Public Investment in the Knowledge Economy

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In the spring of 2020, the world was faced with a new, highly contagious and deadly disease. Epidemiological, medical and public health expertise became rapidly salient, the potential life and death consequences of scientific technology and expertise made apparent. At the time of writing, it is not clear what the long-term consequences of the Coronavirus pandemic will be. At its outset, the huge importance of knowledge and scientific expertise in government responses and national well-being provides a stark example of a more general underlying trend in the political economies of advanced industrialised capitalist democracies. Though without the same universal life-and-death stakes, changing technologies of production have been increasing the importance of knowledge as an input to economic progress and prosperity for the past forty years.

But ensuring adequate investment knowledge is difficult, whether through market mechanisms or democratic political processes. In the United States, proposals for the federal budget made by the President before the outbreak of the pandemic included reductions in federal research spending for the fourth year running, including deep cuts to the budgets of the National Institutes of Health and National Science Foundation (Mervis 2020). Meanwhile, public support for American higher education has also been in long-run decline, as direct state support has declined, and federal aid to students (such as Pell grants) cover only a diminishing share of the cost of pursuing tertiary education (Mettler 2014).

Viewed in isolation, it is possible to see these outcomes the apotheosis of a particular, but long- running, Republican aversion to science (Mooney 2005) and to (typically liberal)

institutions of higher education (Fingerhut 2017). But these explanations (and typically, criticisms) neglect broader challenges to public investment which are exacerbated by two features of knowledge generation. First, the public goods characteristics of knowledge, and second, the long-run character of its payoffs, complicate the creation of knowledge. A well-developed literature in political economy highlights potential political-institutional and socioeconomic features which better allow public goods investment for the long run. Thus, this chapter aims to illuminate the dynamics of public investment in these two inputs to the knowledge economy: tertiary education and research and development (R&D), situating the contemporary United States in both comparative and historical perspective, and to consider the determinants of these public knowledge investments.

This is an important gap to fill in the comparative literature as well as in understanding the American political economy, because most analyses of the knowledge economy transition have focused on its highly visible distributive consequences – rising inequality (see Introduction, Kelly and Morgan, and Ansell and Gingrich, in this volume) – and government interventions to address inequality through the fiscal redistribution, welfare state policy, and supply-side regulation. In contrast, while public goods provision will have distributive consequences, it stands in principle to have positive direct aggregate effects on long-run economic performance. Thus the political economy of knowledge production harks back to older challenges for government intervention, in the provision of basic public goods. Solving these problems – in public health and primary and secondary education, for example (Lindert 2004). What explains public investment in knowledge economy inputs, taking this comparative perspective? Political institutions matter. In particular, veto and access points to political decision-making tend to undermine both public goods investments, and political decisions for the long run. Thus the fragmentation of the American political system may not only undermine pro-poor policy (Kelly and Morgan, this volume), but also investments with

widespread aggregate benefit. At the societal level, diversity and conflict – both economic inequality and ethnic fractionalization – may prevent the social compromise necessary for effective knowledge investment. The balance of this internal conflict with external threats which serve to mobilize perceptions of the shared payoffs of making sacrifices for long-run, public goods is central to the comparative politics of innovation overall (Taylor 2016).

In considering public spending on research and development, on the one hand, and higher education, on the other, I find that these political institutions – single-member electoral districts and federalism, in particular – do indeed matter for public knowledge investment: fragmented majoritarian institutions are associated with lower levels of provision. Equally, economic inequality tends to reduce public knowledge investment. External threats act as a countervailing force on R&D spending, but not public support for tertiary education, while ethnic diversity undermines the latter but not the former.

This particular difficulty with securing public support for higher education spending in heterogeneous populations is readily comprehensible given the framing of higher education as a private, distributive benefit rather than a public good (Newfield 2008) and racial and ethnic political divisions over this kind of welfare support (Thurston, this volume).

The Comparative Political Economy of Knowledge Economies

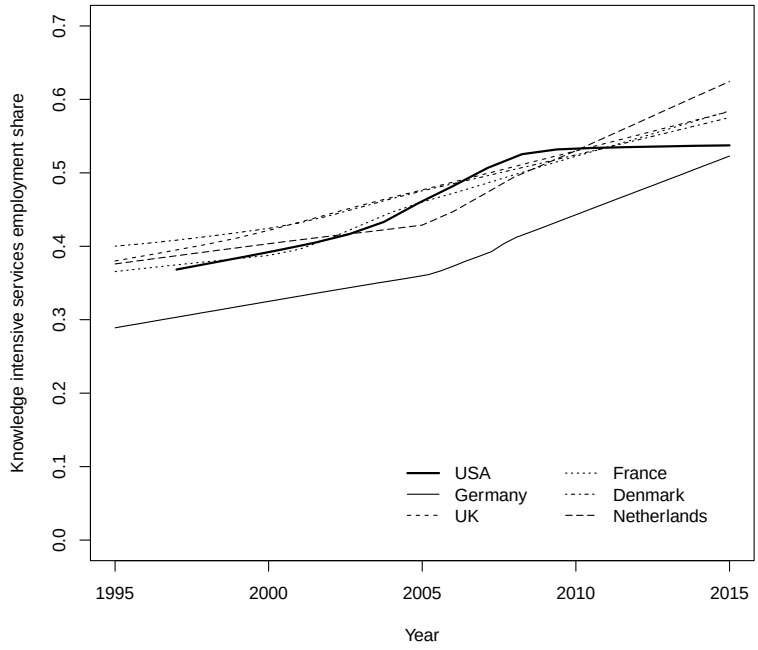
Comparative political economy scholarship at the turn of the millennium was strongly influenced by attention to broad differences between American and western European political economies. Accounts focused on differences in outcomes other than economic growth—such as inequality and poverty (Alesina and Glaeser 2004)—and highlighted different 'varieties' of advanced capitalism that, counter to the expectations and strict prescriptions of neoliberal economic theory, were delivering economic prosperity in different ways, even when faced with similar pressures from increasing international economic

openness. These models also highlighted different outcomes in terms of employment and economic structure. The wage compression associated with the coordinated model inhibited the growth of low-wage service employment (Iversen and Wren 1998). In terms of knowledge investments, one of the central distinctions between the liberal model (as exemplified by the United States), and the coordinated (exemplified by Germany) was on the propensity for the former to generate general skills and radical innovation, while the latter made progress through specific (and often highly technical) skills, and incremental improvements to products and processes.

