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Trust and Productivity Growth - An Empirical Analysis

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ABSTRACT

There is wide acceptance that social capital is important for economic outcomes, for instance through the role of institutions in economic development. However, there is only limited macroeconomic evidence about the channels through which social capital influences the economy. We test the role of trust as a measure of social capital operating as an enabling asset to increase Total Factor Productivity (TFP) growth. We find that trust has a significantly positive association with TFP growth, for a sample of 23 European countries from 2000-2016, controlling for a wide range of other potential contributory factors. Policymakers concerned about the slowdown in productivity growth since the mid-2000s should consider the role of trust or social capital.

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Introduction

Measuring social capital is not a trivial task. Like many other concepts in social science, there is no precise definition, and a variety of indicators have been used in previous research. The term 'capital' reflects the potential for returns to investment and accumulation over time, but the analogy is imperfect, for social capital is not an accounting construct of stocks and flows[4]. Nor is conceptualizing the relationship between the individual and the aggregate straightforward. Yet measuring social capital is important because of the accumulated evidence in the literature, described below, that it significantly affects economic outcomes, whether in terms of national growth rates, firms' profitability and their market value, or individual labour market trajectories.

In the empirical literature, survey-based indicators of trust are often used as measures of the broad and multi-dimensional concept of social capital. Trust facilitates every economic transaction, from shopping online, to trading cryptocurrencies, to extended global production supply chains. By enhancing trust, transaction costs can be significantly reduced, thanks to the reduced likelihood of free-riding or exploitation of information asymmetries. However, if transactions are seen as a one-off, the prisoners' dilemma is likely to apply, so institutional design is critical in discouraging behaviour directed at short-term gain and encouraging long-term trust or the accumulation of social capital. Trust, therefore, relies on cumulative experiences of mutually rewarding interactions with other people, or accommodative social settings, such as a shared set of ethical and cultural norms or institutions. Summary measures of trust reflect numerous dimensions such as institutions, culture, networks and civic norms.

As trust can be seen as an enabling asset, improving the returns to human and produced capital, total factor productivity could be expected to be the channel linking trust to economic growth. We aim to update earlier research by assessing empirically whether trust affects total factor productivity (TFP) from 2000 onwards. While TFP is affected by many things, including technology, as a residual contributor to growth after accounting for inputs to production, it could be expected to capture the influence of social capital whose returns are not captured by individuals.

We find that trust does have a significant positive association with total factor productivity for a sample of European countries over the later, 2002-2016, period. Using data on trust from the European Social Survey and on TFP from two alternative sources the OECD and Penn World Tables, our results consistently show a sizeable and highly statistically significant positive link between trust and

[4] Dasgupta (2016) argues that social capital is best described as interpersonal networks, which is a neutral concept. It only generates positive economic values when it is actively used and not in socially destructive ways (e.g., the criminal network).

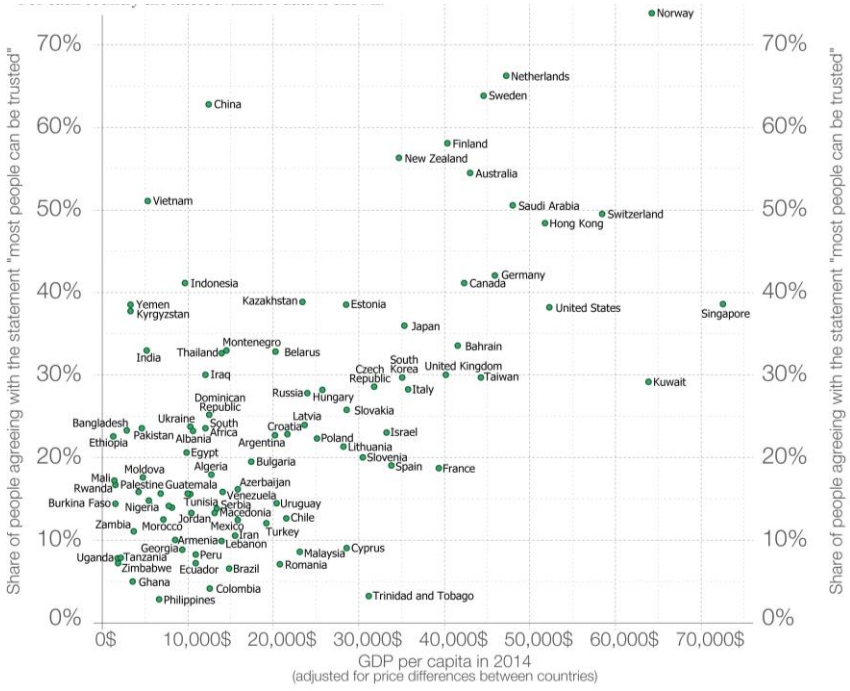
productivity, controlling for a number of other variables. The result is robust to a number of specifications. Identification of macroeconomic relationships is always challenging, but the theoretical emphasis on social capital combined with the strength of our empirical findings suggests the importance of improved measurement of trust or social capital for a better understanding of productivity dynamics.

Previous research

There is a vast social science literature on trust and social capital, but a relatively limited quantitative macro-economic literature; much of the recent research on trust has involved micro-level studies. While work on the macroeconomic effects of economic institutions (especially informal institutions) expanded in the 1990s and early 2000s, there are few formal economic models of how social capital impacts macroeconomic dynamics, partly due to the challenges in quantifying the variables of interest. So paradoxically, although social capital including concepts such as institutional strength (Acemoglu and Robinson, 2012) is widely believed to have significant consequences for economic development and growth, this rests on a limited empirical base.

The empirical macro literature has focused on the relationship between trust and aggregate economic variables, usually GDP per capita or GDP growth. The raw cross-section correlation between trust and GDP per capita is strongly positive (See Figure 1).

Figure 1: Country by country Trust versus GDP per capita



Source: Ortiz-Ospina and Roser (2019)

Broadly, previous econometric studies based on a range of trust metrics support this (Dinda 2008). Knack and Keefer (1997) and Zak and Knack (2001), using data for the period 1970–1992, found that trust indicators were positively correlated with key economic indicators, such as the level and growth of GDP. Berggren et al. (2008), on the other hand, using data for the same sample of countries for 1990–2000 showed that the relationship between trust and economic growth was no longer either as large (after removing China) or statistically significant (after removing Ireland).

