasize social inclusion aims.*

The continued socio-economic viability of collective skill formation systems: Operationalization and empirical evidence

Operationalization

This section operationalizes the first two theoretical propositions as a set of hypotheses to test whether collective skill formation systems deliver economically efficient and socially inclusive outcomes in the context of the knowledge economy. We first outline how we capture these two dimensions. On the economic side, we are interested in discerning whether collective skill

[1]Maintaining standardization might be achieved either via purely collectivist forms as well as via greater state intervention, as exemplified by the case of supra-company apprenticeships in Austria (see e.g., Durazzi and Geyer, 2020).

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formation systems can support a high road to economic development, as they used to do in the industrial era. In the context of the knowledge economy, we posit that such a high road is characterized by occupational upgrading over polarization (Oesch and Rodríguez Menés, 2010). The growing use of information and communication technologies (ICT) in the workplace has replaced many routine tasks previously carried out by middle-skilled workers, reducing the demand for their labour. A shrinking labour market in the middle of the skill distribution may be accompanied by occupational growth at the low and/or high ends (Kurer and Palier, 2019). At the low end, expansion may occur in low-skilled, low-paid, non-routine manual (NRM) occupations that are neither replaced nor complemented by technology because they require agility, communication, and common sense and are, for the time being, impossible to codify. These occupations are typically found in the retail, hospitality and care sectors (Autor, 2022). At the upper end, there is also a growing demand for workers who can carry out tasks that involve complex cognitive abilities and problem-solving skills and do not follow predictable or repetitive patterns. These jobs typically require individuals to adapt to new and unique situations, think critically, and apply creativity and innovation in their approach. Crucially, these jobs are *complementary* to – not replaced by – technology. We call these non-routine cognitive (NRC) workers, who tend to be found in knowledge-intensive sectors (Diessner, Durazzi, and Hope, 2022; Wren, 2013). In the context of the knowledge economy, some countries have seen a polarization of their labour markets (Goos, Manning, and Salomons, 2009), whereby both NRM and NRC jobs have grown. In contrast, other countries have followed an upgrading pattern (Haslberger, 2021; Oesch and Rodríguez Menés, 2010), where the growth of NRC jobs has been predominant over that of NRM ones. However, these studies do not examine the role played by the training system. For our purposes, we consider collective skill formation systems as able to uphold the pursuit of a high road in the transition to the knowledge economy if they support a process of 'upgrading' the labour market. This entails promoting a steady supply of workers equipped with the complex and theoretically oriented skills needed for those NRC jobs that are complementary to technology, favouring, therefore, a shift from routine employment into NRC occupations rather than into NRM employment. We therefore operationalize our first theoretical proposition as follows:

HYPOTHESIS 1: *Collective skill formation systems are associated with a significantly larger share of workers with upper secondary education in NRC occupations and a significantly lower share of workers with upper secondary education in NRM occupations.*

We now turn to the social inclusion dimension. We focus on two particular indicators, the rate of youth unemployment and NEET, both of which disproportionally affect individuals from lower socio-economic backgrounds (Pitkänen *et al.*, 2021; Odoardi, 2020) and further entrench their social exclusion (Bynner and Parsons, 2002; Heglum and Nilsen, 2024). Given the strong socio-economic gradient in access to university, a high-quality training path is crucial to provide students from lower socio-economic backgrounds the skills necessary to compete for non-routine cognitive jobs in the knowledge economy, thereby lowering levels of inactivity and unemployment. We therefore operationalize our second theoretical proposition as follows:

HYPOTHESIS 2: *Collective skill formation systems are associated with lower NEET and youth unemployment rates.*

Furthermore, to examine explicitly how collective skill formation systems perform in the knowledge economy, we develop hypotheses conditional on the extent to which a country has transitioned towards it. We proxy the intensity of a knowledge-based economy using the levels of investments in information and communication technologies (ICT) and examine how the effect of collective skill formation systems varies between high and low ICT intensity contexts. To the extent that collective skill formation systems equip individuals without tertiary education with the complex and theoretically oriented skills needed to access non-routine cognitive jobs, their effect

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on economic outcomes should be larger where the demand for cognitive skills is higher, such as in high-tech contexts, leading to the following hypothesis:

HYPOTHESIS 3: *The association of collective skill formation systems and non-routine cognitive (manual) workers with upper secondary education is significantly higher (lower) in contexts with high ICT investments compared to those with low ICT investments.*

