

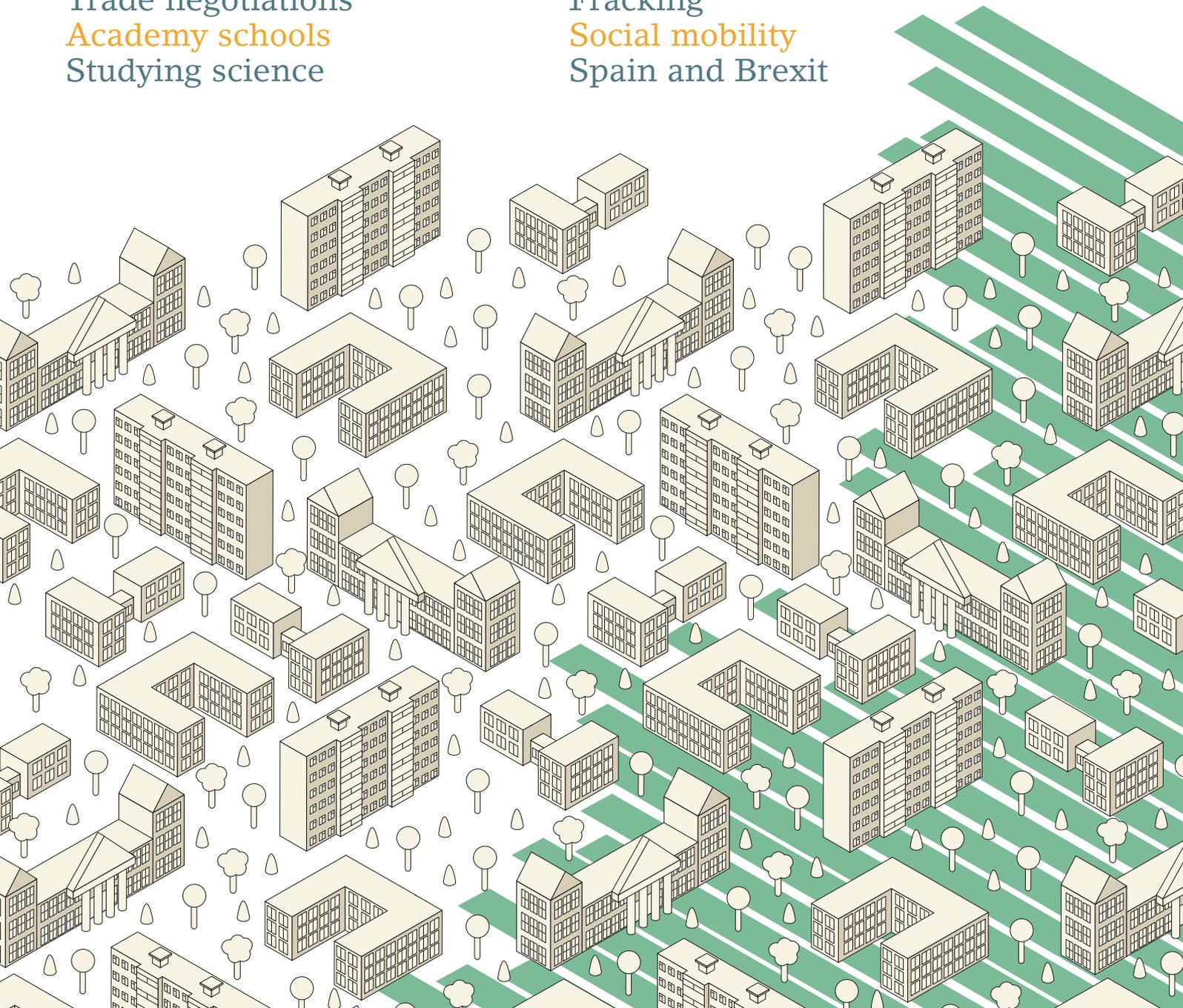
Centre Piece

The Magazine of The Centre for Economic Performance

Volume 21 Issue 3 Winter 2016

Trade negotiations
Academy schools
Studying science

Fracking
Social mobility
Spain and Brexit



UNIVERSITIES AND ECONOMIC GROWTH

CentrePiece



THE LONDON SCHOOL
OF ECONOMICS AND
POLITICAL SCIENCE ■

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Editorial

In early 2013, the LSE Growth Commission published *Investing for Prosperity: A Manifesto for Growth*, a set of recommendations for UK policy-making around infrastructure, skills and financing innovation – some of which were adopted, most notably the National Infrastructure Commission. A number of researchers from the Centre for Economic Performance (CEP) were deeply involved in that project, particularly the Commission co-chair and then CEP director John Van Reenen.

The UK now faces further questions about its economic future, including its relationship with the European Union (EU) following the vote for Brexit, prospects for the City of London, the role of industrial policy and recent developments in labour markets. So the Commission has been re-formed and, as last time, it is drawing on evidence given in public sessions by business leaders, academics, policy-makers and other stakeholders in the UK economy.

The Commission – now co-chaired by CEP's new director Stephen Machin, alongside Tim Besley and Nick Stern – will report in January 2017.

This issue of *CentrePiece* features several articles relevant to the Growth Commission's agenda, not least two on the challenges of Brexit. Thomas Sampson sets out four principles for the UK's approach to trade negotiations, most immediately with the EU. And Luis Garicano outlines the likely attitude of Spain to UK-EU negotiations and the risks posed to what has long been a close and mutually beneficial relationship between the two countries.

Another pair of articles explores the impact of 'fracking' – hydraulic fracturing for shale gas. In the United States, where the process has been used since the early 2000s, it has given a big boost to manufacturing. But in the UK, where fracking is at an earlier stage, the downsides are more in evidence: in the one part of the country where

exploratory drilling has taken place, two earthquakes have led to falling house prices.

Finally, we have three articles on education. One shows that converting primary schools into academies is ineffective at raising pupils' achievement. A second finds that giving able teenagers the opportunity to study 'triple science' increases the number of science students in universities.

And our cover story analyses data on 15,000 universities in 78 countries to demonstrate that the expansion of higher education fuels growth. At a time when the UK's longstanding climate of openness to international students, academics and collaboration is under threat, this result should form a key part of the policy agenda for growth.

Romesh Vaitilingam, Editor
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Lower input costs for energy-intensive US industries have made them more globally competitive

The surge in shale gas production since the early 2000s has made the United States the world's largest producer of natural gas.

As research by **Rabah Arezki**, **Thiemo Fetzter** and **Frank Pisch** shows, it has also given a big boost to output, employment and exports in US manufacturing, particularly in energy-intensive industries.

Fracking: the boost to US manufacturing

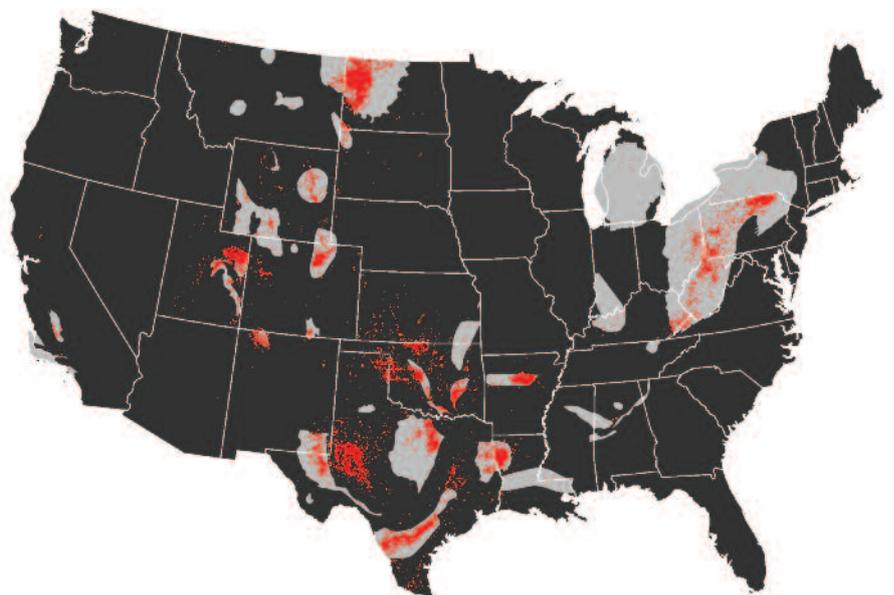
In the United States, exploitation of shale gas resources through a technology called hydraulic fracturing ('fracking') started an energy revolution from the early 2000s onwards. Fracking is now widely used across several major shale gas 'plays' (formations): most importantly, the Marcellus Shale of Pennsylvania, Ohio and West Virginia (see Figure 1). The surge in shale gas production has made the United States the largest natural gas producer in the world. What are the implications for US manufacturing?

What standard trade analysis predicts

Our research starts from the premise that natural gas is predominantly used for energy production, so that the sudden increase in gas supply puts considerable downward pressure on energy prices.

In an open economy, any such price differential vis-à-vis other countries would be arbitrated away through international

Figure 1:
Unconventional oil and gas wells across the United States (red dots) and shale plays (light grey)



Source: Fetzter (2014).

trade in natural gas. But natural gas is not a normal commodity in this respect: its physical properties make transport exceedingly expensive over long distances.

In addition, up until December 2015, the United States enforced an export ban on crude oil and natural gas. Consequently, any ‘buy-cheap-sell-dear’ activities were difficult. This has resulted in a dramatic drop in natural gas prices in the United States vis-à-vis other countries (see Figure 2).

Industries differ significantly in their inherent technological energy intensities. For example, around 10% of the overall input costs for ‘chemical manufacturing’ and ‘primary metal manufacturing’ constitutes energy costs, while the non-durable consumer goods energy cost share is less than 5%.

As a consequence, firms that manufacture energy-intensive products experienced a much more substantial cut in production costs and, hence, a boost to their competitiveness. We therefore expected that both input (employment and capital) and output shares of these industries would increase relative to their ‘low-energy’ counterparts.

Turning to international trade, we hypothesised that this differential cost shock would give US firms an edge over their international competitors: energy-intensive industries should expand their exports more than low-energy ones.

Evidence on the impact of fracking

To elicit the causal impact of fracking on our various outcomes of interest, we compare the development of industries that are similar and differ only in their energy intensity – providing us with ‘treatment’ and ‘control’ groups – as measured by their energy cost shares derived from US input-output tables.

We verify that our two groups behaved similarly prior to the shale gas boom, which gives us confidence in the validity of this comparison. In addition, we are able to rule out a range of alternative explanations, which leaves us confident that our estimates capture the causal impact of fracking on our main outcome: exports in energy-intensive output.