Algan and Cahuc (2010) pointed out that the causal mechanism between trust and economic growth is not fully understood. This might explain why different studies focusing on different periods have found mixed results. It also helps explain why more recent research has focused on disentangling the causal micro-level relationships underlying the macroeconomic outcomes. For example, Nunn and Wantchekon (2011) argued that patterns in the slave trade in the colonial era could explain the current variation in trust levels between African countries. Similarly, Algan and Cahuc (2010) showed that the country of origin and the timing of arrival played an essential role in determining the extent of inherited trust held by the descendants of the immigrants to the US. The 11th-century network amongst Maghrebi traders used reputational mechanisms to augment legal sanctions (Edwards and Ogilvie 2012); Botsman (2017) has drawn a parallel with modern online rating systems. Horsager (2012) uses micro-level case studies to demonstrate the way trust improves efficiency. Network analysis has been an

influential framework for seeking to understand social capital (Durlauf and Fafchamp 2005).

This paper extends the macro-level empirical literature by exploring whether total factor productivity could be the channel through which trust affects levels and growth rates of income, as well as updating the evidence from the earlier literature, most of which uses data up to about 2000. The importance of the potential link from social capital to productivity growth is underscored by the possible impact of the coronavirus pandemic; not only will this directly reduce levels of GDP, it may have lasting effects on future potential growth if it has adverse effects on social capital (Aassve et al 2020).

The Model

We use Dasgupta's (2011) model of the relationship between trust and productivity growth in an economy. An economy with higher social capital might be expected to use resources more efficiently, due to reduced free riding, lower transactions costs and lower costs of monitoring and contract enforcement, and thus generate more income and wealth. How does an increase in trust manifest itself in macroeconomic statistics? Dasgupta notes that this could occur in two ways: either as an increased input into the aggregate production function, with the formation of social networks subsumed into human capital measures; or as increased total factor productivity (TFP). In a sense, these can be thought of as individual and collective aspects of social capital. To the extent that we believe 'institutions' broadly defined matter for economic growth, increased social capital should be part of TFP. Abramovitz (1956) famously called TFP the 'measure of our ignorance', or in other words, described it as a residual capturing all the (as yet) unmeasured inputs into production. However, it will also capture spillovers not attributable to individuals, or enabling assets, including social capital.

In an economy with N households ($i = 1,2,3,\ldots,N$) and a single perishable capital good, the combination of labour and the capital good will result in working capital that is used for production. Hence, we have a production function $F(K_i) = Y_i$. The production function is assumed to be strictly concave; that is, $F'(K_i) > 0$ and $F''(K_i) < 0$. Aggregate output is given by (1):

$$Y = \sum_{i=1}^{N} Y_i \qquad (1)$$

An economy that lacks any interpersonal trust is in a state of autarky: capital is individually possessed and used by people for their production (2):

$$Y = \sum_{i=1}^{N} Y_i = \sum_{i=1}^{N} F(K_i) \qquad (2)$$

where $K = \sum_{i=1}^{N} F(K_i)$ is the total working capital in the economy.

If households i and j, with $K_i > K_j$, start to develop trust between each other, they can reach a higher level of output, with each household producing with $\frac{(K_i+K_j)}{2}$ of working capital. Strict concavity ensures that (3) holds:

$$2 \times F(\tfrac{K_i+K_j}{2}) > F(K_i) + (K_j) \qquad (3)$$

With incomes and output produced by the other $N-2$ households staying the same, adding the interpersonal trust developed between i and j leads to higher production for the entire economy. The model thus suggests that the benefits of interpersonal trust can be reflected in macroeconomic statistics through the improved efficiency of resource allocation, which is captured by the total factor productivity (TFP).[5]

Using this framework, this paper extends the empirical evidence on the relationship between trust, TFP and growth, using data for the more recent period 2002-2016.

The Data

Our estimates are based on a panel of data covering the period 2002-2016. The primary sources for the dependent variable, total factor (TFP) or multifactor productivity (MFP), are the OECD's database and the Penn World Table (PWT). TFP is calculated as the output growth residual unexplained by changes in labour and capital inputs. The measure captures the efficiency of the joint use of (measured) labour and capital inputs in the production process.[6] The OECD database provides multi-factor productivity (MFP) index. Similarly, the PWT provides TFP data at current Purchasing Power Parity (PPP), which enables a comparison of productivity levels across countries.[7] The OECD gives us 13 European countries, the PWT 23 European countries.

Turning to the independent variables, many alternative measures of trust are available from surveys across the globe. These measures cover a broad range of trust indicators — from social institutions (e.g., trust in the police) to interpersonal relationships. Two of the most widely surveyed questionnaire statements are "most people can be trusted" and "you can't be too careful". The World Values Survey (WVS) poses this as a 'yes/no' question, whereas the European Social Survey (ESS) requires the respondents to choose a score from 0 ("you can't be too careful") to 10

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[5] Notice that, like all micro-founded macroeconomic models, this model may suffer from the fallacy of composition. That is, productivity gains for the representative agent do not necessarily lead to the same results at the macro-level, for example because of co-ordination costs on the one hand or positive spillovers on the other hand.

[6] According to OECD (2019), the change in name reflects a certain modesty with respect to the capacity to capture all of the factors' contributions to output growth.

[7] US TFP is normalized to be 1.

("most people can be trusted"). We have used the latter, which is carried out every two years rather than every four years for the WVS.

The European Social Survey (ESS) conducts face-to-face interviews biannually across various European countries. Between 2002 and 2016, there are eight rounds of data available for analysis. Multiple different measures of trust were collected in every round. We focus on the 'horizontal' trust variable (ppltrst: "most people can be trusted" or "you can't be too careful") in the ESS to explore the relationship between general levels of social trust and variations in TFP. The respondents are asked the following the question:

> "Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? Please tell me on a score of 0 to 10, where 0 means you can't be too careful and 10 means that most people can be trusted."

We estimated a trust index for each country by computing the weighted score in each round. Taking Belgium as an example, in 2002, the total number of respondents to this question was 1,899. The general trust index is the weighted average of the reported scores from all respondents, 4.791, where the percentage of respondents[8] selecting each score from 0 to 10 gives the weights. Also, given that the survey results are only available every two years, the average value of the trust index is used to interpolate the gaps between waves. Table 1 demonstrates how the general trust index between 2002 and 2016 is constructed for Belgium.

[8] The number of respondents is adjusted by the post-stratification weights provided by the ESS. Thus, sampling errors and potential non-response biases are effectively controlled.

