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Regular Article

Contingent determinants

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We study the channels through which ‘deep’ historical or geographical determinants of development are connected to present outcomes. We distinguish three classes of theoretical processes that explain this connection—persistence, path-dependence due to multiple equilibria, and transitions between growth regimes—and explore the implications of each for the evolution of deep determinants’ impacts. Replicating the analyses of 43 determinants identified in the literature at different points in time, we find that the evolutionary pattern of the impact of determinants is mostly consistent with a hybrid theory of multiple equilibria and transitions between growth regimes. Specifically, we find that the effects of determinants are neither constant nor slowly waning over time, but appear to be increasing or peaking around the turn of the century.

1. Introduction

In recent decades, explanations of economic growth have increasingly focused on deep determinants of differences in development (Nunn 2014; Rodrik et al. 2004; Sachs and Warner 1997; Spolaore and Wacziarg 2013). This literature seeks to trace back contemporary differences in economic outcomes to historical and geographical root variables, arguing that economic performance is determined by societal characteristics transmitted across generations over the long run.

The body of evidence for the relevance of deep determinants for contemporary outcomes is strong (Nunn 2014). Less clear is the evolutionary path through which past variables make themselves felt in the present. How much time persistence there is in economic outcomes is still a largely open question (Spolaore and Wacziarg 2013). In some arguments, the effects of historical shocks are merely extremely persistent (Comin et al. 2010; GuisoSapienza and Zingales, 2008). In others, initial conditions put societies onto tracks towards separate, stable equilibria, causing permanent divergence (Nunn 2007). To complicate matters further, there is the possibility that the relevance of determinants for economic outcomes varies over time. Determinants influencing human capital, for example, are considered to be main drivers of incomes in modern growth regimes, but less so in a Malthusian context (Galor 2005, 2011). The mostly cross-sectional support for the contemporary relevance of deep determinants in the literature is compatible with any of these scenarios, and therefore not suitable to distinguish between them.

Yet, distinguishing between them is important for theoretical and practical reasons. Theoretically, a better understanding of the

mechanisms through which the past matters for today is an important element of a theory of the process of long-term development. Practically, understanding how the past influences the present tells us how much room there is for policies to break away from deeply determined outcomes. If today’s differences in economic development are the product of variables determined in a distant past, the future for societies at the lower end of the distribution looks rather bleak. For those societies, the impact of inherited conditions implies that they ‘may not easily be able to transplant the modes of production that have proved useful in the West’ (François and Zbojnik, 2005, 51). A better understanding of how the impact of root conditions is sustained over time provides the handles for managing the link between past and present.

In this paper, we address the question how past determinants are linked to present outcomes, by assessing three categories of arguments: persistence, path-dependence, and growth regimes. For each category, we derive the implications for the evolution of impacts of deep determinants in the long and short run. Next, we derive some stylized facts about the effects of deep determinants and compare these to each argument’s implications. Specifically, we investigate the evolution of the impacts of determinants on economic outcomes, focusing on a selection of 28 influential studies (together introducing 43 root variables) into determinants of economic performance. We do so following a very simple approach. We first replicate cross-sectional analyses, using the replication files provided by the authors were possible. We then extend the original dependent variable measured at a single point in time to a historical range of observations. Having thus matched replication files with panel data on the dependent variable, we repeat the replication on a year-

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by-year basis, depending on the time-range for which the dependent variable is available. We then track the coefficients and their confidence intervals over time in order to see how results evolve over time. We complement our repeated cross-sections by a panel analysis, in which we track the evolution of effects of deep determinants by interacting them with time variables.

We perform these simple analyses for a number of the most influential studies introducing deep determinants of development (see Table 2 for an overview of determinants included). We find that for almost all of the determinants of development identified in the literature, the impact of deep determinants is either consistently increasing over time or ‘peaking’ around the turn of the century. Support for a scenario of constant or very gradually declining effects is minimal.

Our results lead us to two conclusions. First, while our results do not allow us to pass a definitive verdict on multiple equilibria versus growth regime mechanisms, they seem to at least rule out mere persistence. Persistence implies that weak economic outcomes today should be preceded by (even) weak (er) economic outcomes before. If deep determinants continue to matter because their initial impacts are transmitted over generations, their effect should slowly wane rather than increase over time. The patterns of emerging or peaking effects that we observe are only consistent with either the restoration of underlying equilibria, or with the transition to new growth regimes.