The expectation that the liberal model would be better at delivering both service sector expansion, radical innovation, and general (especially, general university level) skills is easy to read across, informally, to the expectation that the liberal model might also better provide for knowledge economy expansion. Combined with variations in systems of university education, which also show some clustering across types of political economy, the liberal market, U.S.-style political economy was marked as superior in creating high-skill service employment in the private sector (Ansell and Gingrich 2013). However, while this pattern seems to have held in the early years of the new century, American leadership in the creation of knowledge intensive service employment has since been eclipsed. **Figure 1** highlights that while Germany continues to lag behind, many other western European countries now employ a larger share of their workforce in high-skill service jobs. Moreover, the trajectory of this kind of employment in the USA has flattened since 2010, while other countries continue to increase their skilled service share.[1]

Figure 1: The Expansion of Knowledge Employment: Share of Persons Engaged in Work in Knowledge-Intensive Services

[1] Figures 1 to 3 show the American case in comparison to Germany, the UK, France, Denmark and the Netherlands, to illustrate the comparative context. The full analyses also include Finland, Ireland, Italy, Japan, Portugal, Sweden and Spain, which are omitted from the figures here to maintain their legibility.



Source: Brady, Huber, and Stephens 2020; EUKLEMS 2018

This trend of declining American leadership in knowledge economy development echoes concerns evident in recent scholarship on American politics which highlights declining American leadership in the public provision of investment in two of the central inputs of the knowledge economy: higher education and research and development (Hacker and Pierson 2016; Mettler 2014). Public investment in these knowledge economy inputs provides an important case study through which to link these specific challenges for the American political economy to the broader comparative literature – including what we know about how political institutions affect public goods provision as well as the more visibly distributive politics of inequality highlighted by Kelly and Morgan (this volume).

Investment in Knowledge: Externalities and Public Intervention

I focus on the determinants of public investment in higher education and research and development for three reasons. First, the transition to the knowledge economy makes

investment in these two types of knowledge increasingly important. Second, the inherent characteristics of knowledge investment imply important public goods characteristics, which drives my focus on public provision. Moreover, public spending in these areas is a relatively uncomplicated policy lever. Finally, knowledge investment can be made to fit into existing accounts of policy variation only with some difficulty. As such, understanding what explains variation in public knowledge investments is an outstanding question within the comparative political economy literature.

The increasing importance of these inputs to the economy stem from changing technologies of production. Driven at base by the technological change of information and communications technology, filtered and developed by government policy, economic change led, by the end of the twentieth century, to a situation where knowledge investment is essential "public goods of advanced capitalism" (Iversen and Soskice 2019: 157). My focus on R&D and higher education as public goods inputs to the knowledge economy is distinct from questions of labour regulation, distribution and redistribution, where inequality acts primarily as an outcome of public action (or rather, inaction) (Huber, Huo, and Stephens 2017). While public investment in knowledge goods (and the way that it is financed) clearly has important distributive effects, I follow a distinct literature on the provision of public goods which centers on distributive conflict as an important explanation of variation across space and time.

Scholarship on government intervention in the economy, in the specific context of the knowledge transition, has primarily focused on three policy areas. The first two, labor market regulation and redistribution (efforts to reduce income inequality) fall squarely into traditional comparative political economy concerns with inequality and the welfare state. Government intervention in the economy in the knowledge economy is thus argued to be increasingly important for distributive outcomes as the industrial relations regimes which

underpinned egalitarian outcomes under Fordism have eroded (Iversen and Soskice 2015). Similarly, formal regulation of the labor market remains an important political lever to reduce wage inequalities (Hope and Martelli 2019).

The third area of scholarship on the political economy of the knowledge economy focuses more directly on knowledge production, as I do here. A large literature on the comparative political economy of education and skill formation has emerged. In this, education is usually taken quite broadly, and focused on compulsory school systems or on the entirety of education spending (Busemeyer 2007). Many of these studies also echo the distributive focus of the welfare state literature (Busemeyer 2014), and others stress the interaction between systems of education and training and labor market institutions as part of overall varieties of capitalism with different distributive outcomes, different outcomes in innovation terms, and with different institutional underpinnings (Estevez-Abe, Iversen, and Soskice 2001). Relatedly, the politics of higher education policy have been brought into the mainstream of comparative political economy in accounts that focus on the partisan politics of university expansion and financing (Ansell 2008; Garritzmann 2015). These treatments again tend to focus on the distributive interests of different socioeconomic groups, and the implications of different education policy choices for them, to create explanations of policy variation that run through differences in partisan control, as different parties channel the interests of these different groups.

There has been much less attention in comparative politics to the question of variation in research and innovation policy. This is readily comprehensible in light of the much smaller levels of public funds spent on research and development. R&D spending is also typically a low-salience area of government activity, either for its supporters or its opponents

(Williamson 2017). It has less obvious distributive consequences than other forms of government spending.