Table 1 Calculated weights for general trust index 2002, Belgium (Left) and trust index for Belgium, 2002 – 2016 (Right)

Trust ESS1-2002, ed.6.6, Belgium

Most people can be trusted or you can't be too careful	Percentage of respondents	Weighted score
0	7.11%	0.000
1	3.90%	0.039
2	6.85%	0.137
3	9.90%	0.297
4	10.11%	0.404
5	21.70%	1.085
6	11.90%	0.714
7	17.11%	1.198
8	8.64%	0.691
9	1.11%	0.100
10	1.26%	0.126

General Trust Index for Belgium, 2002-2016

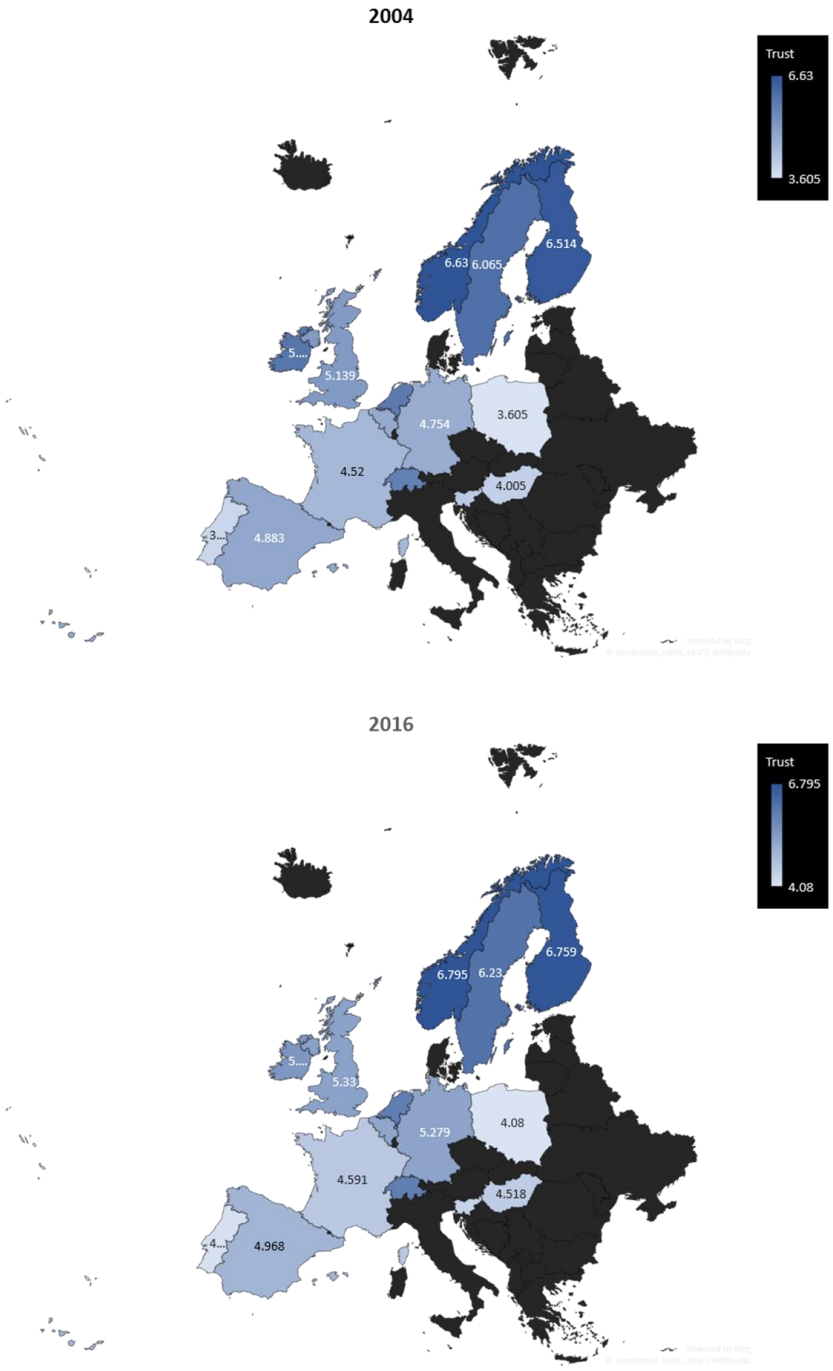
General Trust Index	Belgium
ESS1-2002	4.791
2003 (calculated)	4.790
Trust ESS2-2004	4.789
2005 (calculated)	4.886
ESS3-2006	4.983
2007 (calculated)	5.056
ESS4-2008	5.129
2009 (calculated)	5.087
ESS5-2010	5.045
2011 (calculated)	5.070
ESS6-2012	5.096
2013 (calculated)	5.056
ESS7-2014	5.016
2015 (calculated)	5.092
ESS8-2016	5.167

Sources: ESS, and authors' calculations

We acknowledge that using the average values to interpolate missing data has the limitation that it may smooth out extreme values. However, given that the trends for trust indicators in most countries are relatively stable over time (Ortiz-Ospina and Roser, 2019), a simple interpolation technique seems adequate for our purpose.

As we can observe from Figure 2, there are quite large differences in this level of this index among the ESS survey countries, but the relative ranking among them is broadly stable over time. The three Nordic countries lead the pack throughout, while trust levels in Poland, Portugal and Slovenia—all improving—nevertheless remained at the bottom of the list. The stability of rankings is also apparent at the global scale in the WVS.

Figure 2 General trust index, 2004 versus 2016



Sources: Created by the authors, data from ESS

Figure 4 in Appendix C presents the time series data for both the level of TFP[9] and the constructed trust index. There is a very diverse pattern across the selected countries, which cautions against any simplistic story. On the one hand, the correlation between the TFP level and trust indicator in Germany appears to be highly positive since the early 2000s. On the other hand, although the trust level remained stable in Spain, a secular decline in TFP is witnessed between 2002 and 2014. In contrast, the trust level continued to decline from a relatively high level in the early 2000s, but the TFP level stayed relatively flat. In the UK and France, TFP declined after the 2008 financial crisis. It remains lower than the pre-crisis level in both countries.

Estimation methodology

Given the availability and format of the data, we adopted two estimation strategies.

First, we used a straightforward cross-section OLS regression to estimate the relationship between trust and the level of TFP. Both theory and previous empirical literature informed the choice of control variables. We estimate (4),

$$ln(TFP_i) = \beta_0 + \beta_1 ln(trust_i) + \alpha_i X_i + \varepsilon_i \qquad (4)$$

where $ln(TFP_i)$ is the natural logarithm of TFP, $ln(trust_i)$ is the natural logarithm of the general level of trust and X_i is the vector of control variables as suggested by Gehringer et al., (2016) for EU countries, including a human capital index, research and development (R&D) expenditure, internet access, inward FDI and degree of openness to international trade. We have also included the World Bank (WB) ease of doing business scores as a measure of market efficiency (Kim and Loayza, 2019). Institutional factors, such as the rule of law, are not included as they are partly controlled by the selection of countries, and partially captured by the trust index, as documented by Murtin et al., (2018).

We then used the instrumental variable (IV) approach to test the robustness of the result further – but not for the purposes of causal identification. We have a relatively small sample size (N=23), so the primary purpose of the IV estimation is to provide an additional check for the robustness. With the necessarily limited amount of data of this type, and the complexity of the macroeconomic and social relationships being modelled, statistical techniques are unlikely to ever permit strong causal claims.