The focus of our study is the indirect effect of the shale gas production boom on industrial activity (operating through natural gas prices), as opposed to the direct stimulus effects due to the drilling activity and the associated local income and employment gains that have been

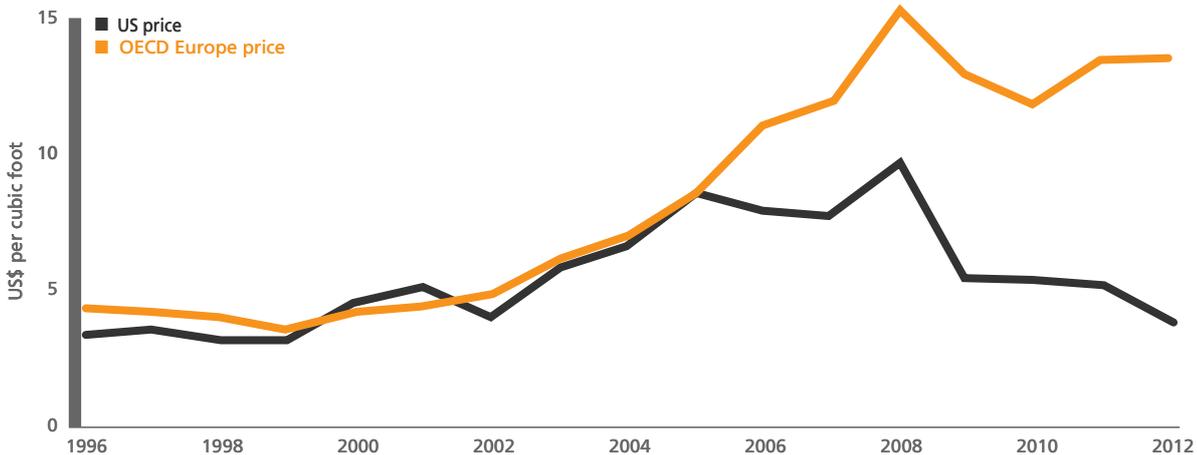
studied elsewhere. Throughout our empirical analysis, we exclude direct effects by focusing on areas of the United States that do not lie right on top of or near to shale plays.

We document that output in energy-intensive sectors expands significantly with the widening of the natural gas price gap. Consistent with that observation, we show that the energy-intensive sectors absorb more capital (measured by capital expenditure decisions as a proxy) and labour (captured by employment) in order to produce this additional output.

Turning to trade, the main focus of our study, we document that the increase in the price gap is associated with a significant expansion in exports of energy-intensive goods. The effect operates at both the ‘intensive margin’ (more exports in an industry-destination pair that had already been engaged in trade) and the ‘extensive margin’ (emerging trade in an industry-destination pair that had not previously engaged in trade). Contrary to the theoretical prediction, we find no consistently significant reduction in imports.

Energy prices for US manufacturing firms have plummeted due to fracking, especially relative to Europe

Figure 2:
Industrial use natural gas prices in dollars per cubic foot in Europe and the United States



The example of chemical manufacturing

The case of chemical manufacturing serves well as an illustration of the effects we estimate. This industry has an energy cost share of roughly 8% (the overall industry average is 5%) and constitutes a significant part of the US economy: on average, between 2006 and 2012, chemical manufacturing accounted for almost 20% of overall manufacturing GDP.

For every dollar increase in the price gap of natural gas between the United States and Europe, output in chemical manufacturing increased by 1.6%. In the face of nearly a \$10 gap by the end of our sample period, this baseline result is large. Moreover, we find that employment and gross capital expenditure increased by 0.6% and 3.3%, respectively, for every dollar price difference.

The shale gas boom provided energy-intensive industries with a cost advantage over their international competitors. We estimate that the value of exports by chemical manufacturing rose by 1.6% for every dollar increase in the natural gas price gap.

Cross-sector average effects

Using the average sector level employment together with average energy intensity, we can arrive at an overall estimate of the employment gains: total manufacturing sector employment increased by around 356,000 jobs up to 2012. A comparison with previous research (Feyrer et al, 2015) suggests that, for every two jobs created in direct relation to fracking, this indirect effect adds more than one additional job elsewhere in the economy.

Even though the United States is considered to be a relatively closed country, it plays an important role on the international stage as one of the largest exporters. Given that the price gap widened to \$10 by 2012, we find that average manufacturing exports have expanded by roughly 10% due to the shale gas boom. This amounts to roughly 4.4% of the overall value of exports of goods and services from the United States in 2012.

Our results suggest that the cost advantage due to the shale gas boom may have helped the US economy recover significantly faster than it would otherwise have done after the financial crisis of 2007/08.

Implications for the UK

The UK is set to explore the potential of fracking technology in exploiting its shale gas resources. But it is important to highlight that there are substantial differences between the UK and the United States, which need to be taken into account when making any inferences based on our research.

Most importantly, the UK is currently reasonably well integrated into the European energy market, with millions of customers at its doorstep and infrastructure available to carry natural gas from the UK to continental Europe. Therefore, it is unlikely that a newly created UK gas supply would have a US-sized effect on natural gas prices – either domestically or in the European market.

This article summarises 'On the Comparative Advantage of US Manufacturing: Evidence from the Shale Gas Revolution' by Rabah Arezki, Thiemo Fetzter and Frank Pisch, CEP Discussion Paper No. 1454 (<http://cep.lse.ac.uk/pubs/download/dp1454.pdf>).

Rabah Arezki is at the research department of the International Monetary Fund. **Thiemo Fetzter** of the University of Warwick is a research associate in CEP's urban programme. **Frank Pisch** is an occasional research assistant in CEP's trade programme.

The shale gas boom helped the US economy to recover faster after the financial crisis



Further reading

Thiemo Fetzter (2014) 'Fracking Growth', CEP Discussion Paper No. 1278 (<http://cep.lse.ac.uk/pubs/download/dp1278.pdf>).

James Feyrer, Erin Mansur and Bruce Sacerdote (2015) 'Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution', National Bureau of Economic Research Working Paper No. 21624.

in brief...

Fear of fracking: the impact on UK house prices

Shale gas offers the prospect of a low-cost energy future – but does extracting it invoke anxieties about the possibility of environmental catastrophe among local residents? **Steve Gibbons** and colleagues detect a distinct ‘fear of fracking’, as indicated by falling house prices in the one part of the country where exploratory drilling has taken place.

The UK government has recently given its approval for exploratory drilling and hydraulic fracturing – ‘fracking’ – for shale gas at two sites in Lancashire. This follows a similar decision for North Yorkshire earlier in the year.

Some will see these approvals as landmark planning decisions marking the way to a low-cost energy future for the UK. For others, particularly those who live locally, the decisions will be seen as leading to potential environmental catastrophe. These fears are fuelled by many reports from the United States about the risks associated with shale gas extraction by fracking – including water contamination and earthquakes – plus concerns about the local impact of traffic and extraction infrastructure.

Our research investigates whether these fears affect what people are prepared to pay to live in areas affected by fracking, by tracing out the impacts of shale gas licencing and exploration on house prices in England and Wales.

Although commercial shale gas development has not yet taken place in the UK, exploration licences have been offered since 2008 and many exploration wells have been drilled. Figure 1 shows the location of these exploration licences (in red) and potential shale gas-bearing areas (in grey). Our findings suggest that licencing and exploration in themselves had little or no impact on house prices throughout most of England and Wales.

The one exception is the one site in the UK where exploratory fracking – the high-pressure injection of fluids to extract shale gas – has taken place (the red dotted area in the North West in Figure 1). Here we find that house prices fell, on average, by up to 5% after

fracking commenced. A specific trigger for this was the occurrence of two highly publicised earthquakes in 2011 that were linked to the fracking.

What happened is illustrated succinctly in Figure 2, which plots the trend in adjusted house prices at quarterly intervals up to and after the earthquakes in 2011. The solid line represents the earthquake zone, while the dashed lines show trends in other licenced areas and where licences specifically mention shale gas. Clearly, there was quite a marked fall in transaction prices in the months after the fracking and the earthquakes.

These earthquakes were minor and would not have caused personal injury or damage to property. So the most likely explanation for any impact on house prices is that the earthquakes reminded people of the potential risks, and so reduced demand for homes in the vicinity.

Figure 1:
Shale gas exploration in the UK

Note: The map shows blocks that were licenced for gas exploration in 2008 (red) and previous rounds (blue).



Figure 2:
The effects of shale gas licencing, exploration and earthquakes on local house prices



Note: Prices are scaled relative to the beginning of 2011.

The implication is that there are ‘psychological costs’ associated with fracking, which should be compensated. An existing industry ‘community engagement charter’ already recommends payments by drilling and exploration companies to local communities: around £100,000 for exploration plus 1% of revenues during extraction.

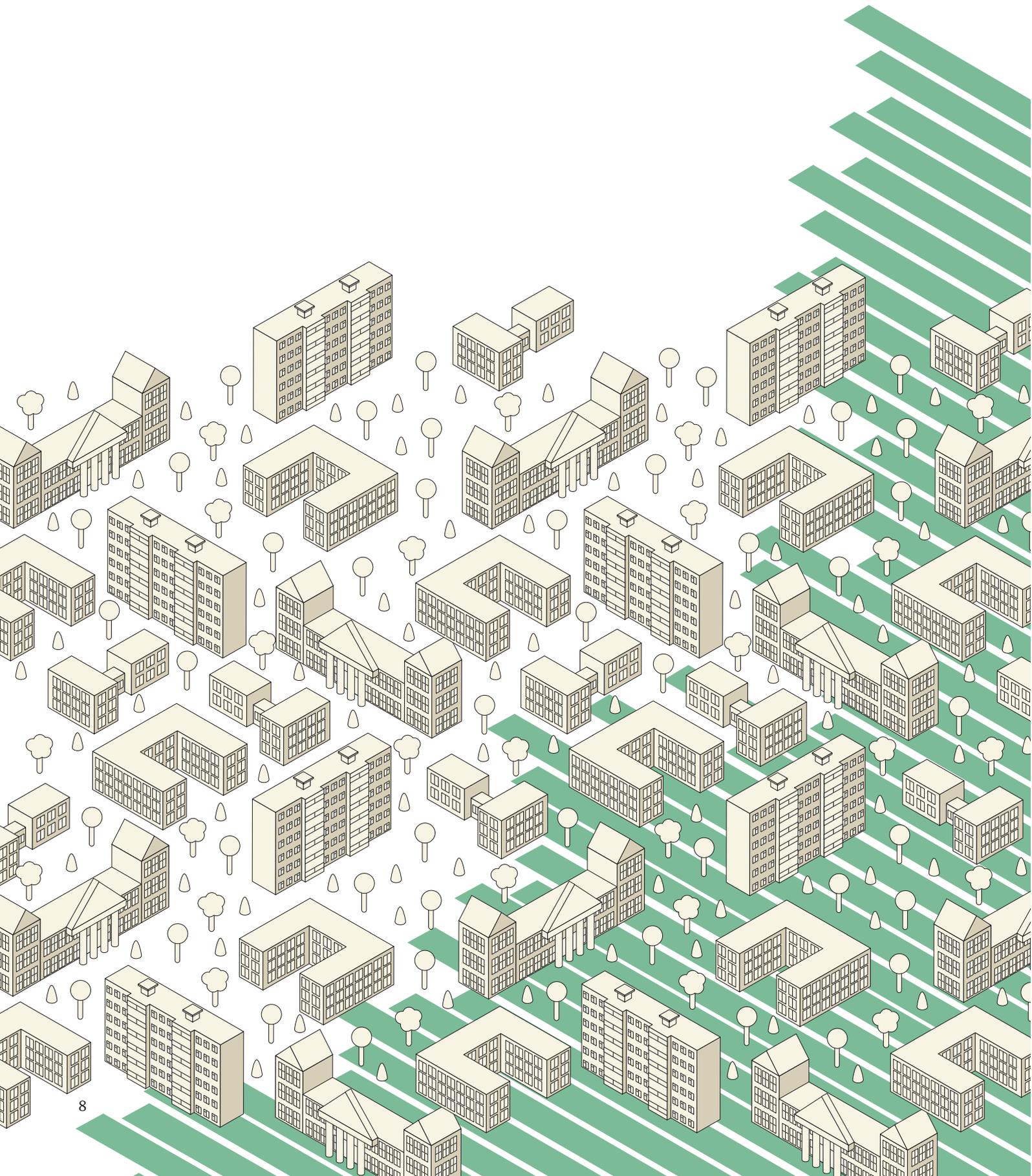
In addition, the government has recently consulted on a new shale gas wealth fund that proposes using 10% of revenues from shale gas to fund payments up to a maximum of £10 million per site to individuals and communities affected by extraction. But aggregate costs per site implied by the house price reductions are far in excess of these.