Nevertheless, I take investment in R&D and in higher education together as both are critical inputs to the knowledge economy. The two types of spending on knowledge inputs have three critical commonalities which we might expect to govern their place and dynamics within the advanced capitalist political economies. First, and as discussed in more detail below, both have important public goods characteristics. Second, both R&D spending and higher education spending represent a particular commitment to the funding of innovation: continued technological and economic innovation requires both good projects and highly skilled people to work on them. Finally, the returns to both higher education spending and R&D spending are likely to be relatively slow to emerge. In part, this is an inherent feature of investment of any kind. But the uncertain, cumulative and complementary nature of intangible investments in knowledge exacerbates this dynamic. For both types of knowledge investment, the long-run payoffs must nevertheless be paid for by immediate financial commitment. The democratic political provision of this kind of good raises a specific set of considerations (Jacobs 2011).

Knowledge Investments as Public Goods

Finally, public investment in knowledge investment has important public goods characteristics. That is, knowledge investment in general has public goods features which lead us to expect its systematic under-provision by private actors, and thus the need for public subsidy or other intervention. The general arguments for government spending on public goods are well known, and I will not rehearse them here. However, the characterisation of investments in R&D and in higher education as public goods is more contentious, and thus merits some discussion.

The public goods features of knowledge investment stem largely from the nature of the investment and the surrounding context. Knowledge as generated by investments both in R&D and higher education is a highly intangible output, not a tangible physical asset (Haskel and Westlake 2017). Haskel and Westlake document the increasing importance of intangible investments and summarise four distinctive features. Intangible investments are scalable (non-rival), subject to spill-overs (non-excludable) and synergies, but highly specific in the precise sense that separating the investment from the original investor is often extremely difficult[2]. The first two of these properties are classic components of the definition of public goods, and apply particularly to advanced research and development. The last, the specificity of investment, is particularly salient for human capital investments. That is, the specificity of a knowledge investment, such as a degree, makes the investment hard to separate from the firm (or student) who makes the initial investment. The knowledge gained working on a particular research project, or through a university degree, cannot easily be sold on, separated from the initial investor. This has the important consequence of making borrowing to finance the initial investment more difficult, as the underlying asset – the knowledge developed – provides no collateral.

Higher education has typically been seen as a less public good than primary and secondary education, on the grounds that the lion's share of the benefits to higher education are captured by the individual decision-makers involved. That is, the extent of spill-overs to higher education, that increase social benefits above the private benefits, has generally been assumed to be relatively limited (Barr 2001). However, more recent evidence indicates that higher education investment may have important external spill-over effects. First, in line with

[2] Haskel and Westlake (2017) use the term 'sunkenness' but specificity captures the dynamics relevant here more clearly.

the importance of 'synergies' in intangible investments, higher education increases the wages not only of the educated individual, but also to other workers (Moretti 2004; Valero and Van Reenen 2019). Taking both the effects on wages and the possibility of endogenous changes in the accumulation of new ideas and technologies makes estimating the effect of externalities to higher education on GDP in the longer run more difficult, but existing estimates are large (if varied).[3]

Importantly, though empirical estimates of the social returns to higher education investments are harder to quantify than the private returns (McMahon 2018), the idea that the balance between private and social returns would remain constant over time and across contexts – and particularly as technologies of production and the share of other workers and jobs with tertiary level skills or requirements change – seems hard to maintain theoretically. The expansion of information and communication technology, the rise of knowledge as an input to production, and changes of work organisation of the knowledge economy all point to increasing externalities to higher education through its impact on others' productivity as well as the generation of new ideas.

This shift in the 'publicness' of a specific good – in this case, higher education – has historical precedent in the late nineteenth century. As externalities to primary and secondary education became more important within industrial production processes, these levels of education came to have the 'public' quality we associate with them today (Lizzeri and Persico 2004). Similarly, public health and sanitation measures became critical public goods only as industrial technologies concentrated populations within cities. The externalities

[3] Hermannsson et al. estimate 40-year effects of around 12% for Scotland (2017); McMahon estimates an effect of 37% (2002).

associated with individual decision-making, and thus what public goods provision entails, depends on the prevailing technologies in the political economy.

Research and development investment has a similarly variable ratio of private to social return, depending on the context of production technologies as well as other legal and institutional features. For example, the prevailing intellectual property regime will shape the extent to which private investors in R&D can protect their knowledge from spill-over externalities. If spill-overs can be minimised, then, perhaps private incentives to invest in new R&D can secure high levels of scientific progress and innovation.[4] Under these conditions, and on this account, maintaining strong material rewards for successful innovation is more important than public funding for research. Moreover, reducing the private returns to innovative success through higher income tax rates (needed to finance public funding) leads innovators to shift their activities across international and US state boundaries, as well as reduce innovative effort (Akcigit, Baslandze, and Stantcheva 2016; Akcigit et al. 2018). Strong material incentives, in the form of high levels of inequality, have been argued to support high rates of US innovation that outpace other advanced economies (Acemoglu, Robinson, and Verdier 2017).

A similar logic is articulated in the varieties of capitalism account of innovation, where high private material rewards (and the privatization and licensed-distribution model of returns to innovation) drive more radical innovation in liberal market economies; their absence (as well as other positive institutional supports to process improvements throughout the production chain) lead to more incremental innovation in coordinated market economies (Hall and Soskice 2001).

[4] However, this kind of proprietary protection may have offsetting costs to the extent that it encourages rent seeking rather than, or alongside, innovation (see Mark Schwartz, this volume).

There are two central problems with these narratives. First, the 'stylized fact' if higher levels of innovation in the United States that material inequality is seen to incentivize, while apparent in data on American patents, does not appear in the international (triadic) patent data more appropriate for international comparison (Maliranta, Määttänen, and Vihriälä 2012). Second, the characterisation of the American system of innovation that emphasises private financial incentives radically understates the importance of less 'liberal market' features in twentieth century US R&D, especially in the most radical innovations. Government support for small business innovation (especially through the SBIR programme), and public support linking academic, corporate and government labs in dense collaborative networks, and the government as a guaranteed buyer for novel technologies, for example, speak to a much more 'co-ordinated' system of scientific and technological development (Keller and Block 2011; Weiss 2014).