In the first stage of a two-stage least squares (2SLS) procedure to produce an unbiased estimator $\widehat{\beta_1}$ of β_1 we regressed the trust indicator on our instrument, the indicator of the quality of media reporting ($press_i$) from the Sustainable Governance Indicators. As is often the case, finding an appropriate instrument is a challenge. According to Murtin et al., (2018), digitalisation has increased the

[9] TFP is at constant national prices and indexed to 2011=1.

consumption of news beyond traditional media channels, primarily via social media. This is contributing to increasingly polarised views (Knobloch-Westerwick et al., 2020). Therefore, the amount of high-quality information content (less-biased content) available should be positively associated with interpersonal trust levels. At the same, there are also limited channels for the media reporting quality to influence TFP. The media quality variable thus satisfies both the relevance condition and exclusion restriction. The estimated trust index from the first stage is then used in the second stage ordinary least squares (OLS) estimation of equation (4), which results in the unbiased estimator $\widehat{\beta_1}$ with a large enough sample.

Our second estimation strategy exploits the longitudinal feature of the survey data and uses panel effects for the estimation. Fixed effects panel models deal with the endogeneity problem by removing all country-specific (and time-invariant) factors in the data, as specified by Equation (7).

$$TFP_{it} = \beta_i trust_{it} + \lambda X_{it} + u_i + e_{it} \qquad (5)$$

where u_i is the country-specific factor that is also time-invariant, such as institutional quality, and all other variables X_{it} represent a $n \times T$ matrix. Both a fixed-effects estimator and a first-difference random effects estimator will be asymptotically unbiased. The choice between the two depends on the behaviour of the error term e_{it}. If u_i is not correlated with any of the independent variables (i.e. $cov(u_i, X_{\text{it}}) = 0$), then a simple pooled OLS estimator will also be unbiased, but the error terms will be serially correlated.

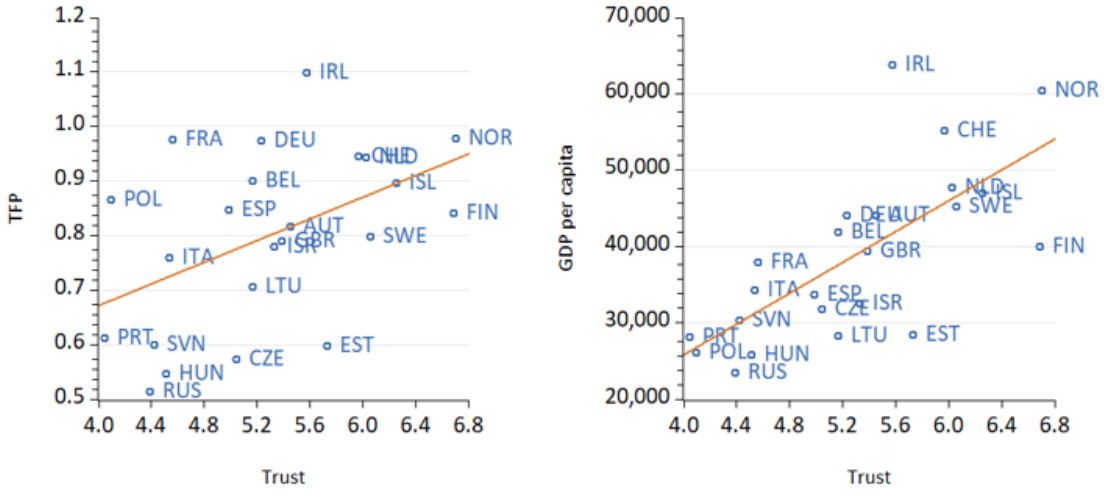
We conducted a Hausman test for the model selection. The null hypothesis (H_0) tests $cov(u_i, X_{\text{it}}) = 0$ against the alternative scenario that H_0 is non-zero. If the null hypothesis is rejected, then only the fixed-effects model provides an unbiased estimator. Otherwise, the random-effects model should be preferred. As the test rejects the null hypothesis, we selected the fixed-effects estimator, which will produce unbiased estimates with smaller standard errors.

Empirical Results

OLS and 2SLS estimation

On the face of it, despite the differences observable in Figure 3 above, the results seem to support the conclusion that higher levels of trust within society lead to higher levels of TFP, as well as GDP per capita. For cross-country comparison, the PWT data normalise the US TFP level to 1 and the TFP levels for all other countries are a relative measure against the US level. Figure 3 shows that a one-unit increase in the 0 to 10 scaled interpersonal trust index is associated with an increase of 9.9 per cent in the relative (to the US) level of TFP.

Figure 3: Trust versus TFP level and GDP per capita (PPP)



Source: created by the author; PWT and ESS data

The OLS and 2SLS estimation results, using 2016 data, are shown in Table 2. Given there are various measurement units involved in the regression, all variables are transformed into logs so that units are normalised to percentage change. The positive link between an increase in the level of trust and TFP from the PWT data[10] remains robust after controlling for a range of other variables, such as an index of human capital measured by average years of schooling and rate of return to education[11], Research and Development (R&D) expenditure as a percentage of GDP, net inward FDI as a percentage of GDP, and an openness to trade indicator measured by total imports and exports as a percentage of GDP.

The simple OLS estimates suggest a significant link between trust and TFP. A ten per cent increase in the trust index is associated with a percentage increase in the TFP (relative to the US) ranging between 5.2 per cent and 7.2 per cent. Adding different control variables has not led to increases in the (low) explanatory power of the regression. All control variables appear to be statistically insignificant once the trust index is included – a striking finding that we now turn to discuss.

Endogenous growth models provide solid theoretical foundations for a positive correlation between human capital and productivity growth, as higher human capital can either facilitate the adoption of the existing knowledge in the economy or generate more innovative ideas for future growth. However, previous empirical studies show mixed results. Consistent with the findings by Pritchett (2001), the coefficients of the human capital index in our OLS models are negative and

[10] The OECD MFP database only provides 13 observations. Hence it is not analysed for the cross-section data.

[11] See Barro and Lee (2013) for more detail on the rationale.

statistically insignificant. There are three possible explanations: firstly, the institutional framework has not been sufficiently efficient to allocate the newly acquired skills into productive activities; secondly, the marginal rate of return to education might decline considering the differences in demand and supply of educated labour across countries; thirdly, schooling may not be effectively transformed into knowledge and skills, particularly for low-income countries (Miller and Upadhyay, 2000).