Compensation to communities could prove to be very costly if local objections to fracking are to be overcome by those who see fracking as the answer to securing the UK’s energy supply.



This article summarises ‘Fear of Fracking: The Impact of the Shale Gas Exploration on House Prices in Britain’ by Steve Gibbons, Stephan Heblich, Esther Lho and Christopher Timmins, Spatial Economics Research Centre (SERC) Discussion Paper No. 207 (<http://www.spatial-economics.ac.uk/textonly/SERC/publications/download/sercdp0207.pdf>).

Steve Gibbons is director of SERC and professor of economic geography at LSE. **Stephan Heblich** is at the University of Bristol. **Esther Lho** and **Christopher Timmins** are at Duke University.



Since the middle of the twentieth century, higher education has flourished around the world. Analysing data on 15,000 universities in 78 countries for the period since 1950, **Anna Valero** and **John Van Reenen** find that there is a strong positive impact of university expansion on regional economic growth.

How universities boost economic growth

In 1900, only 1% of young people in the world were enrolled at universities. Over the course of the next century, particularly after the Second World War, this proportion exploded to 20% as recognition of the value of human capital for both economic and social progress became widespread (Goldin and Katz, 2008; Schofer and Meyer, 2005).

Today, many governments – even in countries with advanced university sectors – see value in further expansion of higher education. In the UK, for example, the Higher Education and Research Bill is being pushed through parliament. This bill includes measures to encourage entry into the sector to foster growth and social mobility. It should be noted however, that at the same time, university maintenance grants have been converted to loans, which, evidence suggests, could harm applications from poorer students (Dearden et al, 2014; Dynarski, 2003).

The most obvious channel through which we may expect universities to have an impact on economic growth is via their role as producers of human capital. There is ample evidence that higher education pays off for the individual as wages of

graduates are much higher than those of non-graduates.

Macroeconomic research has generally found that at the country level, human capital (typically measured by years of schooling) is important for development and growth, but proving the link at the country level is difficult as there are many factors to control for. At the sub-national level – where you can hold unobserved country-specific factors constant, studies have shown that human capital is important for regional GDP per capita in the cross-section and confirmed that this relationship also holds for growth (Gennaioli et al, 2013; 2014).

Over and above producing graduates, universities may be expected to affect growth through stimulating innovation in their surrounding region (for example, Silicon Valley), and indeed there is a large body of evidence for this mechanism. In addition, universities may affect economic growth via their role in the development of institutions, and also as substantial purchasers of goods and services in a region.

Our research considers the effect of the growth of universities themselves on regional growth using a comprehensive

international dataset. We compiled new data based on UNESCO's World Higher Education Database detailing the location of 15,000 universities in 1,500 sub-national regions across 78 countries and examine the relationship between university entry and regional growth between 1950 and 2010.

It turns out that the expansion of higher education in this period was not just the product of riches: it has helped to fuel economic growth around the world. These findings are consistent with other, more contextual papers that have linked universities themselves or their spending to local economic outcomes for firms and regions (Cantoni and Yuchtman, 2014; Aghion et al, 2009; Kantor and Whalley, 2014).

The growth in universities over the last 1,000 years

The word 'university' was coined by the University of Bologna, founded in 1088. As the first modern university, it was distinct from the religion-based institutions that had come before. It was a community with administrative autonomy, courses of study, publicly recognised degrees and research objectives.

Since then, universities have spread worldwide (see Figure 1) in broadly the same form. Economic historians have argued that universities were an important force in the commercial revolution through the development of legal institutions (Cantoni and Yuchtman, 2014) and also the industrial revolution through their role in building and disseminating knowledge (Mokyr, 2002).

While growth has been experienced worldwide, today's distribution of universities across countries is skewed, with seven countries (the United States, Brazil, the Philippines, Mexico, Japan, Russia and India, in descending order) accounting for over half of the universities in the world (see Figure 2). The United States is the country with the largest share, accounting for 13% of the world's universities.

Universities and regional growth

Our analysis focuses on the period since 1950 when, as Figure 1 shows, university



The expansion of higher education has helped to fuel economic growth around the world

growth was particularly rapid. We look at sub-national data at the regional level (for example, US states) and find that increases in university numbers significantly raise future GDP per capita.

Our main result is that a 10% increase in the number of universities (which roughly means adding one more university in the average region in our data) increases that region's income by 0.4% as illustrated in Figure 3. This implies that the effect of adding a university to a region that has 10 universities is much larger (0.4%) than adding a university to a region that already has 100 universities (0.04%), reflecting diminishing returns. Our results are robust to controlling for population and geographical factors and even unobserved regional trends. Moreover, we show that it is not simply that faster growing regions open up more universities (reverse causality).

We find that universities also increase output in neighbouring areas within the same country, with stronger effects for geographically closer regions.

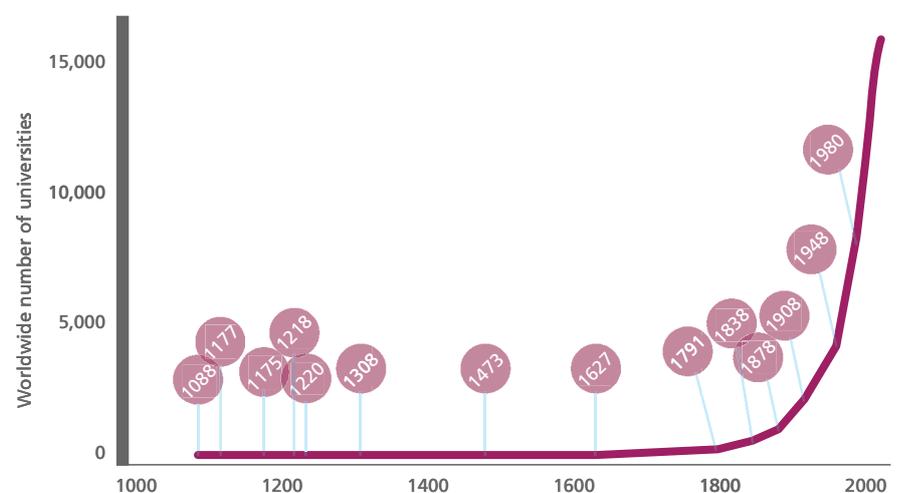
Policy-makers are not only interested in the potential benefits of universities, but also in the costs of building and maintaining them. In the UK, we estimate that if one university were added to each of its 10 regions, this would lead to about 0.7% higher national income (£11 billion based on 2010 figures). This is higher than the likely annual cost, which based on average university expenditure is more like £1.6 billion. The large margin between benefits and costs suggests that university expansion remains beneficial.

Mechanisms

A cynic might claim that universities affect growth in a mechanical way: more people move to the region and consume more 'essentials' there – housing, beer and night club services spring to mind. But our results remain even when we control for population growth. It could also be that when universities are financed by transfers into a region, say from the national government, there is a mechanical impact on GDP per capita. We show that even

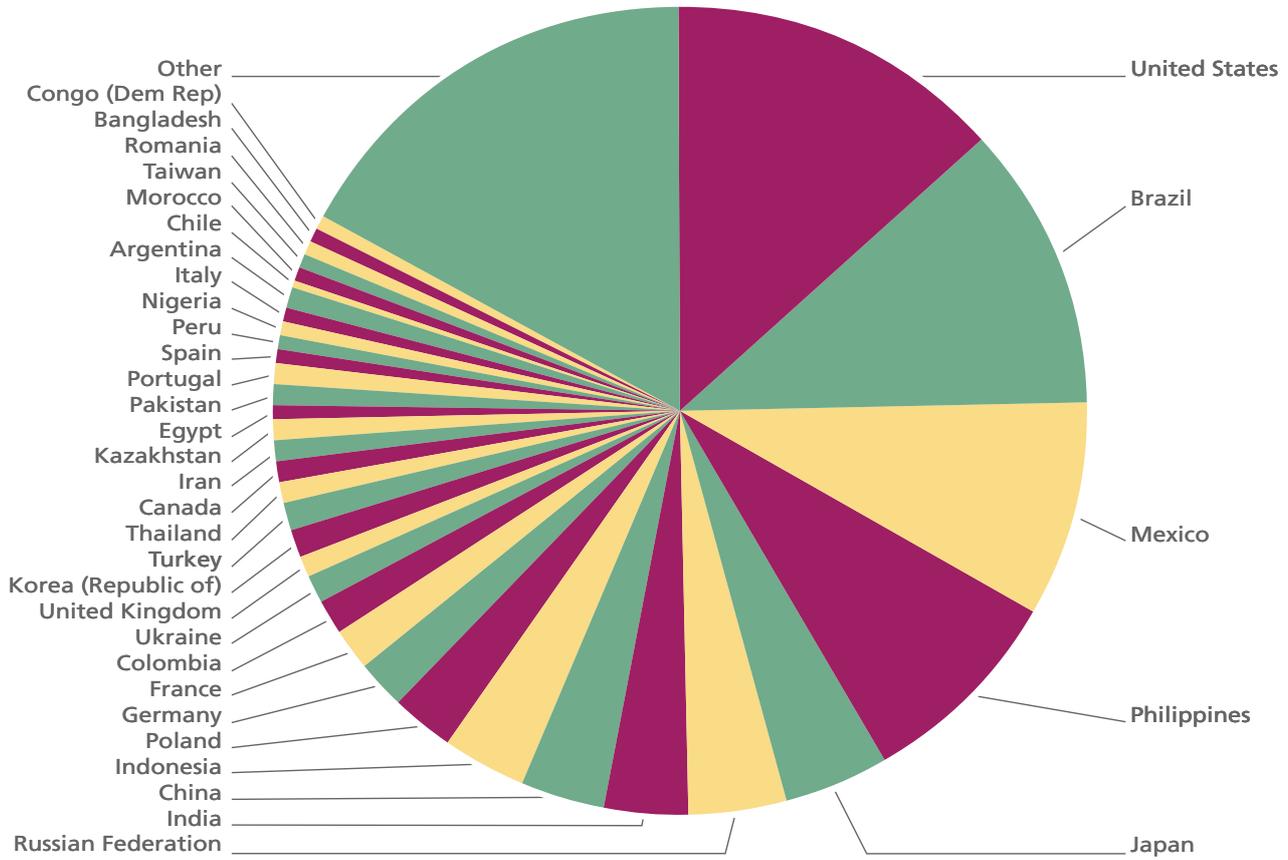
Doubling the number of universities in a region raises future GDP per capita by 4%