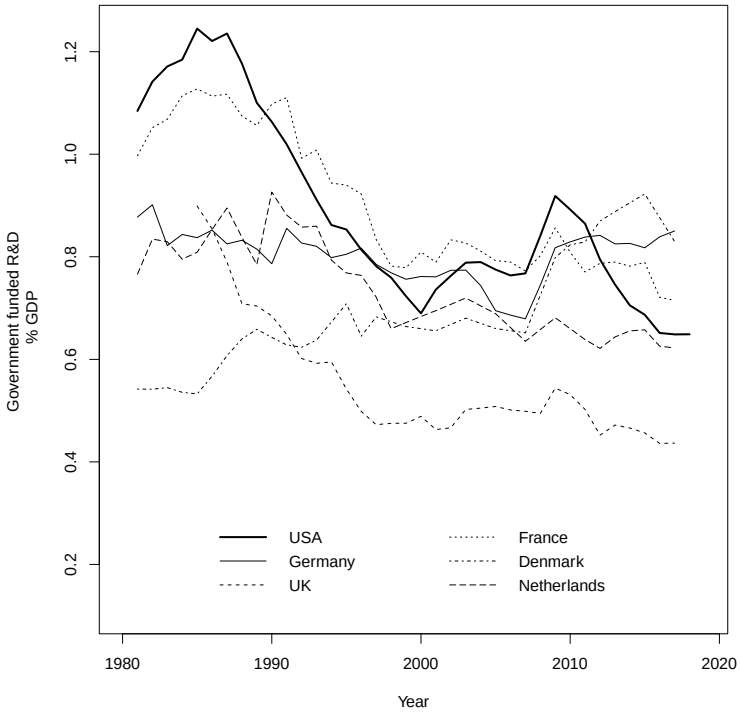
American Knowledge Economy Investment in Comparative Perspective

In the mid-1990s, public spending on our two knowledge economy inputs together made up 2.3 percent of GDP, putting America in a group of high-spending countries alongside New Zealand and just behind Denmark. Only the three other Nordic countries, Sweden, Finland and Norway, spent more public money on higher education and R&D. By 2013, however, the last year for which comparable data are available, US spending had fallen by 12% to just over 2% of GDP, while most of the other high-investment countries increased their spending (Brady, Huber, and Stephens 2020). America's ranking in terms of this combined investment measure dropped from fifth to eleventh, of the twenty countries for which we have data (ibid.). That is, despite the rise of the knowledge economy, American public investment in these two central inputs declined in both absolute terms, and compared to other advanced industrialised countries.

For R&D spending, American decline is even more apparent over a longer time span. **Figure 2** shows data from the OECD (2020b) from 1980 to 2017, comparing the United States to the same five other advanced industrial economies as **Figure 1**. Both the United States and France show a similar pattern here of large declines in public research funding over the late 1980s and 1990s. In part, this reflects the declining incentive to scientific investment occasioned by the waning of the Cold War, but the material imperatives of military and economic competition had been reinforced by a more ideational commitment to R&D as a public good. From the Bush (1945) report onward, US science policy was underpinned by the idea that "the proper concern of the federal government should be the provision of a rich fund of fundamental knowledge" (Elzinga 2012: ?). In short, mid-century American R&D policy was one of high levels of public spending in consequence of the public good characteristics of basic science.

This did not imply a blank check commitment to scientific public goods; rapid wartime and post-war expansion of scientific research funding was met, by the late 1960s, with increasing calls for accountability and budget-consciousness (Elzinga 2012). Even stabilization (rather than growth) of overall resources devoted to research and development required shifts to the internal culture of scientific work, including greater competition for resources and changes to the structure of careers. It also brought a greater emphasis on the external, and usually economic, benefits of scientific research, to be quantified and evaluated (Ziman 1994).

Figure 2: Government Funded Research and Development as a Percentage of GDP



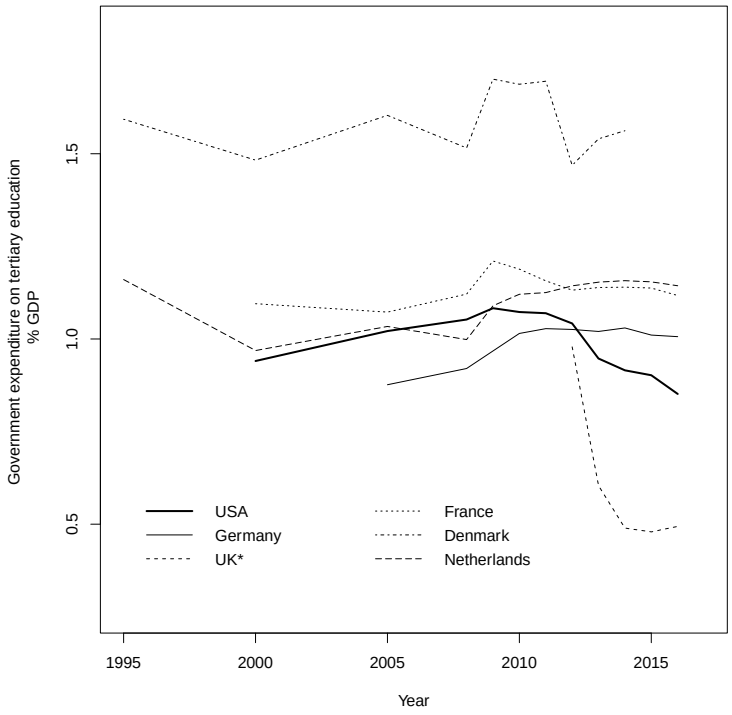
Note: Total funding from government sources (2015 dollars, constant prices and PPPs) divided by GDP. Selected countries.
Source: OECD 2020b; OECD 2020c.