Concerning the conditional effect on social outcomes, instead, we expect to find no differences between low and high-tech contexts. The reason is that collective skill formation systems have developed *before* the knowledge economy era and have been highly successful in that context. We hypothesized that they have successfully adapted to the technologically advanced context of the knowledge economy, but that should not prevent them from being still effective in less technologically advanced contexts, leading us to the following hypothesis:

HYPOTHESIS 4: *The association between collective skill formation systems and youth unemployment and between collective skill formation systems and NEET rates is not significantly different in contexts with high ICT investments compared to those with low ICT investments.*

To test these hypotheses, we pool a time-series cross-section dataset of 24 OECD countries[2] between 2000 and 2020, i.e., the period that the CPE literature identifies as the era of knowledge-based growth (Hall, 2021) and descriptively explore the associations between our main independent variable and outcomes of interest. Our main independent variable is the 'collective' nature of skill formation systems, which we proxy following Emmenegger and Haslberger (2023) as the share of pupils enrolled in dual VET as a share of total pupils in upper secondary education (from now on, dual VET share). We motivate in detail why we deem this approach suitable in Online Appendix 1. We conduct multiple linear regression analyses to assess the association between dual VET share and four socioeconomic outcomes related to the status of young workers with upper-secondary education: the share of those employed as non-routine cognitive (NRC) workers between 18 and 24 years old; the share of those employed as non-routine manual (NRM) workers between 18 and 24 years old; the share of unemployed between 15 and 24 years; and the share of those neither in employment, education or training (NEET) between 15 and 24 years old. We discuss the operationalisation of these indicators in Online Appendix 2. We model these outcomes as a function of dual VET share using an ordinary least square regression with panel-corrected standard errors (Beck and Katz, 1995). We do not include country-fixed effects because we are interested in comparing variations between countries rather than within a country over time. We provide a series of robustness checks in Online Appendix 3 that includes alternative specifications. We discuss the motivation behind the choice of the modelling strategy in detail in Online Appendix 2. We control for several factors expected to impact our outcomes, including the intensity of ICT investments (OECD, 2023f), higher education attainment (EULFS, 2024; CPS, 2024), public expenditure in active labour market policies focused on training (OECD, 2023a) and total public expenditure in active labour market policies (OECD, 2023b), the share of employment in the service sector (EULFS, 2024; CPS, 2024), and the adult share of unemployment and inactivity between 25 and 64 years old (EULFS, 2024). In all specifications, we add macroeconomic controls for GDP growth (OECD, 2023c), labour market productivity growth (OECD, 2023d), and inflation rate (OECD, 2023e). We motivate extensively the choice and operationalisation of all the control variables in Online Appendix 2, where we also provide a summary of the variables included in the model.

[2]Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United States.

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Empirical evidence

Table 1 contains the estimated coefficients of the multiple regression analysis. The coefficient of the share of dual VET is significant across all model specifications, and the directions of the relationships are as expected. In model 1, all other things being equal, a unit increase in dual VET share is associated with an increase of 0.156 percentage points in NRC workers with upper secondary education. This is quite a large effect considering countries' dual VET share span between 0 and 60 per cent. Put in other terms, high-dual VET countries have, on average, 9.5 percentage points more workers with upper secondary education employed in NRC jobs compared to zero-dual VET countries. Similarly, model 2 indicates that a unit increase in dual VET share is associated with a 0.195 percentage point reduction in workers with upper secondary education employed in non-routine manual jobs. Again, quite a large effect translating in high dual VET countries having on average about 12 percentage points fewer NRM workers with upper secondary education than countries with zero dual VET. The effects are significant but smaller for what it concerns the social inclusion outcomes. In model 3, a unit increase in dual VET is associated with a 0.079 percentage point reduction in the youth unemployment rate, indicating that high dual VET countries have about 4.8 percentage points less in youth unemployment that can be attributed to the skill formation system. The association between dual VET and NEET rate is weaker. A unit increase in dual VET share in model 4 is associated with a significant decline of 0.022 percentage points in NEET rate, which translates into a difference between high dual VET and zero dual VET countries of about 1.3 percentage points that can be attributed to dual VET share.