Figure 1: The global growth of universities over the last 1,000 years



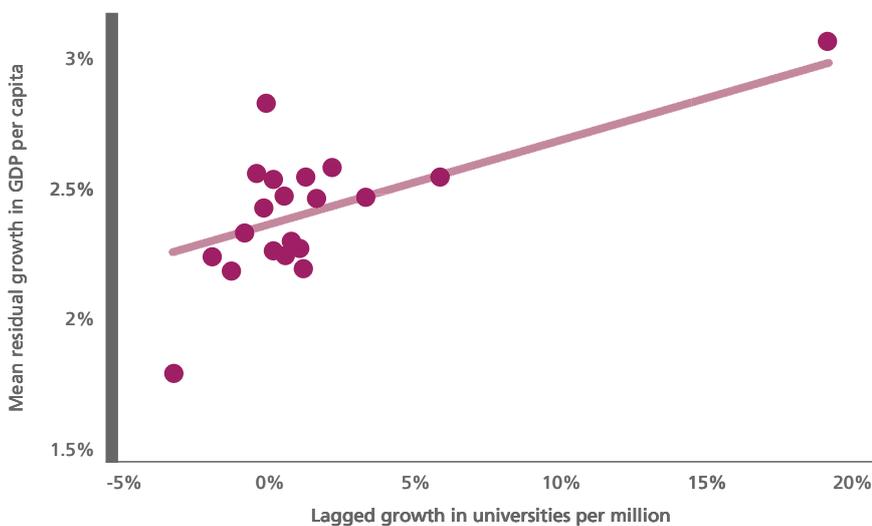
Source: World Higher Education Database; dates marked when the number of universities in the world doubled.

Figure 2:
Location of universities in 2010



Notes: Pie chart shows the share of worldwide universities in each country, as at 2010.
Source: World Higher Education Database.

Figure 3:
Average growth rates, region-year observations



Notes: 8,128 region-year observations are grouped equally into 20 bins, variation is within country.
Sources: World Higher Education Database; Gennaioli et al (2014) for regional GDP per capita and population.

The benefits of university expansion in the UK far outweigh the costs, but Brexit poses significant risks

under some very generous assumptions about the size and spending of a new university, this is unlikely to explain a large fraction of our result.

We find that the university effect seems to be related to increasing the supply of skilled graduates who raise productivity in the firms where they work. We also find that universities boost innovation (as measured by an increase in patenting).

Over a longer time frame, we find that higher university presence in a region is also associated with pro-democracy views among individuals. The striking thing about this result is that it persists even when we control for an individual's own education, suggesting that there could be some kind of externality associated with universities through the diffusion of ideas into their surrounding areas.

The strength of our research lies in the comprehensiveness of the dataset in terms of the coverage of sub-national regions and time periods. Due to our empirical design, we cannot rule out that the effects are at least in part driven by unobservable factors that vary over time, for example, strong regional governments that implement many growth-enhancing policies, including opening new universities.

Moreover, our measure of university presence – the number of universities – does not take account of differences in the size and quality of institutions. Future work, focused on the UK with more granular data, aims to address these issues and shed more light on the mechanisms at work.

Conclusions

International data since the 1950s shows that universities matter for growth, and using the UK as an example, we estimate that the benefits far outweigh the costs. Assuming that any new universities have the same qualities as those we already have, our analysis suggests that policies to encourage entry into the sector would be good for growth.

In the UK-specific context however, the Brexit vote poses significant risks. UK universities have thrived in recent decades in a climate of openness to international students, academics and collaboration, all of which will have contributed to the economy through skilled employees and innovations. It is important that whatever Brexit deal is finally agreed, these key strengths are preserved.



This article summarises 'The Economic Impact of Universities: Evidence from Across the Globe' by Anna Valero and John Van Reenen, CEP Discussion Paper No. 1444 (<http://cep.lse.ac.uk/pubs/download/dp1444.pdf>).

Anna Valero is a research economist in CEP's growth programme. **John Van Reenen** is professor of economics at MIT and was director of CEP from October 2003 to July 2016.

UK universities have thrived in a climate of openness to international students, academics and collaboration

Further reading

Philippe Aghion, Leah Boustan, Caroline Hoxby and Jerome Vandenbussche (2009) 'The Causal Impact of Education on Economic Growth: Evidence from United States', *Brookings Papers on Economic Activity*.

Davide Cantoni and Noam Yuchtman (2014) 'Medieval Universities, Legal Institutions, and the Commercial Revolution', *Quarterly Journal of Economics* 129(2): 823-87.

Lorraine Dearden, Emla Fitzsimons and Gill Wyness (2014) 'Money for Nothing: Estimating the Impact of Student Aid on Participation in Higher Education', *Economics of Education Review* 43: 66-78.

Susan Dynarski (2003) 'Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion', *American Economic Review* 93(1): 279-88.

Nicola Gennaioli, Rafael La Porta, Florencio Lopez de Silanes and Andrei Shleifer (2013) 'Human Capital and Regional Development', *Quarterly Journal of Economics* 128(1): 105-64.

Nicola Gennaioli, Rafael La Porta, Florencio Lopez de Silanes and Andrei Shleifer (2014) 'Growth in Regions', *Journal of Economic Growth* 19(3): 259-309.

Claudia Goldin and Lawrence Katz (2008) *The Race between Education and Technology*, Harvard University Press.

Shawn Kantor and Alexander Whalley (2014) 'Knowledge Spillovers from Research Universities: Evidence from Endowment Value Shocks', *Review of Economics and Statistics* 96(1): 171-88.

Joel Mokyr (2002) *The Gifts of Athena: Historical Origins of the Knowledge Economy*, Princeton University Press.

Evan Schofer and John Meyer (2005) 'The Worldwide Expansion of Higher Education in the Twentieth Century', *American Sociological Review* 70(6): 898-920.

To achieve its post-Brexit objectives, whatever they turn out to be, the UK government needs a trade negotiating strategy based on a clear-eyed understanding of how trade agreements work.

Thomas Sampson sets out four principles that should guide the UK's approach to future negotiations, most immediately with the European Union.

Four principles for the UK's Brexit trade negotiations

The meaning of Brexit is yet to become clear. But if Brexit means leaving the customs union of the European Union (EU), it would allow the UK to pursue its own trade policy for the first time since joining the EU in 1973.

An independent trade policy presents both challenges and opportunities. The most important challenge would be to reach a new trade agreement with the EU. The UK has yet to decide what relationship with the EU it wants following Brexit. But whatever it chooses, whether the government achieves its objectives will depend on the success of its negotiating strategy.

Previous work by CEP researchers has analysed the economic consequences of Brexit (Dhingra et al, 2016a; 2016b) and discussed what policies the UK should adopt if it leaves the EU (Dhingra and Sampson, 2016). The latest report in our series on Brexit asks a different question: what strategy should the UK adopt to

secure its objectives in future trade negotiations?

A successful strategy must be grounded in a clear understanding of why countries negotiate trade agreements and how negotiations are conducted.

When a country sets trade policy unilaterally, it does not account for how

The first priority should be to agree a transitional deal to cover UK-EU relations until a long-term agreement is reached

its choices affect the rest of the world. However, because countries are interdependent, the effects of trade policy do not stop at national borders. In the language of economics, trade policy generates international 'externalities'. And frequently these externalities lead to 'beggar-my-neighbour' effects, which make other countries worse off by lowering their terms of trade or reducing inward investment (see Grossman, 2016).

By negotiating trade agreements, countries can internalise the externalities resulting from international interdependencies, avoid damaging trade wars and improve welfare. Importantly, this is true regardless of whether governments' policy goals are motivated by the desire to maximise economic output, the wish to protect particular groups of workers and firms, or the pursuit of other social objectives (see Bagwell and Staiger, 1999, 2001).

To reap the gains from international

coordination, trade agreements require governments to give up unilateral control over some policies. For example, members of the World Trade Organisation (WTO) give up the right to use import quotas and production subsidies, and they agree limits on the tariffs that each country can charge on imports from other members.

The fact that trade agreements place limits on countries' policy options shapes how trade negotiations are conducted. Trade negotiations are not about countries identifying a common objective and working together to achieve it. They are not a cooperative endeavour.

Instead, trade negotiations are a bargain between countries with competing objectives. Each country must give up something it values in order to obtain concessions from other countries. This realisation suggests four principles that the UK should adopt to guide its trade negotiation strategy.

1: You get what you give

To reap the benefits of trade agreements, the UK must be willing to give its trading partners something they value. In general, the more countries are willing to concede and the more policy control they give up, the bigger are the potential gains from reaching an agreement.

An important question that the UK faces is what it is willing to give up in return for the EU allowing UK services firms to participate in the Single Market. Unless the UK makes a sufficiently attractive offer, the EU will take the opportunity that Brexit presents to impose new barriers on UK services exports.

The fact that free trade agreements are based on mutual concessions also makes unilateral tariff liberalisation a less attractive policy because it would mean the UK giving away a potentially important bargaining chip.

2: Where negotiations start from matters

The outcome of any bargaining game depends on where negotiations start from. Trade agreements are no exception. The policies each country will adopt if no agreement is reached provide a reference point – or 'threat

Triggering Article 50 by March 2017 would be a mistake and should be avoided

point' – for the negotiations. Countries make concessions starting from this reference point.