But in the more recent years shown in **Figure 2**, after some recovery in the 2000s, American R&D funded by the government is in steady decline. This more recent decline is not strongly mirrored in any other national series. While there are still a number of countries who commit less public finding to science, recent political developments in these countries have emphasised the importance of increasing R&D capacity, and of the role of expanding government funding to that end. In the United Kingdom, for example, a laggard as shown in **Figure 2**, has recently seen multi-year commitments to increasing government spending on science and research (Royal Society 2019).

American public funding of higher education has not recently been such a positive outlier in comparative perspective. Nevertheless, the available comparative data show a decline in public funding in America, even from its lower relative position. **Figure 3** again

shows the same six countries. While the data are somewhat patchy, American public investment in tertiary education, as a share of GDP, is lower than any of the other countries here except the United Kingdom. From the peak (in this series) in 1997, the most recent levels of spending represent (again) around a 13% decline.

Figure 3: General Government Spending on Tertiary Education as a Percentage of GDP



Note: Direct spending on ISCED levels 5-8, all educational institutions. Selected countries. UK data reflect the transition to tuition fee funding model in 2012/13 when most ongoing direct public funding for teaching in England was cut.
Source: OECD 2020a.

The radical decline in measured UK spending levels shown in **Figure 3** highlights, the level of public funding for higher education does depend on the funding model, and public spending is not the only way to fund higher education. However, as noted above, the maintained argument here is that assuming that higher education does indeed have considerable public good spill-overs, we should be interested in the direct public component of spending. Moreover, though the increasing importance of private sources of funding has

played an important part in the funding model of the American system over the long run (Garritzmann 2014), an important change occurred around the turn of the millennium when private resources shift from bringing in additional resources to the funding of higher education, to substituting for public funds (Carpentier 2018).

The decline in American public funding for higher education in comparative context is also echoed in more detailed data considering the United States alone. Suzanne Mettler calculates that between 1990-91 and 2009-10, American states' per capita funding of higher education fell 26% (Mettler 2014).

As in the shift of emphasis in scientific research from basic public knowledge towards a more accountable – and economically functional – end goal for research work, perceptions of higher education and its public funding base shifted. Where mid-century ideas emphasised the public good value of higher education, stressing collective benefits and widespread spill-overs, by the late twentieth century higher education was viewed almost exclusively as an individual investment choice and cost-benefit analysis (Newfield 2008). This ideational change justified a shift towards tuition-based, private funding and the decline of public support.

What Explains Public Investment in Knowledge Economy Inputs?

The comparative political economy treatments of public goods provision, investment in long-run goods, and innovation policy provide a clear set of expectations for explaining variation in public investment in knowledge economy inputs across countries and over time. First, an extensive literature on the economic effects of constitutional provisions has taken the provision of public goods – both overall, and as compared to targeted public spending on transfers, with more particularistic benefits – as a central puzzle (Persson and Tabellini 2000). Lizzeri and Persico (2001) argue that the majoritarian, single-member district systems

suffer from the under-provision of public goods compared to proportional systems, because of the greater electoral payoffs to more particularistic spending under majoritarian institutions in general. Similarly, presidential systems provide lower levels of public goods than parliamentary regimes as a consequence of the smaller incentives for legislative cohesion, but greater separation of powers, in the former (Persson, Roland, and Tabellini 2000). This emphasis on the separation of powers in presidential systems echoes the idea that blocking expansions of public spending is easier for (minority) groups in systems with a higher number of veto points that has been emphasised (Immergut 1992), and their importance in preventing policy adaptations to new economic conditions in the United States has been highlighted in this volume with reference to inequality (Kelly and Morgan, this volume).

The importance of veto players – and their negative effect on public investment – is also highlighted in explanations of variation in investments that politically difficult because of the long timeframe associated with their benefits (Jacobs 2011). In considering pension reforms, Jacobs highlights the importance of government insulation from interest groups who are likely to bear, and be aware of, the short-term costs of long term investments, and thus seek to clock them. Lower levels of openness to external influence, in terms of both the veto points and the access points highlighted by Kelly and Morgan in considering hurdles to egalitarian economic policies, also insulate governments to enable worthwhile long run investments. Similarly, the access that the courts, and strong systems of judicial review, can provide to organised interests (Rahman and Thelen, this volume) are likely to dampen knowledge investment as long-run public good provision. On the other hand, the strength of organised interests in areas which are obscure, rather than electorally salient, does not necessarily impede the sacrifices necessary for knowledge investments. Jacobs (2011) highlights the potential for obscurity surrounding the short-run cost of investments, and

clarity and high salience of the long-run benefits, to provide better political cover for would-be public investors. In short, the median voter may not prefer the necessary sacrifice either.

Federalism and decentralization provide a particular kind of veto point, particularly important in the American case (see Introduction, as well as Kelly and Morgan, this volume). Here, however, expectations for public goods investment are mixed. While federalism increases the number of points at which present-oriented interests can gain access to political decision-making and block investment for the long run. Similarly, transferring provision of knowledge goods to the subnational level replicates the public goods problem that individual actors face: any given state will be better off free-riding on knowledge investment pursued elsewhere, rather than making the initial sacrifice of current consumption themselves. On the other hand, federalism may allow decentralised decision-makers to externalise (some of) the present-day costs of financing the public goods (Besley and Coate 2003). To the extent that this sacrifice of current consumption can be moved to other states, while benefits accrue more locally, the distributive (rather than public goods) characteristics of knowledge investment spending may lead to greater provision under federal systems.

When the spill-over benefits of knowledge investment are geographically concentrated, as documented by Ansell and Gingrich (this volume) – federalism may have particularly limiting effects on investment, as pivotal decision-makers are less able to benefit from social spill-overs. The question of the geographic and economic concentration of knowledge spill-overs is a complicated one, which requires a reconsideration of the pure public goods characterisation of knowledge investment (and as such is beyond the scope of this paper). However, it is worth highlighting as it indicates that federal political systems may operate differently, in terms of their impact on investment in the inputs to knowledge, in contexts with different levels of inequality.