The effects presented in Table 1 are in line with our expectations, providing empirical support for Hs 1 and 2. We now move on to assessing Hs 3 and 4. Figure 1 displays the marginal effects of dual VET for different levels of ICT capital stock to examine whether our conditional expectations also hold. Panel a) shows that the effect of dual VET on the number of NRC workers with upper secondary education significantly depends on the level of ICT investments. The effect of dual VET is not significantly different from zero in contexts where the ICT stock is below 1% of the GDP, while a unit increase of dual VET is associated with an increase of NRC workers with upper secondary education of almost 0.3 percentage points where the ICT stock is higher than 5% of GDP. The effect of dual VET is mirrored in panel b), where the association with the share of NRM workers with upper secondary education is indistinguishable from zero in low ICT contexts, while the association is negative and significant for higher levels of ICT. A unit increase in dual VET is associated with about a 0.3 percentage point decline in NRM workers in contexts where the ICT stock is higher than 5% of GDP. Panel c) shows that the association between dual VET and the youth unemployment rate is negative regardless of the level of a country's ICT stock. The effect of dual VET on youth unemployment for low levels of ICT is substantially smaller, not statistically significantly different, than that for higher levels of ICT. Even though confidence intervals overlap, arguably, this is an indication that the ability of dual VET to tackle youth unemployment may be reduced in high-ICT contexts. Indeed, panel d) shows that the association between dual VET and NEET rates is negative and significant only for low levels of ICT stocks. A unit increase in dual VET is associated with a NEET rate reduction between 0.05 and 0.1 in contexts where the capital stock is below 1% of GDP. The effect is diminished and becomes indistinguishable from zero in contexts where the ICT stock is higher than 3% of the GDP. Thus, we find support for Hypothesis 3 but not for Hypothesis 4.

Overall, the multiple regression analysis confirms most of our hypotheses but not all of them. We find that countries with high dual VET share are associated with more young NRC workers and fewer young NRM workers with upper secondary education, fewer unemployed between 20 and 24 years old and fewer NEETs, suggesting that collective skill formation systems have retained an edge on other skill formation systems on both economic and social grounds. The conditional analysis, however, invites nuancing this claim. Dual VET share is associated even more strongly

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Table 1. Multiple regression estimates

VARIABLES	(1) Share of NRC workers with upper secondary education (20–24 years old)	(2) Share of NRM workers with upper secondary education (20–24 years old)	(3) Unemployment rate (20–24 years old)	(4) NEET rate (15–24 years old)
Share of dual VET	0.156***	−0.195***	−0.079***	−0.022**
	(0.027)	(0.027)	(0.011)	(0.010)
Tertiary education attainment	−0.089	0.176	−0.006	−0.027
	(0.103)	(0.118)	(0.029)	(0.021)
ALMP expenditure (Training)	−7.087**	5.524		
	(2.962)	(3.457)		
ALMP expenditure (Total)			−0.169	−0.021
			(0.226)	(0.181)
ICT capital stock	1.781***	−1.372***	−0.272*	0.338**
	(0.433)	(0.516)	(0.162)	(0.148)
Share of service employment	0.070	0.715***		
	(0.119)	(0.137)		
GDP growth	−0.156**	0.108	−0.059*	−0.093***
	(0.061)	(0.085)	(0.035)	(0.031)
Labour productivity growth	0.081	−0.030	−0.011	0.069*
	(0.067)	(0.090)	(0.042)	(0.038)
Inflation rate	0.003	−0.101	−0.101**	−0.045
	(0.088)	(0.124)	(0.048)	(0.057)
Unemployment rate (25–64)			1.912***	0.587***
			(0.043)	(0.057)
Inactivity rate (25–64)				0.238***
				(0.037)
Constant	11.970**	−9.445	4.268***	1.704
	(6.064)	(7.061)	(1.096)	(1.293)
Observations	443	443	443	389
R-squared	0.352	0.472	0.868	0.660
Number of countries	24	24	24	24

Panel corrected standard errors in parentheses.
*** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

