Appendix 1

The models used

The costings for this report have used two growth commission proprietary models plus a considerable amount of off model work. The basis for the calculations for each policy is set out below; this section describes these two proprietary models, the micro model and the macro model.

Micro or ACMD model

The model which we have developed is based on the notion that the three pillars of economic development are property rights protection, domestic competition, and international competition[66]. Broadly, anti-competitive government policy affects the way the market functions through one of these three pillars. We call it the micro model but some also also call it the Anti Competitive Market Distortions model (ACMD model).

[66] As proposed and argued in Singham, Shanker A General Theory of Trade and Competition: Trade Liberalisation and Competitive Markets (Cameron 2007), and Shanker A. Singham and Alden F. Abbott Trade, Competition and Domestic Regulatory Policy (Routledge, 2023); International competition is way of describing the openness of a country's trade regime.

Property rights

The foundation of a productive economy is property rights protection. If property rights are left unprotected, the incentive to invest, compete, and innovate is lost. If the returns from effort cannot be captured, can be taken away, or cannot be regained if wrongly taken away, what incentive is there to exert effort? Furubotn and Pejovich[67]describe the nature of property rights in this way: "... property rights do not refer to relations between men and things but, rather, to the sanctioned behavioral relations among men that arise from the existence of things and pertain to their use ... The prevailing system of property rights in the community, then, can be described as the set of economic and social relations defining the position of each individual with respect to the utilization of scarce resources" (p. 1139, italics are the authors'). The authors add in a footnote that, "Roman Law, Common Law, Marx and Engels, and current legal and economic studies basically agree on this definition of property rights." In other words, the very nature of an economic transaction is defined by the right to property and this definition is not disputed.

Property rights allow four things to occur: (1) investment to create the property (as in the case of intellectual property or IP and machinery); (2) investment to make the property more productive (as in the case of land, machinery, and IP); (3) exploitation to get the maximum productivity out of it (as in the case of land, machinery, IP, etc.); (4) transfer of property to another who might be able to do a better job of the first three instead of the current owner of the property (as in the case of land, machinery, and IP). All these lead to increased productivity, higher incomes, and thus wealth and prosperity. So, a lack of property rights protection effectively undermines the ability of economic agents to operate effectively. It also undermines the process of competition, because property rights are what firms compete with. In developing countries in particular, establishing and enforcing property rights play a significant role in creating the preconditions for growth[68]

[67] Eirik G. Furubotn, and Pejovich, Svetozar 'Property Rights and Economic Theory: A Survey of the Recent Literature' (1972) 10(4) Journal of Economic Literature 1137,1137-1162.

[68] Besley, Timothy. Property Rights and Investment Incentives: Theory and Evidence from Ghana. (1995) The Journal of Political Economy103(5) 903,903-937 and A lack of property rights protection creates what De Soto calls "dead capital" – the poor cannot leverage the assets they do accumulate, which prevents entrepreneurialism. See: Hernando De Soto The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else. (New York: Basic, 2000).

Therefore, all other factors influencing economic outcomes depend on the level and quality of property rights protection. We account for the fact that the effect of domestic competition and international competition on other factors depends on the level of property rights in our model and will discuss how we capture this in the next section.

Property rights protection indicator

Sub component	Source
1. Efficiency of the judicial system	
Efficiency of the legal framework in challenging regulations	Global Competitiveness Index
Efficiency of the legal framework in settling disputes	Global Competitiveness Index
2. Intellectual property protection	Global Competitiveness Index
3. Integrity of the legal system	
Strength of minority investor protection	WB Doing Business
Legal rights index (financial)	WB Doing Business
Judicial independence	Global Competitiveness Index
4. Enforcing contracts	
Enforcing contracts (cost)	WB Doing Business
Registering property (cost)	WB Doing Business
Enforcing contracts (time)	WB Doing Business
Registering property (time)	WB Doing Business
5. Resolving insolvency	
Outcome (0 as piecemeal sale and 1 as going concern)	WB Doing Business
Time (years)	WB Doing Business
Cost (% of estate)	WB Doing Business
Recovery rate (cents on dollar)	WB Doing Business

Intellectual property rights are themselves a type of property rights and are a crucial aspect of economic development.[69] Including this measure as a part of a property rights protection indicator was obvious and necessary. The other subcategories are each different ways in which policy can ensure that the effort of agents cannot be wrongfully expropriated, that when a person's rights are violated the process for righting that wrong is not prohibitively expensive[70], and that the legal system itself has integrity.