It is unclear whether the reference point for UK-EU negotiations would be trade under WTO rules or the status quo in which the UK is a member of the Single Market. Starting from the status quo, the UK would have to negotiate the right to impose restrictions on immigration from the EU. Starting from WTO rules, the UK would not need to negotiate immigration restrictions, but would need to negotiate access to the Single Market.

Before any trade negotiations between the UK and the EU take place, there will have to be an agreement on what the reference point is. The UK government should seek a reference point that helps it to achieve its post-Brexit objectives.

3: Bargain from a position of power

Bargaining power affects the outcome of trade negotiations. Countries that have little bargaining power are less likely to achieve their objectives. Unfortunately, the UK is starting from a weaker position than the EU. Because UK-EU trade accounts for a much larger share of the UK's economy than the EU's economy, the UK needs a deal more than the EU does.

The weakness of the UK's position is exacerbated by the two-year time limit on exit negotiations under Article 50. As the two-year limit approaches,

the UK will become increasingly desperate to obtain an agreement.

There are two steps that the UK should take to improve its bargaining position. First, delay triggering Article 50 until the government has decided its post-Brexit objectives and EU leaders are ready to start negotiations. Theresa May's commitment to invoke Article 50 in early 2017, before the French and German elections, weakens the UK's position because the EU will not be able to participate in meaningful negotiations until after these elections.

Second, the UK's immediate objective after invoking Article 50 should be to neutralise the two-year time limit by agreeing a transition arrangement to govern UK-EU trade relations during the period between when the UK leaves the EU and when a longer-term agreement is concluded. Returning to the principle that you only get what you give, the UK needs to decide what it is willing to offer the EU in return for a transition agreement.



4: Invest in negotiating capacity

Trade agreements involve many simultaneous policy changes, which makes it difficult to analyse their economic consequences. Smart negotiators use this uncertainty to their advantage by ensuring that they are better informed than their counterparts on the other side about who stands to gain and who stands to lose from any policy proposal.

Having not participated in trade negotiations for the past 40 years, the UK currently has very little negotiating capacity. To become a smart negotiator, the UK needs to invest heavily in four areas of expertise: trade lawyers to conduct negotiations; diplomats to provide information on the objectives and strategies of its negotiating partners; business intelligence to understand how firms will be affected by different policies; and trade economists to quantify the welfare effects of proposed trade agreements.

The UK has a weak hand because it needs a deal more than the EU

Conclusion

Since the UK joined the EU in 1973, trade policy has played a minor role in UK politics. Now it's back. Much has and will continue to be written about what the objectives of post-Brexit UK trade policy should be. But whether the UK is able to achieve the objectives it eventually chooses will depend on the success of its negotiating strategy.

The government has a responsibility to ensure it obtains the best possible outcome for the people of the UK. By adopting these four principles, it can have a better chance of making the best out of a bad hand.

This article summarises 'Four Principles for the UK's Brexit Trade Negotiations', CEP Brexit Analysis No. 9 by Thomas Sampson (<http://cep.lse.ac.uk/pubs/download/brexit09.pdf>).

Thomas Sampson is assistant professor of economics at LSE and a research associate in CEP's trade programme.

Further reading

Kyle Bagwell and Robert Staiger (1999) 'An Economic Theory of GATT', *American Economic Review* 89(1): 215-48.

Kyle Bagwell and Robert Staiger (2001) 'Domestic Policies, National Sovereignty and International Economic Institutions', *Quarterly Journal of Economics* 116(2): 519-62.

Swati Dhingra and Thomas Sampson (2016) 'UK-EU Relations After Brexit: What is Best for the UK Economy?', in *Brexit Beckons: Thinking Ahead by Leading Economists* edited by Richard Baldwin, VoxEU.

Swati Dhingra, Gianmarco Ottaviano, Thomas Sampson and John Van Reenen (2016a) 'The Consequences of Brexit for UK Trade and Living Standards', CEP Brexit Analysis No. 2, March (<http://cep.lse.ac.uk/pubs/download/brexit02.pdf>).

Swati Dhingra, Gianmarco Ottaviano, Thomas Sampson and John Van Reenen (2016b) 'The Impact of Brexit on Foreign Investment in the UK', CEP Brexit Analysis No. 3, April (<http://cep.lse.ac.uk/pubs/download/brexit03.pdf>).

Gene Grossman (2016) 'The Purpose of Trade Agreements', National Bureau of Economic Research Working Paper No. 22070.



Since a majority of secondary schools in England are now academies, any further 'academisation' will be concentrated in the primary sector. So the time is ripe for this first comprehensive evaluation of primary academies' effectiveness at raising pupils' achievement, provided by **Andrew Eyles**, **Stephen Machin** and **Sandra McNally**.

Primary academies in England



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Academy schools were first introduced in the early 2000s, largely as a remedial improvement programme for badly performing secondary schools in England. The idea was that private sector ‘sponsors’ would take control of struggling state schools and be given the freedom to innovate. While other state schools are managed by local educational authorities to differing extents, academies enjoy significant autonomy.

Although they are state-funded, academies receive their funding directly from central government with no restrictions on how they spend the money. Furthermore, the sponsor or trust that appoints the governing body and is the *de facto* owner of the school may contribute substantial capital costs in excess of this. With regard to staffing decisions, academies are not required to follow national pay scales and while they are required to use performance management, they are exempt from the regulations governing performance management in state-funded schools.

The initial programme was relatively small-scale; 244 secondary schools had gained academy status before the change of government following the May 2010 general election. CEP research suggests that these early sponsored academies had

a positive impact on both short- and medium-term pupil outcomes (Eyles and Machin, 2015; Eyles et al, 2016a; 2016b).

The election of the coalition government in 2010 and the Academies Act 2010 heralded the start of an ambitious and all-encompassing expansion of the academies programme. Not only were ‘outstanding’ schools given the chance to convert without the requirement of signing up a sponsor, but primary schools were also encouraged to gain academy status. The expanded scope of the programme has led the number of academies in England to skyrocket: 60% of secondary schools and 15% of primary schools now have academy status.

We cannot extrapolate findings from previous research on the original academies programme because the post-2010 expansion was much larger in scale and it made conversion of

outstanding schools the priority (rather than schools in disadvantaged areas). We document the very different profile of post-2010 academies in Eyles et al (2015). Furthermore, no primary schools became academies prior to 2010.

Our latest research focuses on primary schools that did not have a sponsor and which went down the converter route (that is, the majority). Like their secondary school counterparts, these schools tend to be high achieving prior to conversion. In fact, over half of the 270 schools we study were graded outstanding or good in inspections by Ofsted (the Office for Standards in Education) before converting.

The non-random selection of the schools into academy status poses problems when trying to make causal claims about the impact of attending a primary academy. We get around this in two ways.

First, we compare outcomes for those attending primary academies that converted in the 2010/11 and 2011/12 school years with those attending schools that converted in the 2014/15 and 2015/16 school years. The latter schools look very similar in terms of pre-conversion characteristics, which means that their pupils should provide a credible control group for those who actually do attend academies in the sample period.

Attendance at a primary academy leads to no discernible improvement in pupils’ test scores



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Second, because pupils choosing to attend academies may be different from those who choose not to, we limit our study to pupils who enrolled in schools before they became academies, but by virtue of their age at the time of enrolment, spent a significant part of their primary education in a converter academy.

Looking at scores in English and mathematics at key stage 2, we find that schools that converted in 2010/11 and 2011/12 display similar trends in test scores prior to conversion as schools that converted in 2014/15 and 2015/16. But there is no change in these relative trends once the schools gain academy status. These results suggest that attendance at a primary academy led to no discernible improvement, or decline, in test scores (see Figure 1).

A potential explanation for our findings is that nothing actually happens once schools gain academy status. But this explanation is not borne out by the data. In a recent survey by the Department for Education (Cirin, 2014), primary schools stated that they made use of their newly granted freedoms once they converted.

In particular, more than half of the surveyed schools said that they changed their patterns of capital expenditure and introduced savings in back-office functions after conversion. Similarly, just under half chose to diverge from the national curriculum and altered the performance management system of their teachers.

In addition to the survey, schools gain extra income on conversion to spend on services previously provided by the local educational authority. But little of the money appears to be spent on traditional inputs into education production, such as teachers and learning resources.

Our results cast doubt both on the suitability of academisation for primary schools and on whether further expansion of the academies programme will be beneficial to education in England. Given that the majority of secondary schools now have academy status, further expansion is a more pertinent issue in the primary sector. The process of restructuring schools in England in this way seems overly costly if there are no gains for pupils.

Primary academies have been less effective than the disadvantaged secondary schools that thrived in the first wave of academies

Andrew Eyles is a research assistant in CEP's education and skills programme.

Stephen Machin is director of CEP.

Sandra McNally is professor of economics at the University of Surrey and director of CEP's education and skills programme.

Further reading

Rob Cirin (2014) 'Do Academies Make Use of Their Autonomy?', Department for Education research report.

Andrew Eyles, Claudia Hupkau and Stephen Machin (2016a) 'Academies, Charters and Free Schools: Do New School Types Deliver Better Outcomes?', *Economic Policy* 31(87): 453-501.

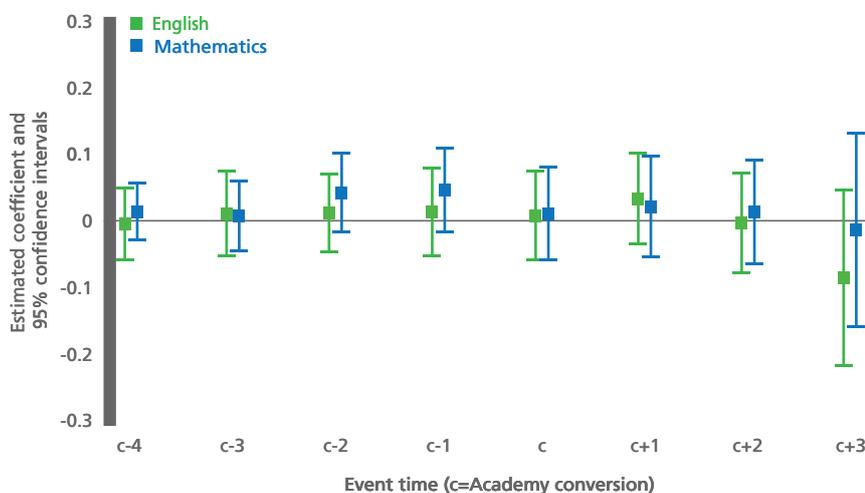
Andrew Eyles, Claudia Hupkau and Stephen Machin (2016b) 'School Reforms and Pupil Performance', *Labour Economics* 41: 9-19.

Andrew Eyles and Stephen Machin (2015) 'The Introduction of Academy Schools to England's Education', CEP Discussion Paper No. 1368 (<http://cep.lse.ac.uk/pubs/download/dp1368.pdf>).