How do these institutional characteristics differentiate the American political economy from comparator countries? The United States is not unique in having any of the specific features of strong federalism, single-member majority electoral districts, or strong processes of judicial review. Among the countries considered in the analysis below, Germany shares strong federalism with the US, the UK shares a system of uniquely single-member majoritarian electoral representation, and only the UK, Netherlands and Finland lack judicial review (according to the CWS data). However, as this makes clear, the American system is unique in combining all three of these institutional features.

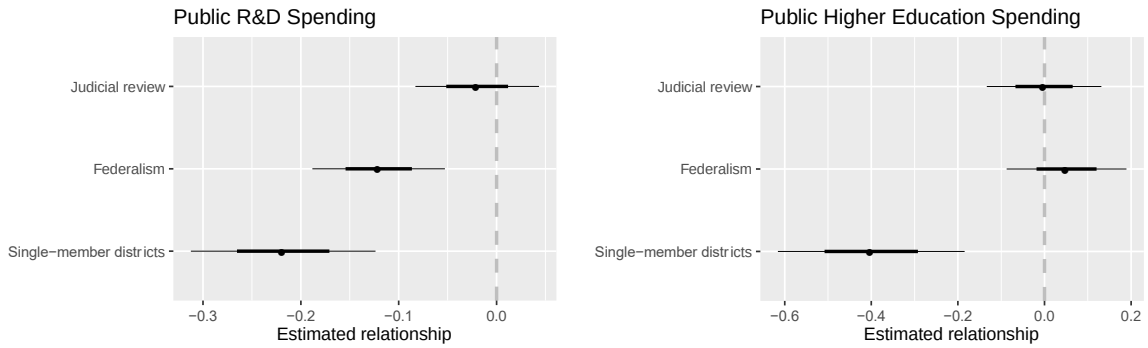
The salience and national benefits of long-run knowledge investment, in particular, is also highlighted in Taylor (2016) in considering the politics of innovation. Specifically, Taylor argues that external threats – both economic and military – increase countries' willingness to sacrifice current consumption to invest in innovation. Both reliance on foreign imports for strategic goods like food and energy and military threats from abroad increase the salience of technical progress, highlighting the benefits that will accrue to the necessary investments. Taylor also notes that the willingness of countries to incur the short-run costs that innovation requires depends on the level of internal conflict. High levels of internal distributive conflict will lead to lower levels of innovation. Taylor highlights the economic inequality as an important element of this domestic conflict, but the logic also echoes a broader literature on the negative impact of racial and ethnic heterogeneity on public goods provision cross-nationally (Alesina and Glaeser 2004) as well as within the United States (Trounstine 2013). In essence, the argument highlights that innovation requires shared sacrifice in the short term; internal division based on economic or identity grounds will make societies less able to agree on who should bear the burdens of that sacrifice, and less willing to share it.

On these characteristics, too, the US is somewhat distinctive. As highlighted by much of the rest of this volume, the income share of the top ten percent is high in America, in comparative perspective: the average value in the US for the years providing observations for analysis below (1997-2011) is 0.44, where the overall sample average is 0.34. The US is also more fractionalised in ethnic terms, although the highest value of fractionalisation (which includes religious and linguistic, as well as racial differences) is found in Spain. The American sample average indicates about a 50-50 chance of two randomly-selected people coming from different ethnic groups (0.47) where the sample average is about a one in four chance. Finally, the US is much more involved in foreign conflict in the period under analysis than almost all other countries. In just over two-thirds of the years observed, the US is involved in foreign conflict – mainly to do with the war on terror. The UK is similarly involved 41% of the time, while all the remaining countries in the sample are not involved in external conflict.[5]

We can get a sense of the relationships between these institutional and political-economic characteristics and knowledge input investment by comparing both characteristics and outcomes across countries and through time. **Figure 4** shows the estimated relationships between the presence of the three institutional characteristics highlighted above. Single member districts are expected to be associated with lower levels of public goods provision as a consequence of the electoral incentives they create, while judicial review and federalism both provide present-day actors liable for shouldering the costs of long-run investment opportunities to block it. This would also reduce public spending on knowledge inputs.

[5] I use the threshold of "war" (1000 or more battle-related deaths in a given year) to code external conflict).

Figure 4: The Relationships Between Political Institutions and Public Knowledge Investment Spending



Note: Coefficient estimates from linear models as described in the main text.
Source: Brady, Huber, and Stephens 2020.

In the case of R&D investment, these theoretical expectations are largely confirmed, although there is no real directional relationship between judicial review and spending.[6] Jurisdictions with single-member district only electoral systems are estimated to commit 0.22 percent less of GDP to R&D spending – since the full range of that outcome runs only from 0.1 to 1.3, this is a substantively large change. It represents one standard deviation's difference, or the gap between Austria (the top spender) and France (the 7th highest) in 2015. The impact of federalism is an also important 0.12 percentage points.

Single-member district electoral systems are also associated with lower levels of spending on higher education. Again the substantive size of the estimated association is large: around one standard deviation: the variable ranges up to 2.6 percent of GDP. The 0.4 percent difference associated with single-member districts is the difference between the high-spending Nordics and Australia in 2015. Though neither federalism nor judicial review are significantly associated with higher education spending, on the whole the results are striking:

[6] These estimates come from models that include all three institutional variables together, as well as controls for per capita GDP, population, and the share of employment in the knowledge economy, and a linear time trend, to account for straightforward structural differences across place and time. The data for the analyses come from Brady, Huber, and Stephens (2020).

the features of institutional fragmentation known to reduce public goods expenditure in general seem to translate to lower public commitment to investments in the necessary inputs to the knowledge economy.