Domestic competition

Domestic competition plays a significant role in the effciency of both domestic and foreign firms. Competition among firms encourages innovation and upgrading of production processes, as well as positive externalities in local markets.[71] Each of these features of competition has a positive impact on welfare, which justifies its inclusion as part of this index.

[69] For a detailed treatment of the importance of intellectual property rights, see chapter 9 of: Singham, Shanker. A General Theory of Trade and Competition: Trade Liberalisation and Competitive Markets. (Kent: Cameron 2007).

[70] Either financially or through time commitments

[71] Michal E. PorterThe Competitive Advantage of Nations (New York: Free Press, 1990). As cited in Sakakibara, Mariko and Porter, Michael E. 'Competing at Home to Win Abroad: Evidence from Japanese Industry' (2001) 83(2)The Review of Economics and Statistics 310,310-322. Positive externalities include, "... supplier availability, easier access to technology and market information, and specialized human resource development" (Sakakibara, et al. p. 310).

Domestic competition components

Sub Index	Source
Labour freedom score Minimum wage Associational right paid annual leave Notice period for redundancy dismissal Severance pay for redundancy dismissal Labour productivity Labour force participation rate Restrictions on overtime work Redundancy dismissal permitted by law	Index of Economic Freedom
Business freedom score Access to electricity Business environment risk Regulatory quality Women's economic inclusion	Index of Economic Freedom
Financial freedom score The extent of government regulation of financial services The degree of state intervention in banks and other financial firms through direct and indirect ownership Government influence on the allocation of credit The extend of financial and capital market development Openness to foreign competition	Index of Economic Freedom
Electricity cost	WB Doing Business
Electricity time	WB Doing Business
Quality of roads	Global Competitiveness Index
Quality of ports	Logistics Performance Index
Mobile telephone subscription	Global Competitiveness Index
Individual using internet %	Global Commpetitiveness Index
Government Integrity Score Perceptions of corruption Bribery risk Control of corruption	Index of Economic Freedom

Typically, the term "competition policy" refers to regulations – and the enforcement of regulations – concerning restraint on competition created by private parties. Our Domestic Competition indicator is, instead, meant to capture the extent to which government policy itself restricts competitive behaviour. Timothy Muris[72] highlights the importance of understanding and correcting restrictive government actions – not just private restrictions. He compares these two sources of competitive restrictions to the forks in a stream and states that, "Protecting competition by focusing solely on private restraints is like trying to stop the water flow ... by blocking only one channel." Muris goes on to say that creating a system which prevents anti-competitive behaviour by firms but allows a government to dictate the same anti-competitive outcome that would have resulted from private action has not eliminated the problem, "It has simply dictated the form that the problem will take." Domestic competition here refers to the domestic policies affecting the way in which firms make decisions and interact with one another. Any policy which limits profit-maximising firms' ability to make their own decisions will reduce the score for Domestic Competition for a country.[73] If a policy reduces the ability of some subset of firms to make their own decisions while not restricting others in the same way, then the Domestic Policy score will be reduced. However, this does not mean that a country with no regulations controlling the decisions of firms will receive the highest score. The goal of this index and the scores it generates is to allow comparisons between countries regarding the degree to which policy is welfare-maximising. If welfare is to be maximized, then some government regulation may be appropriate in many contexts. For example, if a market can be characterised as a natural monopoly, appropriately tailored government regulation may be crucial for welfare maximisation.[74] If there are true market failures that are not being handled adequately through purely private action (severe adverse health effects from pollution, a shortage of funds for post-secondary education, harmfully discriminatory practices, etc.), then government regulation may be necessary.[75]

[72] Timothy J. Muris, Principles for a Successful Competition Agency' (2005) 72(1) University of Chicago Law Review, 165, 165-187, ;