Andrew Eyles, Stephen Machin and Sandra McNally (2016) 'Unexpected School Reform: Academisation of Primary Schools in England', CEP Discussion Paper No. 1445 (<http://cep.lse.ac.uk/pubs/download/dp1445.pdf>).

Andrew Eyles, Stephen Machin and Olmo Silva (2015) 'Academies 2: The New Batch', CEP Discussion Paper No. 1370 (<http://cep.lse.ac.uk/pubs/download/dp1370.pdf>).

Figure 1:
Key stage 2 test scores before and after academy conversion



Source: Eyles et al (2016).

Despite tensions stoked by the position of Gibraltar, the UK and Spain have long enjoyed a close and mutually beneficial relationship. According to **Luis Garicano**, Brexit puts much of this at risk: with Spain unlikely to budge on freedom of movement and Gibraltar as a negotiating card, the UK is likely to find itself with a very bad deal.

Spain's response to Brexit

Brexit was a bombshell in Spain, its impact surpassing that of the country's general election, which was held three days after the UK referendum on membership of the European Union (EU). Spaniards were stunned and worried about both the political and economic implications. Indeed, according to a Bertelsmann study of public opinion in large European countries (De Vries and Hoffman, 2016), Spain was the country most opposed to the idea of Brexit: nearly two thirds of Spaniards said they were against it.

Unlike in some other EU countries, concerns in Spain do not extend to a potential contagion into national politics. Among the mainstream political parties, only Podemos has flirted with 'Euro-scepticism': it once advocated leaving the euro, as the Communist Party, one of its allies, still does.

In fact, Spaniards have historically been among the strongest supporters of the European integration project (as well as being among its main beneficiaries). As of 2016, three quarters of Spaniards would

vote 'Remain' if a similar referendum were held in Spain (De Vries and Hoffman, 2016). But Spain is worried about the future, and there is general concern about what Brexit may mean for Spain and for Europe. There are several reasons for this.

First, the relationship between Spain and the UK is a picture perfect illustration of the economic and political benefits that the EU, and the Single Market, can bring about: large flows of people in both directions, as retired Britons seek out Spain's quality of life and Spanish youth seek jobs and education in the UK; a peaceful and workable non-solution to the Gibraltar question, one of the most intractable territorial disputes left in Europe; large flows of goods and services trade in both directions; and very large foreign direct investment (FDI) by companies from each country to the other.

Untangling this web, as a 'hard Brexit' would require, would be very costly to companies and workers all over Spain (and, of course, in the UK). This economic cost is a particular concern given that Spain is just

The UK-Spain relationship is a picture perfect illustration of the economic and political benefits of the EU and the Single Market

coming out of a brutal economic crisis and levels of unemployment are over 20%.

More broadly, Spain wants a strong Europe. All political parties in the Spanish parliament are in favour of strengthening the Union, including deepening the Eurozone towards a fiscal union, common border and security policy, immigration policy and so on. Spaniards worry that Brexit may begin the unravelling of a European project that has been a crucial pillar of Spain's return to democracy and prosperity.

Finally, Spaniards' worry also has a more local angle, as the referendum has potential – albeit unclear – implications for the regional dispute in Catalonia. A growing minority of Catalans have been agitating for independence. The way Europe deals with a potentially independent

Scotland's likely accession request in the aftermath of Brexit is being closely followed in Spain, even though all parties acknowledge the crucial differences between the constitutional and legal status of Scotland and Catalonia.

In spite of these worries, some in Spain see opportunities in Brexit. Most notably, the Spanish government sees Gibraltar as a UK colony on Spanish soil. There is unconcealed glee in the Spanish conservative government about the broad support that remaining in the EU has commanded in Gibraltar. Many in government see a unique opportunity to solve an issue that has enormous symbolic value for many Spaniards. Spain will also fight to attract the financial services industry and manufacturing jobs that may abandon the UK post-Brexit.

A highly integrated market: the four freedoms in action

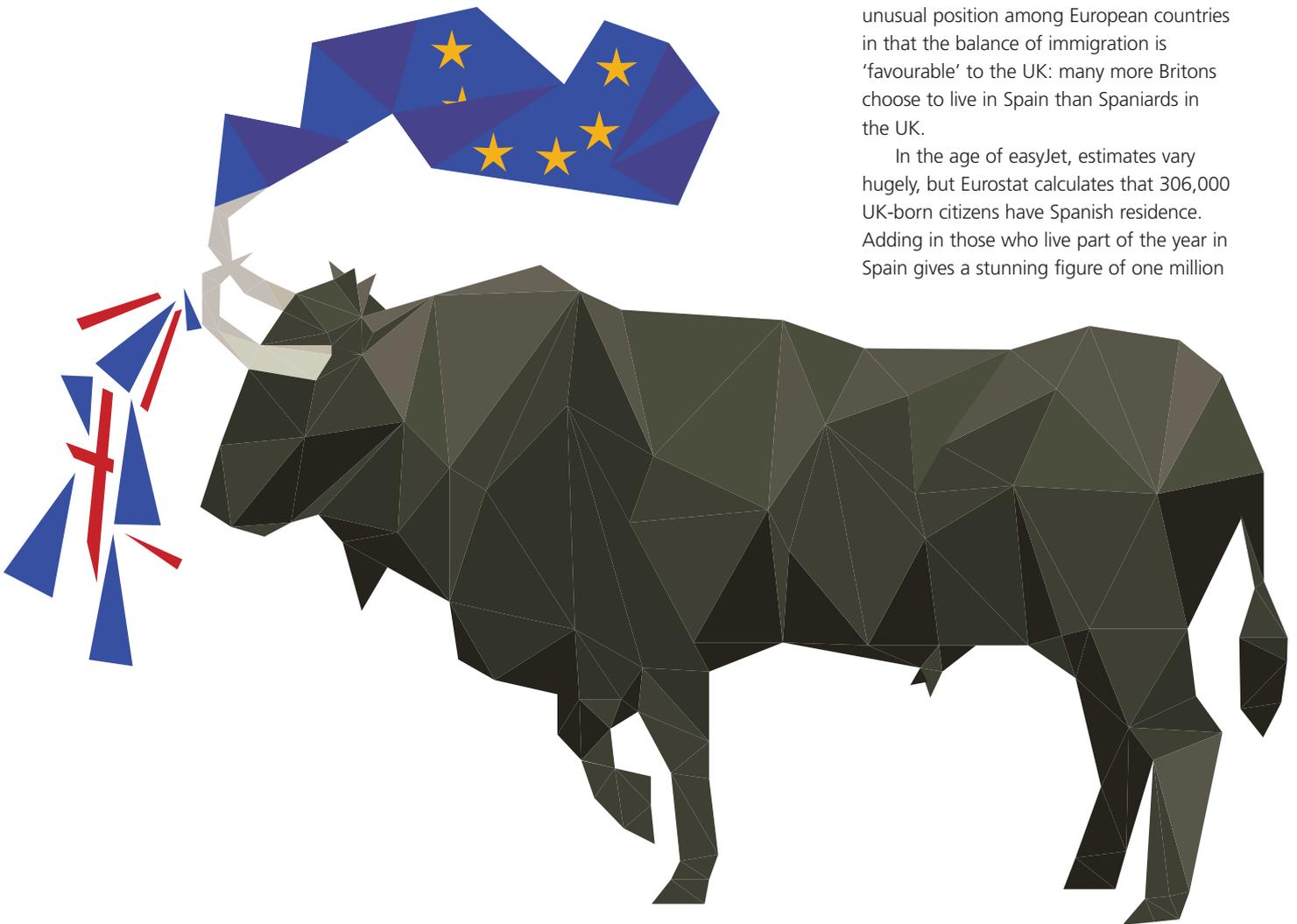
Spain is one of the clear success stories of the European integration project. The Spain-UK relationship in particular features a highly integrated market, with benefits from trade widely spread among the entire population. Spanish and UK citizens have taken advantage of the four freedoms that are basic to the Single Market: free movement of goods, services, people and capital.

Free movement of people has resulted in huge bilateral migration flows

Migration will be the crux of the negotiations, as it was a key driver of the Brexit vote and limiting freedom of movement within the EU is likely to be the one UK request that is most difficult for the EU to accept.

Yet the picture of bilateral flows between Spain and the UK could not be further from that painted by pro-Brexit politicians Nigel Farage, Michael Gove and Boris Johnson. In fact, Spain has quite an unusual position among European countries in that the balance of immigration is 'favourable' to the UK: many more Britons choose to live in Spain than Spaniards in the UK.

In the age of easyJet, estimates vary hugely, but Eurostat calculates that 306,000 UK-born citizens have Spanish residence. Adding in those who live part of the year in Spain gives a stunning figure of one million



full- and part-time residents, according to a study by the Institute for Public Policy Research (Finch, 2010).

On the other side, 79,814 Spanish-born residents were recorded in England and Wales in the last census in 2011. Official estimates by the Spanish Statistical Institute suggest that 102,498 Spaniards live throughout the UK, although again the true number is likely to be much larger.

The potential issues at stake that must be sorted out in negotiations for all of these citizens are many. From access to healthcare to housing and work permits to visa-free travel, Brexit may change it all. According to multiple press reports, it appears to be a source of anxiety and even anguish, particularly for less mobile UK pensioners resident in Spain.

There is a large downside for both Spain and the UK from any disruption to trade and investment flows between the two countries

The freedom to trade goods and services has resulted in large bilateral flows and a substantial trade surplus for Spain

The most recent data (released by the UK's Office for National Statistics in March 2016) show that Spain exported goods and services to the UK worth a total of £24 billion in 2014 and imported £14.8 billion worth. Thus, Spain had a bilateral trade surplus of £9.2 billion, well over 1% of Spanish GDP (depending on the volatile exchange rate). After Germany (which had a £25 billion surplus), this is in absolute terms the largest positive imbalance with the UK of any country in the EU, and the fourth largest worldwide after Germany, China and Norway.

This overall surplus is composed of a surplus in the trade of both goods and services. The UK is the fourth largest market for Spain's goods and services, accounting for 7% of the total. In goods trade, the UK is particularly important for exports of transport equipment (20%), machine tools, chemicals, metals, mining and vegetables.

The large services surplus is due mostly to tourism. The UK is the main buyer of Spain's tourism, with 15.8 million British tourists visiting Spain in 2015 and the UK accounting for more than a fifth of total tourism income (Greenwood, 2016).

Thus, it is difficult to overstate the risk that a hard Brexit would pose, through trade, for Spain's economy. No country is more vulnerable than Spain to the trade disruption, given the trade surplus (in GDP terms); and no country has a larger interest in the 'softest' of Brexits. There is a large downside for both countries from any disruption to all of these flows – and no conceivable upside – from the negotiations. All that remains to ask is how bad the damage will be.

Freedom of capital movement has resulted in enormous FDI flows

According to a recent report (Greenwood, 2016), the UK is the main destination for Spain's FDI, accounting for 14% of the total outflow. This outflow has been directed particularly towards finance, telecommunications and electricity.