R&D expenditure is essential for the generation of new knowledge, presumed to involve positive externalities in the economy according to innovation-based growth models. It is indeed positively correlated with the TFP levels but is insignificant if the regression includes the trust index. The percentage of households with internet access is an indicator for ICT infrastructure development, which spurs productivity through network externalities.[12] The positive coefficients also become statistically insignificant when the trust variable is included.

Kim and Loayza (2019) argue that a market efficiency index should be considered, as it could capture the allocation efficiency of human capital and physical capital in the economy. The World Bank Ease of Doing Business index is used in the analysis, and although the positive correlation seems to hold, the coefficient has no statistically significance. Similarly, a vast empirical literature identifies both openness to trade and net inward FDI as another two critical sources for TFP growth through technology transfers.[13] Neither is statistically significant in our results, albeit we have a modest sample size and do not include any less developed countries, which would introduce more variation.

The 2SLS estimates are reported in the last column of Table 2, testing the robustness of the OLS estimation. The coefficient for general trust remains positive and statically significant at 10 per cent level when the quality of media reporting indicator is used as the instrument. The estimated result for the first-stage is given by Eq (6) below,

$$ln(trust_i) = \underset{(0.00)}{1.036\ ***} + \underset{(0.00)}{0.407\ ***}\ ln(press_i) \qquad (6)$$

where the coefficient for the IV is estimated to be 0.41 and its associated p-value for the t-test is reported below inside the parenthesis. Not only its positive sign is as predicted by theory, but also highly significant at the 1 per cent level. The adjusted R-squared is 0.68 and F-statistic is 44.80, which justifies the relevance condition and rules out this being a weak instrument. The endogeneity test also fails to reject the null hypothesis that the trust regressor is exogenous, as the difference between the restricted and unrestricted J-statistic shows no statistical insignificance.

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[12] See Schreyer (2000) and Van Ark, O'Mahony, and Timmer (2008)

[13] See Gehringer et al., (2016) for a comprehensive literature review.

Table 2: OLS and 2SLS estimation Results

	LOG(TFP)							
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
C	-1.424345***	-1.057230*	-1.251390**	-1.582839***	-3.098791	-1.309882*	-1.481729***	-1.223182**
	(0.0044)	(0.0722)	(0.0245)	(0.0014)	(0.4499)	(0.0942)	(0.0086)	(0.0155)
LOG(TRUST)	0.712325**	0.845661**	0.575690*	0.526491	0.641727**	0.719510**	0.676497**	0.599282**
	(0.0121)	(0.0117)	(0.0915)	(0.2017)	(0.0458)	(0.0117)	(0.0168)	(0.0398)
LOG(HC)		-0.486201						
		(0.2955)						
LOG(R&D)			0.088061					
			(0.4086)					
LOG(INTERNET)				0.122222				
				(0.3256)				
LOG(BUSINESS)					0.412284			
					(0.6782)			
LOG(OPENNESS)						-0.027633		
						(0.8107)		
LOG(FDI)							0.029837	
							(0.6984)	
Adj. R-squared	0.20	0.21	0.19	0.22	0.17	0.17	0.16	0.15
No. of Countries	23	23	23	23	23	23	23	22[a]

***statistical significance at 1%, **statistical significance at 5%, *statistical significance at 10%

P-values are in parenthesis; Huber-White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance are used

[a]Russia is not covered by the SGI report. Therefore, the number of observations becomes 22

Panel estimation

The number of countries involved in the panel data analysis is less than the cross-section analysis. It is determined by the data availability for both the trust index and TFP measures. Among the 23 countries appeared in the cross-section analysis, only 15 of them have been consistently surveyed in the ESS since 2002. If we use the OECD MFP indicator, then the number of countries will be further reduced to 11. The number of observations[14], however, has increased substantially after taking the time-dimension into account. The ICT development index[15], measured by the percentage of households have access to the Internet, only became available in 2005. The ease of doing business index is not included in the panel analysis. As an institutional measure, the index lacks variations over time, which can be effectively controlled when the fixed effects model is applied. The rest of the data are detailed in the Appendix-A.

Before any estimations take place, we conduct panel unit root tests for all variables (in logs) to find out whether they are stationary. Given that the number of countries participated in the ESS survey are likely to be fixed in the long run, a unit root test, such as the Levin-Lin-Chu (LLC) test, that assumes T goes to infinity is better suited for our analysis. Appendix-B shows that all variables reject the null hypothesis in the LLC test, which suggest they are stationary over time. However, the LLC test assumes that all panels have a common unit root process (i.e., the same autoregressive parameter), which is highly restrictive. This assumption is relaxed in the Im-Pesaran-Shin (IPS) test so that the panel-specific unit root process is allowed. Both tests assume asymptotic normality. Although the IPS test assumes a fixed T, it has the benefit of testing unbalanced panel data, such as the ICT index. Hence, we also report IPS results in the Appendix as an additional check.

The first two columns of Table 3 compare the results from Pooled OLS (POLS) estimation with the country fixed-effects model using the trust index as the only explanatory variable. By having country-specific dummies added into the regression, the adjusted R-square (the goodness-of-fit) improved considerably from 7.2 per cent to over 25 per cent. The F-test for the dummy variables appears to be statistically significant at the 0.01 level. It suggests that the time-invariant factors account for a substantial share of the data variations.

Also, all the Lagrange multiplier (LM) tests[16] for the POLS residuals rejects the null hypothesis at the 1 per cent level, which means the residuals are very likely to

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[14] The number of observations is the product of number of countries and time periods. Therefore, we have 225 data points at maximum when using the TFP from the PWT and 165 data points at maximum when using the OECD MFP measure.

[15] 2014 and 2015 data for Switzerland isn't available, hence it results in an unbalanced panel if included in the regression.

[16] We conducted three tests: Breusch-Pagan LM, Pesaran scaled LM and Pesaran CD.

present features of serial correlations. It suggests that random effects also exist. The final model selection is thus down to the Hausman test results, as explained in the methodology section. The Hausman tests (see Appendix-B) conclude that cross-section fixed effects model is more suited for most regression models specified in Table 3, except when the ICT measure is included. As a result, a random effects model is applied for regression (7).

Table 3, using the TFP data from the PWT, reveals that the positive correlation between the trust index and TFP levels is robust and statistically significant in all panel models. For instance, regression (2) shows that a 10 per cent increase in the general trust level is associated with a 2.2 per cent greater TFP level. Regarding the goodness-of-fit, the fixed effects models offer the best outcomes. The adjusted R-square ranges between 25.1 per cent in (2) to 32.8 per cent in (5). In line with the cross-section regressions, human capital index, R&D expenditures and net inward FDI do not generate any significant positive impacts on TFP when trust index is included. Openness to trade index is the only control variable that shows positive influence over TFP, and it is statistically significant at 1 per cent level. As Abizadeh and Pandey (2009) noted, positive impacts of opennex to trade on TFP are particularly noticeable in the service sector, but not in the agricultural and industrial sector. Our 15 sample countries are predominantly developed economies, so service sectors are relatively improtant in these countries, which might have led to the positive coefficients.