[73] Similarly, the Washington Consensus includes privatization as one of the 10 key areas of development because of the belief that that "private industry is managed more effciently than state enterprises, because of the more direct incentives faced by a manager who either has a direct personal stake in the profits of an enterprise or else is accountable to those who do. At the very least, the threat of bankruptcy places a floor under the ineffciency of private enterprises, whereas many state enterprises seem to have unlimited access to subsidies." This theory is the backbone of our Domestic Competition indicator. However, regulation of private markets is not discussed in the Washington Consensus. We correct this oversight by emphasizing the importance of policies which allow firms to make their own decisions. Originally conceived in: Williamson, John. "What Washington Means by Policy Reform." In John Williamson (ed) Latin American Adjustment: How Much Has Happened? (Institute for International Economics, 1990. Also available: http://iie.com/publications/papers/paper.cfm?ResearchID=486 See also: http://www.who.int/trade/glossary/ story094/en/; Tejvan Pettinger 'Washington consensus – definition and criticism' (Economics Help April 25, 2017) <http://www.economicshelp.org/blog/7387/economics/washington-consensus-definition-and-criticism/>Stanley Fischer 'The Washington Consensus' in C F Bergsten (ed) Global Economics in Extraordinary Times: Essays in Honor of John Williamson (Peterson Institute for International Economics, 2012): 11-24.http://www.piie.com/publications/chapters_preview/6628/02iie6628.pdf

[74] When changing market characteristics, such as new technologies, eliminate natural monopoly conditions, however, maintaining government regulation may become counterproductive and welfare-inimical, and such regulation should be lifted.

[75] Before the government acts, care should be taken to ensure that the private sector cannot adequately rectify the market failure at issue, and that the costs associated with government intervention are not likely to outweigh the benefits that flow from eliminating (or reducing) the market failure.

These antitrust, or industrial organization types of regulations are part of the Domestic Competition score. No judgment is made as far as the exact specification of the regulation. Instead, the effectiveness of antitrust policy and the cost of adhering to different policies are the measures used.

The Domestic Competition score is higher when firms are able to make their own decisions because we are trying to evaluate how well domestic policies promote competitive behaviour. It is constructed as follows. Competitive behaviour refers to the behaviour firms exhibit in a particular market which will maximise welfare within the market. Therefore, the Domestic Competition score is higher when policies respond to market failures and antitrust violations effciently but otherwise do not interfere with or dictate firm behaviour. This is because the behaviour of profit maximssing firms – faced with demand from the market, the decisions of competitors, no market failures, and no antitrust violations – will produce and charge a price which generates the welfare maximising equilibrium. That is, once any market failures are corrected for, firms will behave in a way which maximises welfare. Of course, in practice it is often very diffcult or impossible to fully correct a market failure. However, some countries will do a better job than others in choosing and implementing policies that effectively respond to market failures. The closer a country is to actually eliminating a market failure, the closer it will be to moving a market toward its welfare-maximising equilibrium.[76]

The Domestic Competition indicator is defined by infrastructure[77] and the policies concerning how firms make decisions. Infrastructure and the effciency with which it is built have serious implications for the competitiveness of a country. Reliable, well-maintained infrastructure is a crucial component of effcient markets. Here, infrastructure reflects each type of infrastructure in an economy. Labor regulations are defined by how free firms are to hire and fire employees, as well as how firms are then allowed to utilise those workers. Restrictions on the hiring and firing process or deployment of labour decisions will reduce the score for Domestic Competition.

[76] The welfare-maximizing number and size of firms will depend on the market (type of good, substitutes, demand, etc.)

[77] The ideal infrastructure measures would be those that reflect the policy for awarding contracts for infrastructure projects (specifically, for building, managing, or maintaining infrastructure). However, the primary data available is concerned with outcomes, with only a couple of exceptions in financial infrastructure.

The less flexible policy makes the labour force, the higher the cost of production will be because firms will have to work around or suffer the restriction of each policy. Regulatory promulgation process refers to how laws are created. If the government is allowed to make decisions based on favouritism and the process is not transparent, ACMDs can be created at will. There will be no need to disguise them as market failures, or if they are disguised, they will be very diffcult to recognise. Industrial organisation policies refer to the regulations which firms must adhere to in order to participate in a market and how antitrust deals with anticompetitive behaviour when it arises. All of these areas impact a firm's ability to make their own profit-maximising decisions.