Spain has the largest investment in the UK's financial services of all EU countries. It is second worldwide after the United States through two of the largest Spanish banks (Santander and Sabadell). Almost one out of every five pounds of foreign investment in the UK's banking sector is represented by these two Spanish banks (17%, according to Greenwood, 2016). Both banks have huge exposure to the UK through their affiliates, which accounted for around a quarter of the banks' assets and profits in the first quarter of 2015.

The flow in the opposite direction is also large. The UK is the fifth largest investor in Spain, focusing on telecoms and tobacco (Greenwood, 2016).

In sum, the relationship is a clear success for the UK-led project of a Single Market, and one that will be expensive for both parties to unravel. For the UK, the highest human and economic cost will be from unravelling freedom of movement (with significant potential losses to large contingents of British residents in Spain). For Spain, the main potential vulnerabilities are in trade and FDI flows.

For both, there is the possibility of enormous vulnerabilities deriving from potential financial and macroeconomic turbulence as the new steady state is reached. This has the potential to be a really nasty transition.

For the UK, the highest human and economic cost will be from unravelling freedom of movement

Spain's priorities

Spain has three priorities, which are not necessarily compatible.

1: **The politics: preserving the Union**

As one of the most pro-European countries, Spain is committed to preserving and deepening the Union. This indicates that Spain will support the European Parliament's involvement and the European Commission's leadership in the negotiations. It will avoid obvious bilateral discussions (quiet discussions, one imagines, must always be taking place), and push for an arrangement that falls neatly into existing categories – that is, the European Economic Area (EEA) or Switzerland – or if not, Canada.

Political considerations make it likely that Spain will militate strongly against intermediate soft solutions, such as that proposed by Pisani-Ferry et al (2016).

2: **The economics: preserving the tangled web of the four freedoms**

The economics point in quite a different direction. The relationship between Spain and the UK is a very tangled web indeed with large benefits for both parties, and, in trade of goods and services, particularly for Spain. To disentangle it would involve massive costs. A hard Brexit is emphatically not in the interests of either the UK or Spain.

The economics (unlike the politics) suggest that Spain would be likely to militate against any disruptive Brexit and look for middle-of-the-road solutions. But this pragmatism is unlikely to extend to all UK aspirations. In particular, Spain has a very recent memory of large outward migration flows (throughout the period of the dictatorship) that have recently been revived again with the crisis, and so it will be extremely difficult for the government to accept limitations on freedom of movement.

3: **Gibraltar: a potential make-or-break issue**

Gibraltar, a small peninsula with large strategic value, was lost by the Spanish after its capture in 1704, during the War of Spanish Succession, by an Anglo-Dutch fleet; it was ceded to Britain by the Treaty of Utrecht in 1713. After multiple wars and sieges, it has become a highly successful enclave within the EU with a high degree of self-government. The status of Gibraltar, officially a colony, is nevertheless contentious, as is the status of its airport, which was built on land that the Treaty of Utrecht set as neutral territory.

Management of this dispute has been greatly facilitated in the context of the EU. The border between Spain and Gibraltar was only reopened in 1985 – and since then, trade and people have flowed freely between the two territories. Gibraltar has become the second richest territory in the Union.

The previous Spanish minister of foreign affairs, José García-Maragallo, has stated clearly – and his position has been echoed by the Spanish permanent representative to the United Nations at a recent meeting on decolonisation – that after Brexit, a new understanding must be found, and that it must involve co-sovereignty of the UK and Spain over Gibraltar. In his words, 'they will have to choose between British outside the Union or Hispano-British inside the EU'. Only co-sovereignty will allow Gibraltar to have the treaties apply to it.

In the solution that the Spanish government is advocating, Gibraltar citizens would preserve access to the Single Market, obtain both nationalities and conserve a large degree of autonomy. Spain and the UK would be jointly in charge of defence, foreign affairs, border control and immigration. Crucially, the Spanish flag would fly on Gibraltar. (For a good description of the positions of Spain and Gibraltar on these issues, see Machado, 2016).

How much of an obstacle this issue – tiny in terms of welfare for the two countries, but with huge symbolic value – may pose in the negotiations remains to be seen, but it is sure to have considerable weight.

Spain is likely to demand that Single Market access continues to require commitment to the four freedoms

Gibraltar highlights the likely result of Brexit negotiations: the UK's 'death by a thousand cuts'



What can we expect Spain's negotiating position to be?

From the perspective of its commercial, investment and migratory interests, Spain could be willing to accept a soft Brexit – that is, a modified EEA with some governance mechanism for the participation of the UK in joint decision-making.

But Spain has been adopting a low profile in the international arena for many years now. The country's 'Europeanism' suggests that it is highly unlikely to deviate from the position taken by France and Germany. Thus, once Article 50 is invoked, it will demand that the Commission leads and the Parliament has a say in the negotiations. Spain is likely to be a disciplined soldier on the European side, and demand that access to the Single Market continues to require a commitment to all four freedoms, most notably to freedom of movement of people within the Union.

A potential stumbling block is Gibraltar. Everything we have heard from the Spanish government up till now suggests that it is

unlikely that any deal in which Gibraltar retains access in any form to the EU will be reached that does not involve joint (Spanish and British) sovereignty over the peninsula.

The Gibraltar issue highlights the likely result of the negotiation between the EU27 and the UK: the latter's 'death by a thousand cuts'. Every country involved in the bargaining has veto power and every one of them is likely to have a shopping list – some issue that is important enough to block progress. For the Poles, it may be freedom of movement; for the Irish, it may have to do with Northern Ireland. The ability of the UK government to resist these demands, with the clock ticking, simply does not seem to be there.

As a result, the UK is likely to find itself, at the end of these two years, with a very bad deal. By the time that each of 27 countries has finished putting together their own version of 'Yes, but what about Gibraltar?' objections, the pro-Brexit politicians will either have to start explaining to voters the distance between the fantasy they invented and the reality – or be prepared to back off from Brexit.

Luis Garicano is professor of economics and strategy at LSE and a research associate in CEP's growth programme.

This analysis was first published in the VoxEU ebook *What to do with the UK: EU Perspectives on Brexit* edited by Charles Wyplosz (<http://voxeu.org/content/what-do-uk-eu-perspectives-brexit>).

While Professor Garicano is in charge of economic, industrial and innovation policy for the Ciudadanos Party in Spain, the analysis presented here is undertaken in a personal capacity as an academic observer and LSE professor. He says: 'None of what is written here should be taken to be the position of the party or a recommendation of what it should do; it most emphatically is not.'

In the interest of full disclosure, Professor Garicano adds: 'I am a Spanish citizen, my kids live in Holland and my job is in London. Thus, my life will be directly affected by the negotiations that are the subject of this analysis, as will the lives of many other UK and European residents.'

Further reading

Catherine De Vries and Isabell Hoffman (2016) 'Keep Calm and Carry on: What Europeans Think about a Possible Brexit', *EUpinions*, BertelsmannStiftung.

Tim Finch (2010) *Global Brit: Making the Most of the British Diaspora*, Institute for Public Policy Research.

Nick Greenwood (2016) 'Referéndum de Reino Unido sobre la permanencia en la UE: consecuencias para las economías británica, de la UE y española', *Cuadernos de Información Económica*, Confederación Española de Cajas de Ahorro.

Andrés Machado (2016) 'Picardo repica a Maragallo: Ni en cuatro años ni en 4000 ondeara la bandera Española en Gibraltar', *El Mundo*, 6 October.

Jean Pisani-Ferry, Norbert Röttgen, André Sapir, Paul Tucker and Guntram Wolff (2016) *Europe after Brexit: A Proposal for Continental Partnership*, Bruegel.

in brief...

Social mobility in the United States

There is considerable geographical variation in the opportunities available to disadvantaged children in the United States, according to research by **Raj Chetty**, who delivered the 2016 Lionel Robbins Memorial Lectures at LSE. **Maria Molina-Domene** talked to him about his findings, the use of big data and the implications for policy.

Raj Chetty was in London recently to deliver three lectures on the theme of social mobility in the United States. While he was at CEP, I talked to him about the use of big data in economic research, notably in the Equality of Opportunity Project that he leads. His findings on the differences in opportunity across local areas in the United States and the causal impact of neighbourhoods were the core of his lectures.

Raj began his first lecture with a striking comparison of how far the United States is from achieving ‘the American Dream’ in terms of social mobility. He highlighted the fact that the probability of a child born to parents in the bottom fifth of the income distribution reaching the top fifth is 7.5% in the United States. This compares with the figure of 9% for the UK revealed in CEP research by Jo Blanden and Stephen Machin.

But the US figure of 7.5% at the national level is not constant across local areas. Using tax records and fine-grained geographical data, Raj’s research shows that place has a significant causal impact on upward mobility for a given person. For example, the chances of reaching the

top fifth from the bottom fifth is only 4.4% for children born in Charlotte, North Carolina, compared with 11% for children born in Washington DC. Furthermore, children’s exposure to better or worse neighbourhoods has significant effects on their outcomes.

To identify the causal impact of the environment in specific places, Raj’s work uses a quasi-experimental design to exploit variation in children’s ages when their families move. Under the assumption that the timing of family moves is uncorrelated with children’s potential outcomes, 70-80% of the variation in children’s outcomes across areas is due to place effects. Remarkably, moving to a place with high rates of upward mobility improves a child’s chances of success linearly in proportion to the time they spend growing up in that area.

This evidence triggers a natural question: what is it about

There is substantial variation in intergenerational mobility across areas within the United States



Children of inventors and those raised in areas with more inventors are more likely to be inventors themselves

an area that influences the degree of upward mobility? Raj drew our attention to the main features of the areas he has studied. His strategy was to correlate the characteristics of low versus high mobility areas (segregation, income inequality, school quality, family structure and social capital) and upward social mobility.

In his second lecture, Raj focused on the correlation between social mobility and two key factors: segregation and housing policy; and education. From these key features, he drew out the implications for policy on how to improve social mobility in areas where it is low. He reflected on the policy design and effectiveness of different affordable housing policies to promote integration.

Recalling the Moving to Opportunity experiment, which was implemented in 1994-98 covering 4,600 families at five US locations. Raj noted that some scholars find little impact on adults of moving to a better area on outcomes such as earnings, but it can improve outcomes for children who move when young. He showed that housing vouchers can be very effective if carefully targeted. In particular, he underlined two key criteria: vouchers should go to families with young children; and they should explicitly encourage families to move to affordable areas with good opportunities for the young.

Promoting integration through housing vouchers can have some limitations: for example, families might stay in neighbourhoods that ultimately harm their children because of a lack of information about that threat or because poverty leaves them focused only on immediate needs. But Raj suggested that place-based approaches can also be beneficial for increasing residential housing integration. He gave a couple of examples of place-based policies centred on improved urban planning and investing in local schools.