Table 1 extends the analysis to consider the faster-changing features of the political economy cited in explanations of public goods provision in addition to the institutional features. I use the income share of the top ten percent to measure income inequality, and an index of ethnic fractionalization (Drazanova 2019) to capture ethnic diversity. To indicate the level of external threat, I use an indicator variable which is equal to 1 when a country is involved in an external armed conflict (Pettersson, Högbladh, and Öberg 2019; Gleditsch et al. 2002). To capture the capacity of policy-makers to obfuscate the short-term costs required for long-run payoffs, I use the size of the government's budget deficit under the assumption that higher deficits make all current spending more salient and contested, while periods of surplus allow for the present-day sacrifices involved in knowledge investments to be more readily obscured.

The results in Table 1 are quite striking. Economic inequality and external threat affect public research funding exactly as expected, though there is no obvious negative association with ethnic fractionalization. In contrast, ethnic fractionalization is significantly negatively associated with higher education outlays. Economic inequality also dampens public higher education spending, but external threat is of little consequence. Higher budget deficits do appear to reduce higher education spending, but the results for research and development investment are inconsistent across specifications, and wrongly signed where statistically significant. The negative association with higher education spending is consistent with the logic of electoral insulation being required for long-run investment, and the difference between the two types of investment makes sense given the higher visibility and higher levels of expenditure on higher education compared to R&D. However, budget

deficits are also likely to put downward pressure on spending via mechanisms other than electoral insulation (such as constitutional budget rules or economic pressures). As such this result should be taken as only indicative of the plausibility of this logic.

Table 1: Explanations of Public Knowledge Investment

	Research spending			**Higher Ed. spending**		
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Income inequality	-1.513***	-1.970***	-1.990***	-5.939***	-5.181***	-0.174
	(0.370)	(0.530)	(0.490)	(0.752)	(1.364)	(0.976)
Ethnic fractionalization	0.019	-0.049	-0.536	-0.565***	-0.544***	-0.078
	(0.083)	(0.072)	(0.367)	(0.174)	(0.165)	(0.638)
External threat	0.137***	0.133***	0.094***	0.131	0.193*	-0.003
	(0.045)	(0.041)	(0.028)	(0.117)	(0.113)	(0.060)
Budget deficit	-0.354	0.247	0.760***	-2.309***	-2.133***	-0.015
	(0.247)	(0.218)	(0.176)	(0.511)	(0.505)	(0.331)
Single-member districts		-0.115*			-0.070	
		(0.068)			(0.180)	
Federalism		0.233***			0.363***	
		(0.046)			(0.105)	
Judicial review		-0.244***			0.044	
		(0.031)			(0.065)	
Time trend	Linear	Linear	Year FEs	Linear	Linear	Year FEs
Country fixed effects	N	N	Y	N	N	Y
N	172	172	172	153	153	153
R-squared	0.453	0.632	0.925	0.720	0.756	0.966
Adj. R-squared	0.422	0.604	0.895	0.702	0.735	0.955

***p < .01; **p < .05; *p < .1

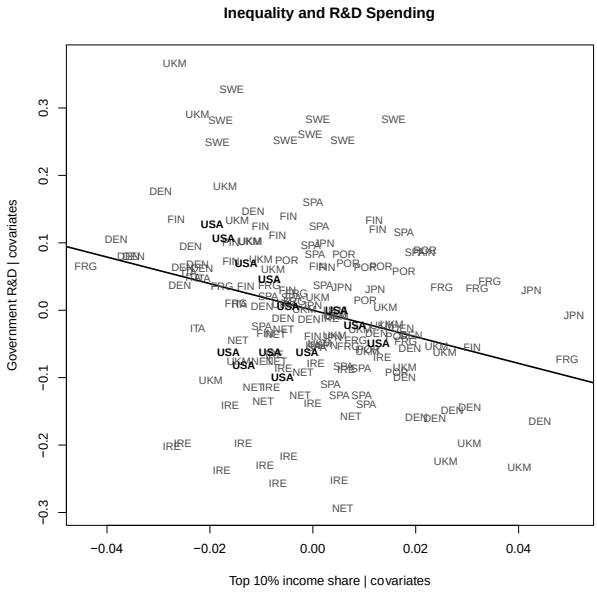
Note: All models include controls for GDP per capita, population, knowledge employment and economic growth.

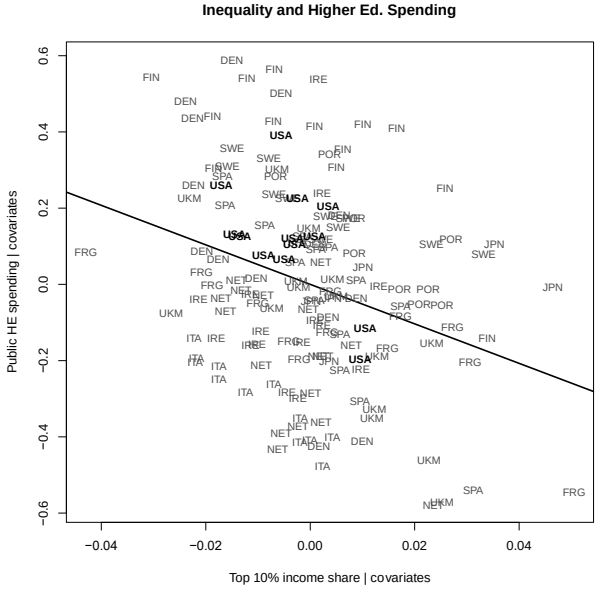
Models 2 and 4 add the institutional variables to the analyses with little substantive change to the conclusions about inequality, fractionalization and external threat and cost-obscuring. Models 3 and 6 add country fixed effects to the analyses to capture the effects of any unobserved, time-invariant characteristics across countries. Interestingly, the patterns of spending on R&D are robust to the inclusion of these variables, but not the higher education investment results. The latter timeseries is of shorter duration, and we see relatively less variation within countries, so this is not a surprising finding. While our interest in the

differences across countries point to the value of leverage derived from the cross-country variation (in models 4 and 5), this does counsel against strong causal interpretations of the higher education associations, since there may well be unobserved country characteristics which drive both inequality, fractionalization and public higher education investment.