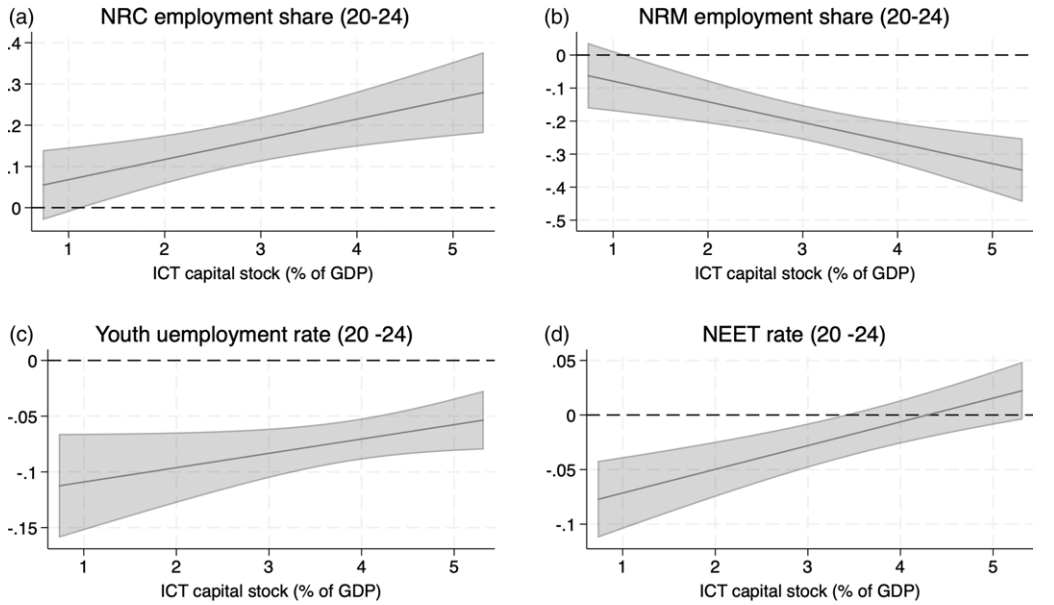

Figure 1. Marginal effects of dual VET conditional on ICT stocks.

with more NRC and fewer NRM workers in contexts of high investments in ICT, but its relationship with youth unemployment and NEET rates becomes weaker in high-tech contexts. This suggests that as the adoption of technology increases, collective skill formation systems will keep performing strongly on economic grounds but might struggle to keep up its socially inclusion function equally effectively.

Changing policy arrangements in collective skill formation systems: operationalization and empirical evidence

Operationalization

Section 4 tested the first part of our argument, which focussed on differences *between* collective skill formation systems and other types of skill formation systems. We now turn to the second part of our argument, which focusses on differences *within* collective skill formation, and in particular on the different patterns of policy change that unfold across countries depending on the varying distribution of power among key actors – business, unions and the government. We opt for a three-country cases set-up, focussing on Austria, Germany and Switzerland. These three countries belong to the universe of collective skill formation systems and together with the Netherlands and Denmark, i.e., the other two countries unequivocally classified by the literature in this universe of cases (Busemeyer and Trampusch, 2012), are top performers across the four socio-economic indicators that we have systematically analysed in the previous section.

However, each of the three countries that we select as a case study has a unique configuration in terms of the distribution of power between the key actors that have been hypothesized to matter in Section 3, allowing us to leverage a 'diverse cases' design (Seawright and Gerring, 2008). In Austria, trade unions have significant (institutional) power over training (Durazzi and Geyer, 2020) and the state has a long tradition of public provision of training (Graf, Lassnigg, and Powell, 2012). The employers' camp is characterized by the pre-eminence of SMEs over large firms (Trampusch, 2010). In Germany, the constellation of actors is rather different. Unions and large firms both enjoy a position of power in the training system (Busemeyer, 2012; Culpepper, 2007; Durazzi and Geyer, 2020; Emmenegger, Bajka, and Ivardi, 2023; Trampusch, 2010), while SMEs and the state are

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Table 2. Distribution of power between unions, firms and the government in the field of training policy

	Unions	Large firms	Small firms	Government
Austria	Strong	Weak	Strong	Strong
Germany	Strong	Strong	Weak	Weak
Switzerland	Weak	Strong	Strong	Weak

relatively weak (Durazzi and Geyer, 2020; Trampusch, 2010). The Swiss case offers yet another configuration with a strong presence of large firms (Culpepper, 2007), coupled with a significant organizational capacity of SMEs, too (Emmenegger and Seitzl, 2019; Trampusch, 2010). Unions and the state actors are instead relatively weak vis-à-vis capital (Di Maio, Graf, and Wilson, 2020; Emmenegger, Bajka, and Ivardi, 2023; Emmenegger, Graf, and Strebel, 2020). Table 2 summarizes how each country provides a unique configuration in the distribution of power between capital, labour and the state.