Second, our results suggest that the recent *empirical* relevance of deep determinants is a temporary restricted phenomenon. The term ‘empirical’ is emphasized here because our findings do not necessarily imply that root variables did not matter, say, 50 years ago. All we can say is that, for a variety of potential reasons, the impacts of deep determinants were not visible back then. Thus, the empirical developmental impact of root variables appears contingent on the specific historical context over which it has been identified in the literature, which in most cases is the period around the year 2000. This result mirrors the recent finding in the convergence literature of a ‘millennium peak in club convergence’ (Krause 2017), showing that the selection of economies into two separate convergence clubs peaked around the year 2000. This is a highly relevant finding for policy purposes. It confirms that while history and geography matter, their importance is contingent on (potentially manageable) conditions in the present.

Ours is not the first attempt to investigate the intertemporal evolution of results. Many if not most of the studies in the field include results with outcomes measured at different points in time (e.g. Acemoglu and JohnsonRobinson, 2001; Bleakley and Lin 2012; Chen, 2013; Henderson et al. 2017; Nunn 2008; Gorodnichenko and Roland 2017). However, such analyses are typically conducted as a robustness check of the initial results. Few studies address the evolution of effects as an important question in itself (Bai and Kung 2011; Maseland 2018).

Our paper contributes to the literature on long term development and the origins of divergence, by shedding a new light on the mechanisms through which the past is connected to the present. It also provides a response to the oft-heard criticism that the deep determinants literature is guilty of ‘compressing history’ and inferring general insights about the historical impact of deep determinants from data representing two points in time that are wide-apart (d’Alpoim-Guedes et al., 2013; Austin 2008). By adding an analysis of the evolutionary patterns through which determinants have affected outcomes over time, we are able to assess the historical process and mechanisms driving divergence in a systematic manner.

The remainder of this paper is organized as follows. In Section II, we review the theoretical mechanisms and derive their implications. Section III describes the research methodology. Results follow in Section IV. It addresses the main analysis, based on repeated replication of originally published models, followed by a number of robustness checks. We interpret and discuss our findings in Section V. Section VI concludes.

2. How do deep determinants affect outcomes? Theoretical mechanisms

Why do differences in economic outcomes persist? At first sight, it appears two classes of determinants exist. The first class concerns historical events and circumstances that have shaped the development of societies ever since. Examples include the impact of the slave trade (Nunn 2008), or the continued effect of medieval self-government among Italian cities (Guiso et al. 2016). The second concerns geographical variables that are still present today. A prominent example is the prevalence of malaria (Sachs and Malaney 2002).

However, evidence suggests that most of the impact of deep determinants—even of those geographical—is not direct, but occurs through historical effects of initial circumstances on intermediate variables (Spolaore and Wacziarg 2013). Intermediate variables include institutions, human capital or cultural values (Rodrik et al. 2004; Nunn and Wantchekon 2011). Intergenerational transmission of intermediate variables generates relatively stable differences. Different variants of this argument emphasize biological transmission channels (Ashraf and Galor 2013; Galor and Moav 2002; Clark 2007), cultural transmission (Bisin and Verdier 2000; Gorodnichenko and Roland 2017; Greif 2006; Guiso et al. 2016; Tabellini 2010), or a combination thereof (Spolaore and Wacziarg 2013). In biological transmission, members of a society inherit certain biological traits that impact development directly from their ancestors. Under cultural transmission, older generations transmit ideas, norms, values and behaviors to the newer ones through socialization (Bisin and Verdier 2000; Bisin et al., 2011; Fernández and Fogli 2006). Institutional persistence—famously discussed in Acemoglu and JohnsonRobinson (2001)—works mainly through the latter channel; the rules of the game are passed on through socialization at home or in schools, or via legal texts.