On education, Raj emphasised the need to understand which educational inputs matter most for children's long-term success. Approaches to improving children's outcomes include smaller classes, better teachers and more spending, and he focused on teacher value-added. Showing results from a quasi-experiment, he stressed that improving the quality of elementary education can be a key policy tool to increase upward mobility.

His third and final lecture posed a fundamental question about the desirability of social mobility in relation to justice, equity and efficiency. Raj argued that increasing equality could actually increase efficiency, which, in turn, can generate increases in aggregate growth. He then discussed the role of innovation as a key driver of sustainable growth, and how the rate of innovation could be increased by reducing inequality.

In a study entitled 'The Lifecycle of Inventors', Raj and his co-authors (which include former CEP director John Van

Reenen) provide a concrete example of how parental income correlates with children growing up to be inventors. This correlation seems not to be driven by the children of high-income families having higher innate ability, but rather by the constraints of a poorer environment faced by lower-income children.

Related to the findings of different opportunities offered by different localities is the unexpected one that difference in exposure to innovation during childhood helps to explain the innovation gap between children of parents in the top 1% of the income distribution and those in the bottom 50%. Parents are a key source of exposure to innovation and Raj presented striking results: children of parents who are not inventors register patents in later life at around a tenth of the rate of children whose parents are inventors. But parents are not the only source: Raj has looked at broader sources of exposure to innovation, and finds that children raised in areas with more inventors are more likely to be inventors themselves.

This last lesson emerged as a specific example of how increasing equality of opportunity can increase efficiency and growth, and informs Raj's call for policies to increase innovation. One desirable policy may be to increase top income tax rates to finance programmes that draw more low-income children into innovation. Raj concluded his lecture series pointing to the need to tackle social mobility at the local level and to seek to improve children's environments at all ages.

Raj and I also talked more generally about the opportunities for economic research that big data offer. We discussed how harnessing large volumes of unstructured big data helps to evaluate substantive policy questions. Big data emerges as an important tool for evaluating policies scientifically and measuring local performance more systematically.

The Lionel Robbins Memorial Lectures by **Raj Chetty**, professor of economics at Stanford University, were delivered in October 2017. Videos of the lectures are available here: http://cep.lse.ac.uk/_new/events/event.asp?id=291

Research reports from the Equality of Opportunity Project are available here: <http://www.equality-of-opportunity.org/>

Maria Molina-Domene is a research officer in CEP's labour markets programme and leads on the Centre's work with big data.

Does greater exposure to science at secondary school encourage more young people to study for degrees in STEM subjects?

Marta De Philippis assesses the impact on university enrolment and graduation of an educational reform in England in 2004 that entitled higher ability school students to take the so-called 'triple science' course.

Studying science: the impact of school curriculum on degree choice

Are school students in the UK making GCSE choices that hold them back for the rest of their lives, as some policy-makers claim? Do students in secondary schools focus too much on arts and humanities and not enough on sciences and mathematics? Does this prevent them from enrolling in more technical degrees with greater earnings potential after university?

Subject choice at university is extremely important in determining lifetime earnings. For example, in the United States in 2009, the wage gap between the average electrical engineer and someone with a degree in education was almost identical to the wage gap between the average college graduate and the average secondary school graduate (Altonji et al, 2012). What's more,

studying engineering may be an even better investment than going to Harvard (James et al, 1989).

Policy-makers around the world are investing a very large amount of funds to encourage more graduates in science, technology, engineering and mathematics (STEM) subjects. But they continue to claim that the current supply of STEM skills is insufficient and presents a potentially significant constraint on future economic activity.

The policy debate mentions many possible factors to explain the lack of STEM graduates – for example, students' preferences, expected earnings, skills or self-confidence. Economic research suggests that students actually tend to have realistic beliefs about the returns to STEM subjects and that they do not react much to changes in expected earnings

(Befy et al, 2012). Moreover, students tend to enter university being over-confident – not under-confident – about their ability in science (Stinebrickner and Stinebrickner, 2014).

Other research finds that there is a large unexplained heterogeneity in secondary schools' effectiveness in developing talents in technical subjects like mathematics (Ellison and Swanson, 2012). This leaves considerable scope for policies that can improve the quality of secondary school education, one obvious candidate being to change the curriculum offered.

My research explores whether more exposure to science in secondary school encourages students to enrol and graduate in STEM degrees at university. Tweaking the subjects offered may be an effective way to intervene. While preferences and innate ability may be difficult to shape, it is easy to intervene in the design of the secondary school curriculum. And in contrast with other policies, such as trying to make changes in the composition of young people's peer groups, this is not a zero-sum game: everybody may potentially benefit from a well-designed curriculum.

I analyse the effect on university outcomes of introducing an advanced science course in secondary schools in England: the so-called 'triple science' course, which requires students to take one full GCSE exam in each of biology, chemistry and physics rather than only two exams. In particular, I consider the effect on the degree course chosen and the probability of graduating in this course.

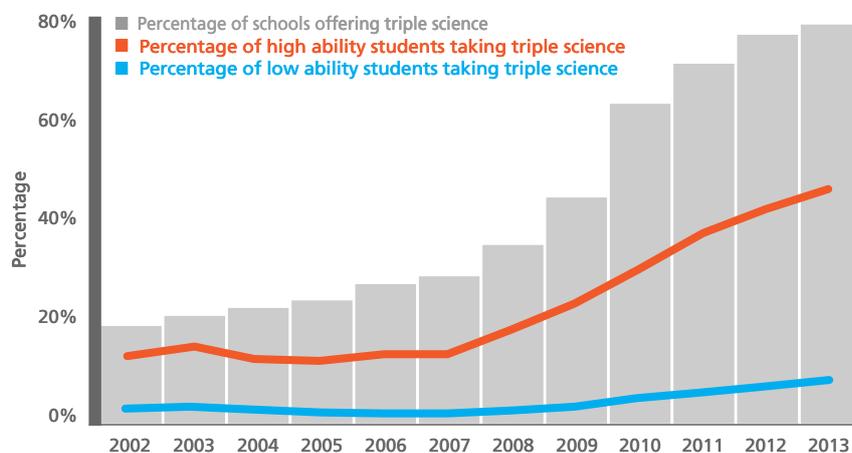


In 2004, the UK government introduced an entitlement to study triple science for higher ability students at age 14, with the explicit aim of fostering enrolment in post-secondary science education. This resulted in a strong increase in the number of schools offering triple science: from 20% in 2002 to 80% in 2011.

As a consequence, the share of students taking triple science increased from 4% in 2002 to 20% in 2011, an increase that was almost entirely concentrated among higher ability students (see Figure 1). Among students who were in the top 30 percentiles of the primary school grades distribution, the increase was around 35 percentage points: from 15% to about 50%.

But a simple comparison of university outcomes of students taking and not taking triple science would be misleading.

Figure 1:
Share of schools in England offering 'triple science' and take-up by high and low ability students



Source: National Pupil Database; high ability students are those in the top 40% for average English, mathematics and science primary school grades, low ability students are those in the bottom 60%.



Those taking triple science may already be different along many dimensions and it would be inaccurate to attribute all differences in university performance to the triple science course.

I therefore focus on 14 year olds whose school did not offer the triple science course when they had enrolled at that school at age 11. I compare those in schools that subsequently (because of differences in timing of the policy adoption) introduced the triple science course and those in schools that did not.

In this way, I compare two groups of students, *a priori* identical because they all applied to the same type of schools – those not offering triple science – but *ex post* different because some were unexpectedly exposed to the option of taking the triple science course.

I find that taking triple science at age 14 increases the probability of choosing science as a subject for testing at age 16 by five percentage points. It also increases the probability of enrolling in a STEM degree at university (narrowly defined to include the pure natural sciences, technology, engineering and mathematics) by about two percentage points. This is a very sizeable effect, given that the share of STEM students is 13% of those going to university in England.

I also find that taking more science courses at secondary school not only encourages more students to enrol in STEM degrees, but it also increases the likelihood that they will graduate in these degrees. I estimate that the 2004 policy contributed almost one third of the increase in the share of STEM graduates in England between 2005 and 2010.

The effect on STEM degrees (in its narrow definition) is entirely concentrated among boys. One might think that

stronger secondary school science preparation should affect girls more than boys, girls typically being less confident about their ability and more risk-averse. But the gender gap in STEM subjects widens because of this policy.

The difference between (very highly skilled) boys and girls does not arise in the take-up of the triple science course at age 14, since boys and girls at this stage select into triple science in the same proportion. The difference arises later on, at university, when subject choice is more related to occupations and jobs.

At university, both boys and girls are encouraged by the triple science course to take more challenging courses on average. But girls still choose more female-dominated subjects, such as subjects allied to medicine, instead of pure STEM degrees like engineering, physics and mathematics. This suggests that job characteristics play a very important role in the choice of subjects at university, with women and men displaying very different preferences, even at the very top of the ability distribution.

My results have important policy implications. First, governments should pay careful attention to the structure of their secondary school curriculum: working on an optimally designed curriculum may help to address apparent mismatches and market frictions in the supply and demand for skills.

Second, when it comes to choice of university subjects, there are other elements much more related to actual future jobs and occupations, such as preferences for job attributes, which are very relevant. Modifying preparation in science or mathematics at school may not be enough to shrink gaps related to more structural and cultural factors.

This article summarises ‘STEM Graduates and Secondary School Curriculum: Does More Exposure to Science Matter?’ by Marta De Philippis, CEP Discussion Paper No. 1443 (<http://cep.lse.ac.uk/pubs/download/dp1443.pdf>).

Marta De Philippis is a research economist at the Bank of Italy and a research affiliate in CEP’s education and skills programme.

Taking more science courses at school encourages students to enrol in STEM degrees

Further reading

Joseph Altonji, Erica Blom and Costas Meghir (2012) ‘Heterogeneity in Human Capital Investments: High School Curriculum, College Major, and Careers’, *Annual Review of Economics* 4(1): 185-223.

Magali Beffy, Denis Fougère and Arnaud Maurel (2012) ‘Choosing the Field of Study in Postsecondary Education: Do Expected Earnings Matter?’, *Review of Economics and Statistics* 94(1): 334-47.

Glenn Ellison and Ashley Swanson (2012) ‘Heterogeneity in High Math Achievement Across Schools: Evidence from the American Mathematics Competitions’, National Bureau of Economic Research Working Paper No. 18277.

Estelle James, Nabeel Alsalam and Joseph Conaty (1989) ‘College Quality and Future Earnings: Where Should You Send Your Child to College?’, *American Economic Review* 79(2): 247-52.

Ralph Stinebrickner and Todd Stinebrickner (2014) ‘A Major in Science? Initial Beliefs and Final Outcomes for College Major and Dropout’, *Review of Economic Studies* 81(1): 426-72.

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