To avoid any spurious relationships due to the time trend and to account for structural breaks such as the Global Financial Crisis (GFC), it is also useful to examine if time-specific effects are present in our data. We add the year dummies (θ_t) in the panel model and conduct another F-test for their coefficients. The test results are present in Table 4. When both country-fixed effects and time-fixed effects are considered, the positive effect of the trust index persists, and the adjusted R-square improves steadily. Model (4) and (5) can explain over 50 per cent of the total variations in TFP levels. In both regressions, all the time dummies for the post-crisis periods appear to be statistically significant at 1 per cent level. As a result, we notice that the coefficient for the inward FDI indicator becomes positive and statistically significant as well.

When using the OECD MFP data as an alternative source for TFP measure, the number of countries in the panel are reduced to 11 but time periods stay the same. Similar to the findings by Berggren et al., (2008) based on data between 1990 and 2000, Ireland still remains an outliner among the OECD countries in our analysis. What is different from Berggren et al., (2008) is that our results remain robust when Ireland is excluded not included. As one of the worst hit economies by the GFC, Ireland's TFP level rose above its pre-crisis level and persisted at a high level after 2009[17]. On the other hand, the general trust level went through a secular decline

[17] Moreover, the 2015 and 2016 MFP data for Ireland are missing so it also results an unbalanced panel once included.

since 2004 (See Figure 5). IMF (2016) studied the differences in TFP levels in Ireland between 2007 and 2014. They found that the post-crisis TFP growth in Ireland is mainly driven by foreign-owned and large-scale corporates, as these firms are the primary financers for R&D activities in the economy. However, the Irish domestic R&D expenditure is still below the OECD average. The lack of a corresponding relation between TFP and trust index in Ireland is still not well understood, which deserves a more in-depth case study.

Table 5 shows the results from the country-fixed effects models for the OECD MFP data (excluding Ireland). Again, the F-tests for the coefficients for all cross-section dummies confirm the presence of country-fixed effects. Then the results from the Hausman tests conclude that the fixed effects model are preferred over random effects for all specifications. The results are in line with our estimates in Table 3. When country-fixed effects are included, a 10 per cent increase in the general trust level is associated with an increase in TFP level between 1.8 percent and 3.1 per cent.

Like Table 4, Table 6 presents the results from two-way fixed effects models that also include time-specific effects using the OECD data. Most of the estimated coefficients are consistent with the previous results. Model (2) with the human capital index is an exception. The trust index becomes statistically insignificant when the OECD MFP data is used. Such finding is also noticed by Égert, (2017). In his sensitivity analysis, the MFP data are particularly sensitive to the inclusion and exclusion of the human capital measures. Distortions in estimation could arise due to measurement issues. For example, the MFP measures could have captured some contributions from the human capital. Given that the human capital indicator in our paper comes from the PWT database, it is thus more likely to show consistency with the PWT TFP data.

Table 3: Model results from Pooled OLS and cross-section fixed/random effects model, PWT

	Dependent variable: LOG(TFP)						
	(1)	(2)	(3)	(4)[a]	(5)	(6)	(7)[b]
C	-0.091845***	-0.377229***	-0.271295**	-0.383076***	-0.657181***	-0.661552***	0.014267
	(0.0000)	(0.0003)	(0.0338)	(0.0003)	(0.0000)	(0.0000)	(0.7346)
LOG(Trust)	0.056718***	0.232562***	0.262471***	0.241407***	0.120699*	0.120628*	0.061491***
	(0.0000)	(0.0003)	(0.0001)	(0.0002)	(0.0640)	(0.0648)	(0.0026)
LOG(Human capital)			-0.132541				
			(0.1512)				
LOG(R&D)				-0.015196			
				(0.2978)			
LOG(ICT)							-0.026252**
							(0.0152)
LOG(Openness)					0.102260***	0.105481***	
					(0.0000)	(0.0000)	
LOG(FDI)						-0.002607	
						(0.8058)	
Adj. R-squared	0.072533	0.256109	0.259915	0.256426	0.329722	0.325280	0.047715
F test that all u_i=0		4.93***	4.32***	4.68***	7.18***	7.05***	
Country-fixed/random effects?	N	Y: Fixed	Y: Fixed	Y: Fixed	Y: Fixed	Y: Fixed	Y: Random
Time-fixed/random effects?	N	N	N	N	N	N	N
Sample period	2002-2016	2002-2016	2002-2016	2002-2016	2002-2016	2002-2016	2005-2016
No. of Countries	15	15	15	15	15	15	15

***statistical significance at 1%, **statistical significance at 5%, *statistical significance at 10%; P-values are in parenthesis

[a] The R&D expenditure data for Switzerland are only available in 2000, 2004, 2008, 2012, 2015 and 2017, the rest years are estimated

[b] Unbalanced panel due to missing data

Table 4: Model results for two-way fixed effects model, PWT

	Dependent variable: LOG(TFP)				
	(1)	(2)	(3)[a]	(4)	(5)
C	-0.317588***	0.259467	0.293571	-0.533529**	-0.494939*
	(0.0033)	(0.3796)	(0.3237)	(0.0460)	(0.0573)
LOG(TRUST)	0.195812***	0.183720***	0.189026***	0.121643**	0.134596**
	(0.0033)	(0.0055)	(0.0045)	(0.0310)	(0.0146)
LOG(HC)		-0.478284**	-0.523432**	-0.729697***	-0.775263***
		(0.0371)	(0.0255)	(0.0002)	(0.0001)
LOG(R&D)			0.017688		
			(0.3286)		
LOG(Openness)				0.262967***	0.232103***
				(0.0000)	(0.0000)
LOG(FDI)					0.034438***
					(0.0008)
Adj. R-squared	0.350501	0.361647	0.361513	0.541292	0.565214
F test that all u_i=0	5.34***	4.29***	4.82***	12.21***	7.05***
F test that all θ_t=0	3.17***	3.30***	3.43***	2.71***	3.17***
Country fixed effects?	Y	Y	Y	Y	Y
Time fixed effects?	Y	Y	Y	Y	Y
Sample period	2002-2016	2002-2016	2002-2016	2002-2016	2002-2016
No. of Countries	15	15	15	15	15

***statistical significance at 1%, **statistical significance at 5%, *statistical significance at 10%; P-values are in parenthesis

[a] The R&D expenditure data for Switzerland are only available in 2000, 2004, 2008, 2012, 2015 and 2017, the rest years are estimated