Reading Table 2 in light of theoretical propositions 3, 4, and 5 developed in Section 3, we advance the following hypotheses:

HYPOTHESIS 5: *The German system, where large employers have the upper hand over small employers, steps up the provision of complex and theoretical skills while also undergoing a process of de-standardization of training to respond more flexibly to the needs of large employers.*

HYPOTHESIS 6: *The Austrian and Swiss systems, where large employers are comparatively weak (Austria) or co-exist with equally strong small employers (Switzerland), step up the provision of complex and theoretical skills without undergoing de-standardization.*

HYPOTHESIS 7: *The Austrian system, where unions and government are more powerful relative to Germany and Switzerland, more explicitly emphasizes social inclusion aims.*

We focus on the introduction of ICT training to proxy the ability of collective skill formation systems to provide a skill set that is quintessentially related to the knowledge economy (the economic dimension) and on the introduction of measures to support the inclusion of unsuccessful apprenticeship seekers in the training system (the social dimension). The case studies are based on secondary sources and cover major policy initiatives that took place since the second half of the 1990s, i.e., when pressures started mounting on collective skill formation systems to adapt to the knowledge economy.

Empirical evidence

Austria

The Austrian constellation of actors proved conducive to the emergence of an alliance between trade unions and the government in reforming the system on both economic and social grounds, while the employer camp, dominated by small firms, played a relatively marginal role. The relationship between unions and the government varied depending on partisanship, ranging from a tight alliance during centre-left cabinets to a rather reluctant cooperation with the centre-right in office (Geyer and Durazzi, 2022). Despite such a wavering relationship, these two actors have driven major changes in the Austrian collective skill formation system since the late 1990s. On social inclusion grounds, the inability of the apprenticeship system to offer a training place to all applicants became a salient issue at the end of the 1990s. Trade unions and employers offered widely different solutions to the problem. Unions pushed for the introduction of 'supra-company'

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apprenticeships, i.e., training programmes that mimic the dual system by combining theoretical and practical learning, but where the latter takes place in publicly-funded training workshops rather than in-firm. Importantly, supra-company apprenticeships would lead to the same certification as regular apprenticeships (Carstensen, Emmenegger, and Unterweger, 2022; Durazzi and Geyer, 2020; Seitzl and Unterweger, 2022). Employers, on the other hand, favoured government intervention in the form of financial incentives for firms who agreed to take on more apprentices. Unions strongly opposed employers' plans because the decision to offer training would remain, in that scenario, in the hands of firms and would not guarantee an expansion of apprenticeship places. A compromise was reached through the introduction of supra-company apprenticeships, as advocated by the unions, but only as a temporary measure to tame employers' scepticism (Durazzi and Geyer, 2020). Over time, however, supra-company apprenticeships proved to work well and, as a consequence, even gathered support from employers (Seitzl and Unterweger, 2022), leading to their institutionalization as a permanent feature of the Austrian skill formation system and characterized by a guarantee under-written by the state that every young person who unsuccessfully seeks an apprenticeship in the 'regular' system must be offered a supra-company apprenticeship place, should they wish so (Schlögl *et al.*, 2020). The unions forcefully pushed for this option, believing that a publicly-funded supra-company apprenticeship system would work on the back of historical legacies (Durazzi and Geyer, 2020). Indeed, the Austrian government has a successful tradition of intervention in training policy (Graf, Lassnigg, and Powell, 2012) that stands out by comparative standards (see Section 5.2 on the case of Germany for a sharp contrast on this issue), making the government an ideal partner for the unions to translate their equity-enhancing preferences into concrete policy measures.

Similarly, on economic grounds, small firms were, as hypothesized in Section 3, reluctant to contribute significantly to upgrading training profiles to meet the needs of the knowledge economy. Training in the field of ICT is a case in point here. Government and unions sought to strengthen apprenticeship training in this field, but while employer associations concurred, individual firms were reluctant to participate in the process (Seitzl and Unterweger, 2022). As a result, it was again down to unions and the government to lead the adjustment of the training system to meet the skill needs of a crucial sector in the transition to the knowledge economy, such as that of ICT. Indeed, the vast majority (roughly 70%) of ICT training at the post-secondary non-tertiary level in Austria takes place outside of the 'regular' dual system. It is the system of supra-company apprenticeships and school-based vocational training that provides the lion's share of ICT training (Seitzl and Unterweger, 2022). Comparing, for example, the distribution of apprentices by sector between the regular dual system and the supra-company apprenticeship system shows that training in 'traditional' manufacturing occupations is over-represented in the former, while training in the future-oriented ICT sector is over-represented in the latter[3] (WKO, 2023), testifying to the primary role of unions and government in adjusting the Austrian system to the needs of the knowledge economy.