The question is how much persistence there is (Spolaore and Wacziarg 2013). The answer to that question depends on the mechanism for replication of the distribution of outcomes. What connects the past to the present? There are three general paths along which this can come about. The first two reflect the distinction between persistence and path-dependence (Allen and Donaldson 2020). The third adds transitions between growth regimes.¹

In the scenario of persistence, deep determinants provide an exogenous shock, giving some societies an edge over others early on. While there is a single equilibrium, initial differences persist for a very long time, because growth is partly endogenous. Higher output breeds the conditions for subsequent growth, so that the initial edge gets locked in. The result is ‘long-term persistence’ (Guiso et al. 2016). Arguments in this category include Jared Diamond (1997) thesis that, due to their continental characteristics, Eurasians had an advantage in developing early agricultural civilizations that triggered their dominance ever since (Olsson and Hibbs 2005). Comin, Easterly and Levine (2010) similarly show that the current distribution of income is related to whoever had a technological edge in 1000BC.

What does this scenario imply for the evolution of the distribution of income? Outcome-persistence suggests that a current edge in performance is the product of a consistently superior performance over history. That is, societies doing better today have done better ever since the initial determinants set them on a higher development path. New shocks may have occurred, but none of these has been substantial enough to qualitatively change the overall distribution in outcomes. In the long run, the ranking of societies caused in terms of performance caused by deep determinants is consistent. Persistence still implies, however, that societies converge to a single equilibrium steady state eventually. Since, as any parent knows, transmission is never complete (Giavazzi et al. 2019) and

¹ Note that this is an ideal-typical categorisation. In reality, most papers in the literature invoke multiple arguments, fitting in more than one of these categories, or are implicit about what drives the current impact of determinants.

populations do not develop in isolation, mutations to the original set of variables inevitably occur, over time diluting the effects of initial conditions.² This process is hastened by increased exposure to outside influences. Voigtländer and Voth (2012) show, for example, how the persistence of anti-Semitism in German regions is reduced in places with high trade and migration rates. The impact of initial conditions is thus weakening over time, but only (very) gradually. The pattern that fits this class of arguments is one in which, to paraphrase Tobler (1970) first law, everything is related to everything else, but more recent things are more related than earlier things. The effects of deep determinants are consistent but gradually waning over time.

The second category of arguments highlights multiple equilibria. In this set of arguments, path-dependence arises because deep determinants trigger initial changes in self-reinforcing intermediate variables, setting economies off on a path towards one of multiple equilibria. Thus, mechanisms such as agglomeration effects (e.g. Bleakley and Lin 2012, 2015), institutional path-dependence (Acemoglu et al. 2005) symbiosis of formal institutions and mental models (North 2005), institutional complementarities (Hall and Soskice 2001), or interdependencies in actors' behavioral strategies and their expectations about those of others (Guiso, Sapienza and Zingales 2008; Nunn 2007; Persson et al. 2013; Tabellini 2008a) drive divergence after the initial (effects of) deep determinants are long gone. Whether such effects are powerful enough to create path-dependence and multiple equilibria depends on the strength of these spillovers relative to dispersion forces (e.g. new shocks, technological transfers) (Allen and Donaldson 2020).

The implications of this class of arguments for the evolution of the impact of deep determinants are rather different from those of Scenario 1. Persistence arguments require an unbroken line from past to present. Any shock hitting after the initial root variables have set societies on their development paths have the potential to weaken or even forever break the connection between deep determinants and current outcomes. In contrast, in the multiple equilibria-scenario, economic performance is not a function of past performance but of path-dependent underlying variables. For this reason, the impact of initial root variables may survive large subsequent shocks in performance, as long as these underlying variables are not affected. Davis and Weinstein (2002), for example, show that even after the devastation of Japanese cities in World War II, the pre-war distribution of income in Japan was restored fairly quickly. On a larger scale, Chanda and Putterman (2007) suggest that we are currently going through a phase in which the long term order is restored, after the temporary 'reversal of fortunes' that favored European economies. The 'East Asian Renaissance' (Gill and Kharas 2007) and the recent rise of China may according to this scenario reflect a restoration of a long-run institutional equilibrium.

Over the long-run, the multiple equilibria-argument is therefore consistent with a pattern of long-standing differences in trends, produced by deep determinants. In the short-to medium run, however, deviations from these trends are possible as countries remain subject to new exogenous shocks. As long as these shocks are limited enough to not affect underlying equilibrium conditions, they do not break the link with the past, but are followed by a process of restoration of underlying equilibria (Bosker et al., 2007; Davis and Weinstein 2002). Hence, societies benefiting from favorable deep determinants do not necessarily stay ahead at all times. They will regain their position after each period of relative decline. The long-run pattern is one of fluctuations around an underlying trend of stable differences. In the short-term, this implies that the impact of deep determinants is likely to either be stable or be increasing, if recent output shocks have pushed societies of their equilibrium level of performance.