Table 5: Model results from Pooled OLS and cross-section fixed effects model, OECD

	Dependent variable: LOG(MFP_EXIR)[c]						
	(1)	(2)	(3)	(4)[a]	(5)	(6)	(7)[b]
C	4.568552***	4.106150***	4.156094***	4.110544***	3.905225***	3.889665***	4.060453***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LOG(TRUST)	0.023098*	0.303062***	0.312029***	0.302295***	0.192549***	0.192004***	0.177268***
	(0.0530)	(0.0000)	(0.0000)	(0.0000)	(0.0046)	(0.0045)	(0.0045)
LOG(HC)			-0.055678				
			(0.4878)				
LOG(R&D)				-0.004746			
				(0.7306)			
LOG(ICT)							-0.049327***
							(0.0000)
LOG(Openness)					0.087247***	0.102905***	0.106063***
					(0.0000)	0.0000	(0.0000)
LOG(FDI)						-0.013536*	
						(0.0942)	
Adj. R-squared	0.017911	0.265536	0.262798	0.260851	0.359203	0.367633	0.359261
F test that all u_i=0		6.54***	6.54***	5.84***	9.43***	7.80***	6.87***
Country-fixed effects?	N	Y	Y	Y	Y	Y	Y
Time-fixed effects?	N	N	N	N	N	N	N
Sample period	2002-2016	2002-2016	2002-2016	2002-2016	2002-2016	2002-2016	2005-2016
No. of Countries	10	10	10	10	10	10	10

***statistical significance at 1%, **statistical significance at 5%, *statistical significance at 10%; P-values are in parenthesis

[a] The R&D expenditure data for Switzerland are only available in 2000, 2004, 2008, 2012, 2015 and 2017

[b] Unbalanced panel due to missing data

[c] Ireland is excluded from the MFP data as an outlier

Table 6: Model results for two-way fixed effects model, OECD

	Dependent variable: LOG(MFP_EXIR)[b]				
	(1)	(2)	(3)[a]	(4)	(5)
C	4.272518***	5.302599***	4.277031***	3.617174***	3.624104***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LOG(TRUST)	0.219233***	0.093793	0.203815***	0.174806***	0.173419***
	(0.0043)	(0.2155)	(0.0078)	(0.0082)	(0.0092)
LOG(HC)		-0.731553***			
		(0.0003)			
LOG(R&D)			-0.010564		
			(0.5380)		
LOG(ICT)					
LOG(Openness)				0.159456***	0.160520***
				(0.0000)	(0.0000)
LOG(FDI)					-0.002408
					(0.7973)
Adj. R-squared	0.355029	0.416116	0.351821	0.466806	0.462760
F test that all u_i=0	6.07***	8.22***	5.22***	9.34***	6.96***
F test that all θ_t=0	2.37***	3.58***	2.38***	2.99***	2.73***
Country-fixed effects?	Y	Y	Y	Y	Y
Time-fixed effects?	Y	Y	Y	Y	Y
Sample period	2002-2016	2002-2016	2002-2016	2002-2016	2002-2016
No. of Countries	10	10	10	10	10

***statistical significance at 1%, **statistical significance at 5%, *statistical significance at 10%; P-values are in parenthesis

[a] The R&D expenditure data for Switzerland are only available in 2000, 2004, 2008, 2012, 2015 and 2017, the rest years are estimated

[b] Ireland is excluded from the MFP data as an outlier

Conclusion

Gordon (2016) pointed out that the slowdown of TFP growth since 2004, particularly during the post-crisis period, has significant implications for potential real GDP growth in advanced economies. Identifying the determinants of TFP growth is central to current policy and academic debates. We argue that social capital should be taken into consideration when designing and implementing structural policies that aim to improve productivity growth in the medium and long term.

Our paper has shed light on trust, social capital, and economic outcomes in two ways. First, we update the evidence from the earlier macroeconomic literature, most of which uses data up to about 2000, confirming the positive association between trust and macroeconomic outcomes during the past 20 years. Second, our empirical results suggest that total factor productivity should be considered as a channel through which trust affects levels and growth rates of income, as suggested by Dasgupta's (2011) conception of trust or social capital as an enabling asset. Although as discussed we do not make causal claims from the statistical results alone, in the context of the general slowdown in TFP growth since the mid-2000s, this is a potentially important conclusion.

The difficulty of identification is partly down to the incomplete understanding of the transmission mechanism at the macro-level, but it also reflects the lack of readily available statistics on social capital. Collecting additional data on social capital would be desirable, over different geographies.

Future research also needs to take into account the important changes in the way economic transactions and connections are occurring. For instance, big online shopping platforms (such as Alibaba or Amazon) connect millions of sellers and buyers across the world every day, and having sufficient trust to transact between these strangers relies heavily on the rating systems and the secure payment systems in place. As trust mechanisms are so different in these technologically-enabled contexts of anonymous electronic transactions, compared with more localised transactions, its nature and consequences are ripe for further study. Furthermore, the global economy has experienced a further big shock in the shape of the coronavirus pandemic, following on from the financial crisis, which is also likely to impact social capital. Our results confirm social capital operating through its consequences for productivity growth could be a useful indicator, whose relevance for economic policy in the years ahead can only increase.

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Appendix-A Data description

Variable	Definition	Data source
CTFP	TFP level at current PPPs (USA=1)	PWT 9.1
RTFPNA	TFP at constant national prices (2011=1)	PWT 9.1
MFP	It is measured as a residual, i.e. that part of GDP growth that cannot be explained by changes in labour and capital inputs. In simple terms therefore, if labour and capital inputs remained unchanged between two periods, any changes in output would reflect changes in MFP. This indicator is measured as an index and in annual growth rates.	OECD
Trust	Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? Please tell me on a score of 0 to 10, where 0 means you can't be too careful and 10 means that most people can be trusted.	ESS
Human capital (HC)	It is based on years of schooling and returns to education	PWT 9.1
R&D	Gross domestic expenditures on research and development (R&D), expressed as a percent of GDP. They include both capital and current expenditures in the four main sectors: Business enterprise, Government, Higher education and Private non-profit. R&D covers basic research, applied research, and experimental development.	UNESCO Institute for Statistics
Internet	It is defined as the percentage of households who reported that they had access to the Internet. In almost all cases this access is via a personal computer either using a dial-up, ADSL or cable broadband access. This indicator is measured in percentage of all households.	OECD

FDI (cross-section)	They are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.	IMF
FDI (panel)	Foreign Direct Investment (FDI) stocks measure the total level of direct investment at a given point in time, usually the end of a quarter or of a year. The outward FDI stock is the value of the resident investors' equity in and net loans to enterprises in foreign economies. The inward FDI stock is the value of foreign investors' equity in and net loans to enterprises resident in the reporting economy. FDI stocks are measured in USD and as a share of GDP. FDI creates stable and long-lasting links between economies.	OECD
Business	The ease of doing business score helps assess the absolute level of regulatory performance over time. It captures the gap of each economy from the best regulatory performance observed on each of the indicators across all economies in the Doing Business sample since 2005. One can both see the gap between a particular economy's performance and the best performance at any point in time and assess the absolute change in the economy's regulatory environment over time as measured by Doing Business. An economy's ease of doing business score is reflected on a scale from 0 to 100, where 0 represents the lowest and 100 represents the best performance.	World Bank
Trade Openness Index (open)	The sum of exports and imports of goods and services measured as a share of gross domestic product.	World Bank national accounts data, and OECD National Accounts data files.