Germany

The German case is different. Large firms, enjoying a relative position of power within the employer camp, have been very active in the reform of the skill formation system (Busemeyer, 2012; Thelen and Busemeyer, 2012; Trampusch, 2010). Their preferences, however, clashed with those of another strong actor, trade unions (Durazzi and Geyer, 2020). Since the turn of the century, large firms have pushed for a de-standardization of the training system, which was needed to better cope with a fast-changing labour market while also welcoming higher-level, more theoretically oriented skills (Busemeyer, 2012; Graf, 2018). While unions did not object to the latter, they forcefully opposed de-standardizing reforms, fearing that this would reverberate in segmentation in the labour market, undermining solidarity and collective action among workers

[3]We thank Leonard Geyer for pointing this out to us.

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(Geyer and Durazzi, 2022). Although employers did see many of their demands met (e.g., the re-introduction of shorter two-year apprenticeships and the modularization of training), the presence of strong unions as (potential) veto-players also incentivised employers to look for unilateral 'Sist' solutions outside of the boundaries of the 'regular' apprenticeship system (Emmenegger, Bajka, and Ivardi, 2023). A major development in this respect has been to meet the skill needs of knowledge-intensive sectors increasingly through 'dual study programmes', which are based on cooperation agreements between individual (usually, large) firms and universities (usually, of applied sciences), where students learn in a dual setting, but where the theoretical component is delivered at the level of higher education (Durazzi and Benassi, 2020; Graf, 2018). Dual study programmes proved to be a valuable source of skill provision for the ICT sector, with training in informatics, for instance, being the second most popular discipline among students enrolled in dual study programmes after engineering. While a sizeable amount of ICT training takes place within the 'regular' dual system, enrolments in ICT apprenticeships have been roughly stable over the last decade (Schwarz, Conein, and Tutschner, 2017). Instead, the number of students in ICT-related dual study programmes has seen an eight-fold increase (BIBB, 2022). The different pace of expansion of ICT-related training between dual system and dual study programmes testifies to the increasing importance of segmentalist solutions in satisfying the skill needs of the knowledge economy within the German system.

On social inclusion grounds, actors' preferences mirrored the Austrian context, but the ability to translate preferences into policies was radically different. In Germany, too, the late 1990s and early 2000s were characterized by the problem of an increasing number of young people unable to land a place for apprenticeship. The unions were particularly vocal in seeking to address this issue, but unlike Austria, they did not want to pursue the option of strengthening a public alternative to the regular system. The position of the German government in training policy is weaker compared to Austria, and such historical weaknesses made unions sceptical of greater government involvement in training policy (Durazzi and Geyer, 2020), which was feared to lead to training in occupations for which there was a supply of teachers in schools rather than demand for skills in the labour market (Geyer and Durazzi, 2022). Rather, unions wanted to introduce a training levy to force firms to train more (Durazzi and Geyer, 2020). The government entertained the idea for some time but ultimately refrained from turning the proposed levy into law, fearing employers' threat of disinvesting in the dual system had the levy been introduced (Busemeyer, 2012). The outcome was, therefore, the expansion of the so-called 'transition system', a set of publicly-provided training that, however, unlike the Austrian case, does not have buy-in from either unions or employers and does not lead to a standardized certification of skills (Durazzi and Geyer, 2020; Geyer and Durazzi, 2022). If the transition system is, to an extent, inclusive because it provides some form of training for unsuccessful apprenticeship seekers, it also pushes the risk of social exclusion down the line, given the uncertain – and generally poor – returns that these qualifications lead to in the labour market (Durazzi and Geyer, 2021). Acknowledging the sub-optimality of this solution, successive governments have in recent years tried to step up the quality of inclusion-enhancing measures (Busemeyer, Carstensen, and Emmenegger, 2022), including passing a law in 2023 that lays the ground for the introduction of a training guarantee (Eckelt, 2023). The latter, however, does not seem to enjoy (at least not yet) the same degree of support from other actors (notably the unions), and it is far from being as encompassing as the Austrian model, although it should be noted that the Austrian supra-company apprenticeship system is the explicit reference that advocates of a training guarantee in Germany have been bringing up as the ideal-typical policy to be pursued (Euler and Seeber, 2023).