International competition

International Competition refers to the degree to which a country allows foreign firms to access its domestic market and the degree to which it allows domestic firms to access foreign markets. Any restriction on the free flow of trade which is not the correction to a market failure will reduce the score for International Competition. Greater access to a wider variety of goods benefits consumers and greater access to less expensive or higher quality inputs benefits firms. Also, exposing firms to potentially more effcient foreign firms promotes innovation. All of these forces combine to generate gains in welfare.[78]

[78] For a description of the theory see: Claustre Bajona, Mark J. Gibson, Timothy J. Kehoe, and Kim J. Ruhl 'Trade Liberalization, Growth, and Productivity' (2008) Prepared for the conference "New Directions in International Trade Theory" at the University of Nottingham also available <http://www.econ.umn.edu/~tkehoe/papers/BajonaGibsonKehoeRuhl.pdf>Note: These authors also highlight the fact that trade openness does not always lead to increased GDP and that the theory does not predict an increase in GDP from openness. The theory does predict greater welfare from openness, though. We will use GDP per capita as our proxy for welfare because we do not have a direct measure of welfare. There are many sources which do find a positive relationship between openness and GDP. A few examples include (as cited in Bajona et al. (2010)): Jeffery A. Frankel, and David H.. Romer (1999), 'Does Trade Cause Growth?' (1999) 89(3) American Economic Review 379,379-399; Robert E.Hall, and Charles I. Jones 'Why do some countries produce so much more output per worker than others?' (1999) 114(1) Quarterly Journal of Economics 83 83-116. Francisco Alcalá and Antonio Ciccone 'Trade and Productivity' (2004) 119 Quarterly Journal of Economics, 613-46.

International Competition refers to how open a country is to interacting with foreign markets (a measure of the openness of its trade policy). The policies which reduce the score here are those that make it more costly or burdensome to transact internationally. The indicator is constructed as follows.

International Competition components

Sub component	Source
LPI timeliness indicator	Logistics Performance Index
LPI international shipment indicator	Logistics Performance Index
LPI customs indicator	Logistics Performance Index
Trade Freedom score	Index of Economic Freedom
Freedom of foreigners to visit	Human Freedom Index
Freedom to own foreign currency	Human Freedom Index
Capital controls	Human Freedom Index

- The LPI Timeliness indicator measures the frequency with which shipments reach consignees within schedules or expected delivery times from hardly ever to nearly always.
- The International Shipment indicator measures the ease of arranging competitively priced shipments from very low to very high.
- The LPI Customs indicator measures the efficiency of customs and border management clearance from very low to very high.
- The Trade freedom score is a composite measure of the extent of tariff and non-tariff barriers that affect imports and exports of goods and services. The trade freedom score is based on two inputs, the trade-weighted average tariff rate and a qualitative evaluation of non-tariff barriers (NTBs).

Tariffs and procedural burden directly affect the flow of goods. Financial restrictions affect the flow of capital. The freedom of foreigners to visit is a measure reflecting the general openness of the economy to outsiders visiting. A policy which restricts visitation by foreigners would make it more diffcult for foreign firms to have a presence in an economy. If any of these categories is restrictive, it will be more diffcult for trade to occur. The Washington Consensus[79] also noted the importance of eliminating distortionary trade policies applied differently in different areas.[80] Import liberalisation is seen as particularly important because it eliminates the export disadvantage created by restricted access to less expensive imported intermediate goods. This type of ACMD is exactly what we are trying to capture with our International Competition index.

Combined effects

An important point to be made is that if one of these three areas is improved while the other two are left in a poor condition the impact on productivity will be reduced or reversed. For example, if Domestic Competition is improved by making it faster and less costly for domestic firms to start a business but property rights are left unprotected and international competition is prevented, the impact on productivity will likely be zero because firms will still be uncertain about entering the market (because their property can be expropriated, for example) and will not need to compete as fiercely as they would in the face of foreign competition.

[79] Williamson, John "What Washington Means by Policy Reform." in Jeffry A Frieden (ed) Latin American Adjustment: How Much Has Happened? (Routledge New York, 1990) also available <https://www.piie.com/commentary/speeches-papers/what-washington-means-policy-reform?ResearchID=486>

[80] Though, again, no emphasis was given to the competitive environment within a country except for the stress on privatization.

Each of the three categories has an impact on how an improvement in the other categories will be realised in terms of productivity. As stated previously, without property rights protection agents cannot act in their own economic interests. This means that without property rights protection improvements in the other two categories will have no effect on the determinants of productivity. Domestic competition determines the structure of a domestic market which determines the equilibrium of each domestic market. If firms are not allowed to decide how they will behave then imported foreign goods will enter an ineffcient market and face ineffcient constraints on their position in that market. It is possible that distorted domestic competition may help or hurt foreign firms. Similarly, international competition policies can prevent foreign firms from entering the domestic market, or may prevent domestic firms from reaching foreign markets. In either case, the total effect in the long-run will be a reduction of welfare.[81] Also, improving each of these three areas simultaneously will have a combined effect. If a country can correct the ACMDs in every area it can move toward its optimal welfare level. Leaving ACMDs uncorrected in any area will negatively affect the benefits from correcting other ACMDs.