Quality of media reporting (press)	The index seeks to assess the extent to which the media provide timely and contextualized information, analysis, as well as background information that enables the broader public to assess critically the rationale and impact of public policies. It refers to a country's 10 most important mass media brands (print, tv, online, radio)	SGI 2016

Appendix-B Supplementary test statistics

Panel unit root tests

Variables	Levin-Lin-Chu test	Im-Pesaran-Shin test
RTFPNA	-2.68445***	-1.11873
MFP	-3.71788***	-2.30476**
MFP_EXIR[a]	-2.52023***	-1.67108**
TRUST_ESS	-3.82108***	-2.23738**
HC[b]	-6.17125***	-3.23068***
R&D	-2.66916***	0.45649
ICT	-15.8717***	-11.6879***
Openness	-2.73591***	0.15743
FDI	-1.98262**	-0.09459

***, **, *statistical significance at 1%, 5% and 10% respectively; [a]Ireland is excluded; [b]test equation includes both intercept and trend, otherwise intercept only.

Hausman test

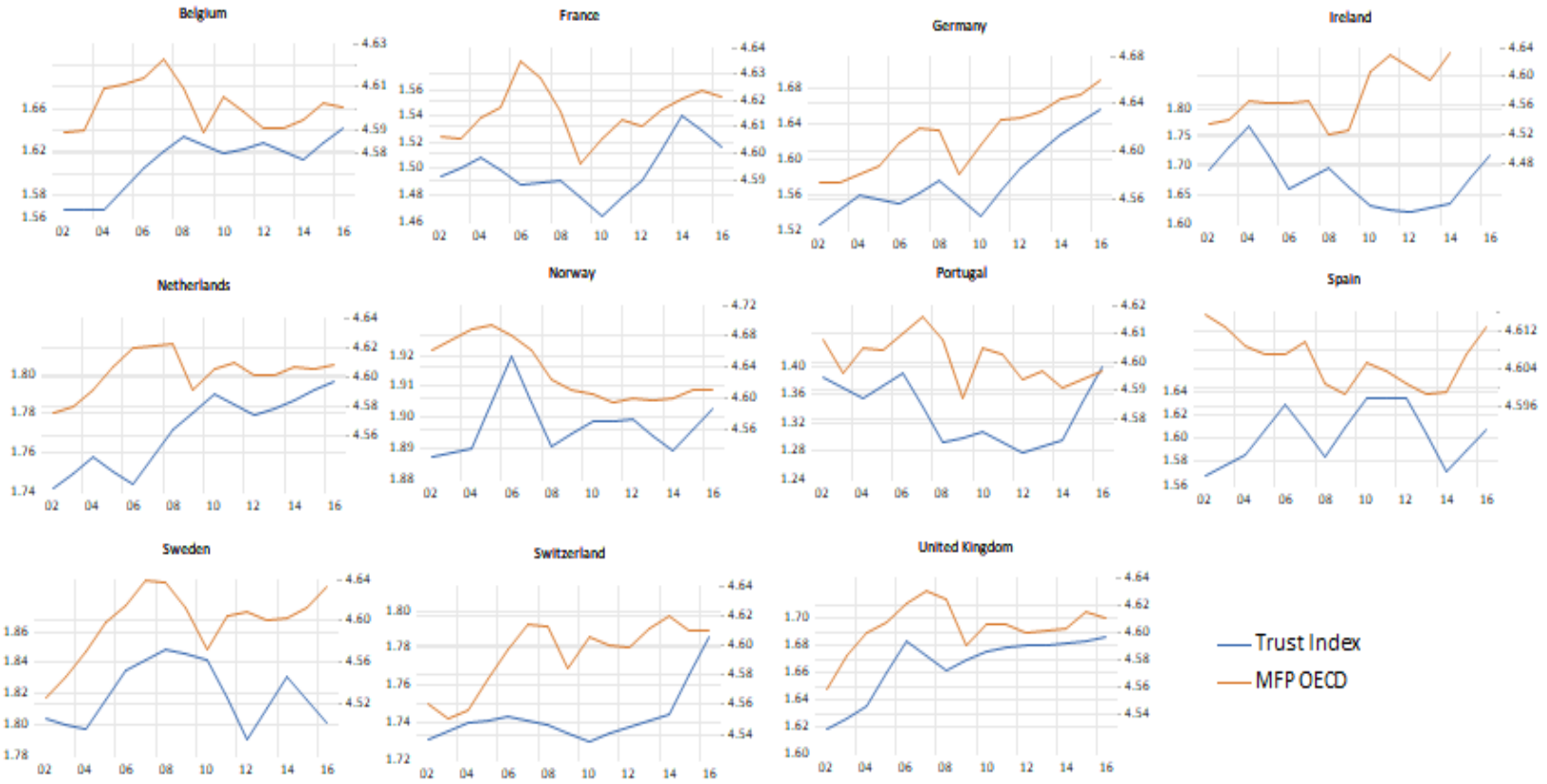
Equation No. in Table 3	P-value	Model selection
(2)	0.0083	Country fixed effects
(3)	0.0315	Country fixed effects
(4)	0.0503	Country fixed effects
(5)	0.0000	Country fixed effects
(6)	0.0000	Country fixed effects
(7)	0.6087	Country random effects
Equation No. in Table 5	**P-value**	**Model selection**
(2)	0.0001	Country fixed effects
(3)	0.0005	Country fixed effects
(4)	0.0006	Country fixed effects
(5)	0.0000	Country fixed effects
(6)	0.0000	Country fixed effects
(7)	0.0000	Country fixed effects

Appendix – C Descriptive Data

Figure 4 TFP (right axis) and ESS trust index (left axis) in logarithm, selected countries, 2002 – 2016

Sources: Created by the author, data from ESS and PWT

Figure 5: MFP (right axis) and ESS trust index (left axis) in logarithm, OECD countries, 2002 – 2016



Sources: Created by the author, data from ESS and OECD