Switzerland

Switzerland is characterized by yet another distribution of power between actors. Like in Germany, training policy is firmly in the hands of collective actors, granting limited authority to

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the government. But within the collective governance structure, employers enjoy a position of power over unions in what has been labelled as a *liberal* collective skill formation system (Emmenegger, Graf, and Strebel, 2020) characterized by 'polite employer domination' (Di Maio, Graf, and Wilson, 2020). As a consequence, measures related to both economic upgrading and social inclusion were introduced on 'employers' terms' (Carstensen, Emmenegger, and Unterweger, 2022). Because Swiss employers do not have a credible countervailing power that is able to act as a veto player, they did not have an incentive to seek segmentalist solutions *outside* of the 'regular' system (as was the case in Germany), nor a credible coalition between unions and the government that could emerge (as in Austria) to create alternative 'public' solutions, given the structural weakness of both actors vis-à-vis employers in the realm of training policy (Emmenegger, Bajka, and Ivardi, 2023). Hence, when in the late 1990s, Switzerland was also confronted with a lack of apprenticeship places, resulting in exclusionary dynamics for young people, the solution that emerged was introducing shorter, two-year apprenticeships with less demanding entry requirements that could cater for academically weaker candidates (Di Maio, Graf, and Wilson, 2019, 2020). These apprenticeships are also characterized by additional remedial measures to ensure that participants at the low end of the ability range can successfully complete their training programmes, unlike two-year apprenticeships in Germany which were introduced entirely as an additional form of flexibility within the system and not as a form of social inclusion (Di Maio, Graf, and Wilson, 2019). The government designed such a reform 'anticipating' employer preferences and, in particular, ensuring that employers' discretion in how many apprenticeships to offer and to whom would not be challenged – although explicit provisions to enhance the inclusive nature of the system were included (Di Maio, Graf, and Wilson, 2020). In terms of policy design, there are differences with both Germany and Austria. The Swiss solution is less exclusionary compared to Germany because the inclusion-enhancing two-year apprenticeships have, unlike the German transition system, employers' buy-in and, therefore, expected to carry value in the labour market (Durazzi and Geyer, 2021). It is, however, more exclusionary than the Austrian policy option because access to shorter apprenticeships is not guaranteed, but it rather depends on firms' willingness.

Equally, on efficiency grounds, Swiss employers did not pursue a segmentalist route outside of the system given their pre-eminent position of power (unlike in Germany), while the strong presence of large export-oriented firms ensured the willingness of the business community to upgrade the training system to meet the evolving skill needs of the knowledge economy (unlike Austria). In the ICT sector, apprenticeship programmes have been developed through the 1990s and saw a five-fold expansion in terms of participants in less than two decades (Peter, Kraft, and Krebs, 2019). Interestingly, and in sharp contrast with both Austria and Germany, the provision of ICT training in Switzerland is characterized by an unchallenged primacy of the dual VET system over any other educational and training path at both the post-secondary and tertiary levels (Bundesamt für Statistik, 2023) testifying to the persistent centrality of the 'regular' apprenticeship system in the Swiss skill formation model even in the 'new' socio-economic context of the knowledge economy (Emmenegger, Bajka, and Ivardi, 2023). As demonstrated by the analysis performed in Section 4 and captured descriptively by Figure 2, the Austrian, German and Swiss skill formation systems are among the top performers across a range of socio-economic indicators. However, as discussed theoretically in Section 3, their strong performances occurred against the backdrop of rather different policy changes. Broadly speaking, the empirical evidence presented in the form of case studies lent support to the hypothesized patterns of change formalized through Hs 5–7. Germany, where large employers dominate, have gone the farthest in upgrading their training profiles by embracing 'segmentalism'. Austria and Switzerland, instead, have maintained greater standardization as they upgraded their systems – either through a compromise between large and small employers (Switzerland) or by stepping up public provision of training through a government-union alliance (Austria). On social inclusion grounds, the Austrian system, as expected, was the one that most explicitly emphasized social inclusion aims. At the same time, and