Nevertheless, the finding that ethnic fractionalization is associated negatively with higher education provision resonates not only with the comparative political economy literature on public goods provision, but also with explanations of increasing American underinvestment in higher education over time. As noted by Thurston (this volume), American willingness to support public spending on higher education has been undermined by the perception of an increasingly non-white student population and resistance – especially among (white) Republicans – to expanding spending seen as a private benefit to a racial or ethnic out-group (Taylor et al. 2020).

Figure 5: Conditional Relationships Between Economic Inequality and Public Investment in Knowledge Economy Inputs





Note: Added-variable plots from models 2 and 4, Table 1.

Figure 5 shows the conditional relationships between knowledge investment and inequality as estimated in models 2 and 4, which show the negative relationship, in both cases, quite clearly. In both cases we note that the United States is not providing particularly high-leverage observations – conditional on the other covariates in the model, its values for inequality are relatively near the cross-national average. Second, for R&D spending the US observations lie close to the overall regression line, indicating that the relationship between

inequality and R&D spending in the US is quite similar to the overall cross-national association. For higher education investment, the US observations are not dissimilar to the overall pattern, but it is one of greater variation. Significantly, though, it is the UK (in 2000 and 2001), Spain, the Netherlands and Germany (in 2008) which provide the high-leverage high-inequality, low public investment observations in the bottom right corner of the figure, rather than the United States.

While we would not want to over-interpret these results, the negative associations between inequality and public investment in knowledge in the form of R&D and higher education spending are particularly important in the context of other known dynamics about the knowledge economy. That is, we know that the knowledge economy transition increases inegalitarian pressures on incomes, if not redressed by government intervention in the form of redistribution and regulation (Iversen and Soskice 2019). But it arguably makes public investment in knowledge increasingly important (Haskel and Westlake 2017). If increases in inequality are an endogenous consequence of increasing knowledge economy production, but also undermine the conditions for effective investment in continued economic success in a high-knowledge context, the long-run prospects for adequate public goods provision without deliberate redistribution are dim. Indeed, those countries which have maintained or increased public knowledge investment are also those that feature high levels of this kind of egalitarian intervention – Denmark (as in **Figures 2** and **3**) and (to a lesser degree) the other Scandinavian countries.

Conclusion

A comprehensive account of all the details of American investment in knowledge, placed into broad comparative and historical context, would require a more extensive treatment than a single essay can allow. Nevertheless, this chapter describes the

contemporary challenge facing American public support for research and for higher education, documenting its recent decline in both absolute and comparative terms. I argue that this is a particular problem due to the increasing importance, and increasing 'public-ness' of knowledge in modern economies, and with this motivation try to explain variation in this public support on the basis of canonical political economy approaches.

Overall, the implications for understanding the American political economy are threefold. First, economic production in twenty-first century advanced industrialised countries – knowledge economies – requires us to reconsider the nature of various government interventions in the economy. The importance of different inputs to production (among other things) changes with technological change, and the characteristics of these inputs also change. High-skill knowledge is increasingly required for inclusion in the productive economy (Carnevale, Smith, and Strohl 2013), and new ideas at the technological frontier increasingly necessary for economic progress. Both exemplify intangible capital investments, with important public goods characteristics (Haskel and Westlake 2017). As such we should see government intervention in these areas not – or not only – as distributive and redistributive social policy, but also through the lens of public goods provision. This requires broadening any comparative political economy focus away from the questions of inequality and redistribution that have dominated treatments of the knowledge economy transition so far.

Second, this broader literature in political economy, and in studies of the comparative politics of long-run investment and of innovation, provide useful candidate explanations for variation across time and across countries in this kind of public goods provision. While the broad comparative lens derived from this kind of general theory necessarily requires some abstraction of the details of the political economy of any given state, it does allow us to place particular cases – such as the United States – in the context of these general explanations. Not

only does this help us understand the challenges to American public knowledge funding, it also considers some of the important features of the American political economy (as highlighted elsewhere in this volume) through the question of their impact on knowledge investment provision.

The marriage of the quantitative CPE approach to the study of American knowledge investment pursued in this chapter also imports another feature of this comparative political economy tradition, namely the focus on national-level aggregates, institutions and explanations. In this specific context, this leads to two important caveats to the analysis. First, the scope of the spill-overs to knowledge investment may not be truly national. This implies that while individual decision-making would still lead to the under-provision of investment, national-level subsidies will have important geographic distributive consequences. In the cases of higher education and R&D funding, these could well look like redistribution towards the most prosperous areas within national economies (see Ansell and Gingrich, this volume). This raises important questions as to the economic desirability, political feasibility and normative justice of this public funding which are side-stepped here. Second, these dynamics will obviously play out differently across countries with varying levels of political and fiscal decentralization. Given the importance of federalism in the American political economy, this feature of empirical reality is a question of substantive importance (see also Grumbach, Hacker and Pierson, this volume).

Finally, the prognosis for continued growth in knowledge production and economic well-being may be less optimistic than other treatments allow, both generally and for the United States in particular (Iversen and Soskice 2019). My analyses of the correlates of public investment in higher education and R&D indicate that the fragmentation of American political institutions, and its majoritarian single-member districts in particular, undermine the provision of these valuable knowledge inputs. Similarly, while external threats may increase

the capacity of the political system to find compromises facilitating valuable long-run public goods investment, internal divisions undermine it. To the extent that increasing economic inequality and social division are a consequence of other trends in the knowledge economy, the endogenous dynamics of change in public investment may mean that ensuring good (innovation) challenges can be paired with the good (well-educated) workers to solve them is increasingly difficult.

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