The ACMD model considers effects across each of these pillars or indices separately, but it will certainly part of the ongoing work of the model to consider how feedback loops and combined effects can be properly measured.

[81] See SRB (2014)

Initial projections

Initial projections from the Singham Rangan Bradley model suggest that a reduction in ACMDs does lead to a significant increase in GDP per capita in line with the projections from the agency based model and from other sources, such as OECD and other figures on the impact of anti-competitive regulation on growth.

Our latest build on the SRB Model will look at the impact on GDP per capita of distortions in each of the three pillars distinctly. This enables us to measure the impact of particular policies on scores within each of the pillars and thus on GDP per capita.

$$\ln(GDP\ per\ capita)_{it} = \beta_0 + \beta_1 Domestic\ Competition_{it} + \boldsymbol{Xit}'\boldsymbol{\gamma} + \upsilon t + \lambda i + \epsilon it \quad (1)$$

$$\ln(GDP\ per\ capita)_{it} = \beta_0 + \beta_1 Property\ Rights_{it} + \boldsymbol{Xit}'\boldsymbol{\gamma} + \upsilon t + \lambda i + \epsilon it \quad (2)$$

$$\ln(GDP\ per\ capita)_{it} = \beta_0 + \beta_1 International\ Competition_{it} + \boldsymbol{Xit}'\boldsymbol{\gamma} + \upsilon t + \lambda i + \epsilon it \quad (3)$$

We construct a panel data model of GDP as a function of each competition index, several observed control variables and an unobserved time invariant country specific effect and a country invariant time period specific effect.

There are likely factors that impact a country's income that we have not included in our model. If they are systematically related to our index of interest this will bias our estimates. We minimise this risk by introducing time and country dummy variables.

These capture the time invariant country effects, λ_i, and country invariant time effects, ν_t, specified in equations (1-3). An example of a time invariant country effects might be omitted institutional factors, geographical factors or cultural factors that impact the level of income. An example of a country invariant time effect is a global trend such as oil prices. It is plausible that our indices are correlated with these factors. If this is the case, then our coefficient of interest will be biased by their omission. A country dummy variable eliminates this source of bias as we only attribute variance in income to varying factors inside a country that cannot be explained by global trends.

Findings

- A unit increase in domestic competition index is on average associated with increase in GDP per capita of 12.1% or 13.3%[82]
- A unit increase in property rights index is on average associated with increase in GDP per capita of around 6.5% or 11.1%[83]
- A unit increase in international competition index is on average associated with increase in GDP per capita of around 7.6%[84]

[82] The lower estimate is the result from a model which controls for both country and time fixed effects whereas the higher estimate is given by the model with country fixed effects.
[83] Same as above
[84] Given by the model with country-fixed effects

Macro model

The macro model has been prepared by the consultants Cebr.

Cebr's macroeconomic models reflect its understanding of how economies work in practice. They are heavily influenced by the models developed by the London Business School in the 1980s, building up aggregate demand from its individual components and with supply-side effects working through real variables, such as the exchange rate and wages.[85]

There is a role for monetary policy, which influences the model through the exchange rate and impacts on asset prices. Labour market variables, such as wages and employment decisions, are endogenously determined within the model. The modelling approach has of course been refined to capture more contemporary developments within the U.K. economy, including the lull in productivity growth since the global financial crisis, the impact of recent shocks such as the Covid-19 pandemic, and changes in the relative importance of sectors, notably the growth of information and technology.

The modelling is also informed by Cebr's understanding of the structure of the U.K. economy relative to other countries. The U.K. is a fairly advanced and heavily service-based economy. It has a large public sector with relatively high taxes, though some neighbouring economies have much higher taxes. It is relatively heavily regulated, though its labour market is less so, especially compared with other European economies. These characteristics all impact the U.K. economy's performance relative to others, which in turn affects a range of variables from migration to business performance.

The U.K. is an open economy. As a result, external circumstances affect its performance. Modelling the external sector and international capital flows is therefore important to understanding how the effects of policies develop.

[85] Budd et al (1984) - The London Business School econometric model of the UK