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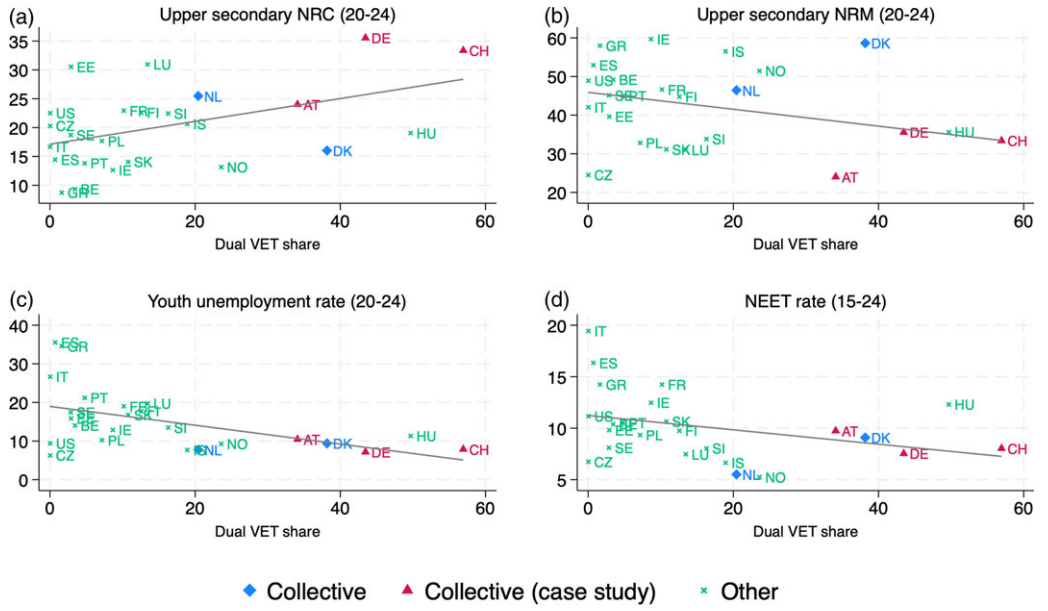

Figure 2. Bivariate correlation between dual VET share and the outcome of analysis.

somewhat deviating from the theoretical expectations, the Swiss system seems to have gone further than Germany in terms of social inclusion, despite unions being much stronger in the latter than in the former. This testifies to the structural difficulties that unions face in today's knowledge economies in achieving inclusionary policy changes in the absence of a credible coalition with state actors (cf. Thelen, 2014).

Conclusions

This paper re-assessed collective skill formation systems' ability to still provide high-quality skills to the advanced segments of the labour market while upholding social inclusion in today's knowledge economy. We argued that the transition to the knowledge economy strengthens the 'traditional' advantage of collective skill formation systems over other skill formation systems on both economic and social grounds, while simultaneously exerting pressure on them to recalibrate some of their underlying policy arrangements. We further contended that this dual relationship has to do with the institutional architecture of collective skill formation systems and with the nature of technological change in the transition to the knowledge economy. The argument was probed empirically through a multi-method approach. A panel regression analysis tested the effect of collective skill formation systems on a range of outcomes in the economic and social domains. With respect to the former, we hypothesized that collective skill formation systems contribute to the pursuit of a high road in the transition to the knowledge economy if they support upgrading – rather than polarization – of the occupational structure. The empirical evidence lent support to this claim. Moreover, it showed that such an effect is greater at high levels of technology. On social inclusion grounds, we found that dual VET systems dampen youth unemployment and NEET rates, but they do so with decreasing effectiveness as levels of technology increase. This suggests that as the adoption of technology increases, collective skill formation systems keep performing strongly on economic grounds but might struggle to keep up with equal effectiveness its socially inclusion function. The second part of the article provided a comparative analysis of actors that have sought to adjust collective skill formation systems to the needs of the knowledge economy in Austria, Germany and Switzerland. In

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line with our theoretical expectations, we found evidence that in all three countries, active coalitional work underpinned important reforms of collective skill formation systems over the last three decades. Yet, these followed highly country-specific logic, reflecting the relative power enjoyed by each actor across countries. In the Austrian case, unions and the government were the protagonists in promoting more state intervention in training policy; in Germany, adjustment was characterized by large firms seeking segmentalist solutions outside of the perimeter of collective governance; in Switzerland, large and small employers together imposed change at their own terms within the traditional structures of collective skill formation.

The paper also delves into a broader and more fundamental question: can 'coordinated capitalism' still offer today a model to reconcile economic efficiency and social inclusion? The evidence presented here suggests that while challenging, this is not impossible. The case of VET is crucial in this respect: a quintessential element of coordinated models of capitalism, VET has been theorized to be an inferior source of skills relative to higher education, usually associated to liberal models of capitalism, in the transition to the knowledge economy. Our article finds, instead, that VET can also be a viable route to secure skills for NRC occupations in the transition to the knowledge economy while potentially producing better social pay-offs compared to higher education. However, assuming that coordinated capitalism inherently leads to economically efficient and egalitarian outcomes would be misleading. Instead, such outcomes are likely to emerge as a consequence of concrete choices made to adapt policies and institutions to the changing socio-economic context – and such choices are in themselves the product of active coalition-building and power relationships among actors with different preferences.

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