Predictions about the set of countries responsible for such short-term

changes depends on identifying the reason for the movement out of equilibrium. If colonialism left some societies poorer than they would have been in an autonomous development process, the restoration of underlying equilibria once colonial legacies wear off (Maseland 2018) is likely to be driven by former colonies. If war has pushed economies temporarily out of their equilibrium, restoration will be driven by those countries experiencing the most severe wartime destruction. In all cases, changes in impact of deep determinants are driven by economies that for some reason were over- or underperforming relative to their equilibrium performance.

The third set of arguments focuses on transitions between growth regimes. The starting point of this scenario may be similar to either the first or second categories. Exogenous, initial circumstances have given some societies a slight edge over others which creates a persistent but minor divergence. In this scenario, however, growth is not uniform throughout history, but various growth regimes exist. These growth regimes occupy different moments on a single, universal evolutionary path, such that societies progress from one stage to the next (e.g. Galor 2011; Rostow and Rostow 1990). Galor (2005, 2011) argues that the modern growth regime, characterized by high growth rates and human capital intensity, naturally evolves out of the Malthusian growth regime once a certain threshold level of productivity is reached. In such a framework, countries with a slight edge may reach a new growth regime with higher growth rates first, setting off a period of strong divergence (Olsson and Hibbs 2005). Such a process may be amplified by variables that are more relevant in one growth regime than in another. Gorodnichenko and Roland (2017) maintain that individualism is a boon for growth in a modern economy as it spurs innovation, but may have been a drag in more technologically stagnant regimes because it limits cooperation. Acemoglu and JohnsonRobinson (2002) and Olsson and Paik (2020) arguments about the reversal of fortunes show that advantages in the pre-modern economy turn out to be disadvantages in reaching the later stage. Eventually, however, all societies will reach the new higher-growth regime and the countries initially left behind enter a process of catching up.

In this category of arguments, the impact of deep determinants on performance levels is likely to be largely transient. The effect observed today reflects a transitory dynamics in which some societies have settled in the new growth regime and others are not there yet. Changes among leading economies are driving the increasing impact of determinants in this stage. The subsequent declining impact of deep determinants is driven by growth in lagging economies that enter the new growth regime as well. Deep determinants set the moment where growth takes off, but have no (strong) impact on long-run equilibrium levels of output. Table 1 presents an overview of the three classes of arguments with their implications for the evolution of the impact of deep determinants in the long and medium run, and for the countries driving the expected medium-run patterns.

Table 1
Persistence mechanisms and their empirical implications.

	Long-run pattern	Medium-run impact of DD	Class of countries driving changes in impact
<i>Persistence</i>	Consistent differences	Slowly dissipating	Any
<i>Path-dependence/ Multiple Equilibria</i>	Fluctuations around consistent trend	Stable or increasing	Countries subject to recent shocks
<i>Growth regimes</i>	Limited differences followed by temporary divergence.	Temporary increase followed by decrease	Increasing phase: leading economies Decreasing phase: lagging economies

² It should be noted that persistence in cultural transmission models such as Bisin and Verdier (2001) is exclusively about persistence of identities, and not about persistence of the substance of these identities.

3. Empirics

What do the empirics tell us about the scenarios discussed in Section II? In Table 1, we have derived three sets of implications of each theoretical mechanism, dealing with long-term effects, short-to medium term effects, and the units responsible for any short term changes in effects. Our next step is to assess observable patterns in the evolution of impacts of deep determinants, and compare these to each scenario's predictions.

3.1. Long term evolution

The long-term economic evolution of societies has been studied extensively. Historical statistics by Maddison (2007) and the Maddison project (Bolt and van Zanden 2020) reveal a well-known pattern of relatively limited differences between world regions until the last two centuries. The final two centuries appear to present a break with the past, with the industrial revolution setting off a phase of 'divergence, big time' (Pritchett 1997).

A second observation is that the long-run evolution of the global economy is characterized by alternating dominance of different world regions. Comparing East Asia, Europe and the Middle East, Fig. 1 tracks the income in each of these regions' richest economy over time, using data from the Maddison project (Bolt and van Zanden 2020). It reveals that Europe (with Italy as its core) was the leading region in the world around 1AD. After the collapse of the West Roman Empire, dominance shifted to the Middle East and Northern Africa, before East Asia took over the lead (in Fig. 1 this East Asian dominance is somewhat masked by the lack of regional data within China). While the 'reversal of fortune' from the period of China's lead to the European industrial revolution is well-documented (Acemoglu, Johnson and Robinson, 2002), it is worth pointing out that this shift was part of a wider pattern of fluctuating dominance. Different regions have come out on top in different periods of global history. There is no straight line from past to present.

How do both these facts—long-run stagnation followed by strong growth and divergence, and the repeated alternation of economic

leadership—compare to the implications of the three mechanisms? Galor (2010) points out that the pattern of stagnating income per capita everywhere, followed by a phase of sharply increasing, unevenly distributed growth is incompatible with exogenous and endogenous growth models. Neither the notions of persistence and path-dependence can be squared with such a radical break in economic development, except possibly for deep determinants that act as exogenous triggers right at the start of the divergence. That is implausible for a large share of deep determinants identified in the literature. In contrast, the evolutionary models of Unified Growth Theory are explicitly formulated as an attempt to bring growth theory in line with the empirical facts of long-term evolution (Galor 2005, 2010, 2011). The break from stagnation to divergence marks a transition to a new growth regime for some economies, while others stay behind. The historical pattern is therefore most compatible with such evolutionary, growth regime arguments.

The pattern of alternating leadership is most obviously incompatible with persistence, which requires an unbroken line from past to present (Morris 2010). It may reflect a multiple equilibrium situation, in which temporary set-backs such as the collapse of the Roman Empire mask a long-term equilibrium. Eventually, such set-backs are reversed and the very long-term distribution is restored. Yet, Fig. 1 suggests that even if such a mechanism is present, the restoration of equilibrium takes up to a millennium, which renders even the Maddison data too short-term to discern an underlying equilibrium from this pattern.

In short, long-term evolutionary patterns are most strongly at odds with the notion of persistence alone. While path-dependence cannot be ruled out, the class of arguments most compatible with the long-term patterns observed highlights the presence of growth regimes.

3.2. Medium term evolution

Our main analysis focuses on the medium-term evolution of the impact of deep determinants. Here, the differences in implications between the classes of arguments are most obvious. Persistence arguments are compatible with a pattern of stable or slowly weakening effects. Path-

This figure presents the long-run evolution of per capita income in various world regions. (Own calculations on basis of Maddison data (Bolt and van Zanden 2020)).

Fig. 1. Long-run Comparative Development. *This figure presents the long-run evolution of per capita income in various world regions. (Own calculations on basis of Maddison data (Bolt and van Zanden 2020)).*

dependence may result in increasing effects after exogenous shocks. In growth regimes-arguments, divergence is most likely to be temporary, resulting in a pattern of increasing, then decreasing impacts.

3.3. Selection of determinants

The first step in our strategy is to select the most influential studies into deep determinants of development. The most common method for selection in meta-analyses is to rely on a decision rule based on keywords or JEL-codes. A careful look at a selection of papers that such a strategy should minimally net on theoretical grounds (e.g. [Acemoglu and JohnsonRobinson, 2001](#); [Nunn 2008](#); [Ashraf and Galor 2013](#)) reveals that the overlap in keywords or JEL-codes used in this literature is minimal, rendering this approach impractical for our purposes. For this reason, we rely on an alternative decision rule, based on expert surveys. Specifically, we take all 265 references in two recent overview articles published by [Nunn \(2014\)](#) and [Spolaore and Wacziarg \(2013\)](#) as our base sample. Where the surveys refer to working papers, we trace them to the published versions of those. This implies that the sample extends well beyond 2014 and includes many of the most recent contributions.

We have manually gone through all papers in this list, selecting those that (a) have eventually been published; (b) contain empirical analysis; (c) use a measure of contemporary economic performance as outcome variable; (d) use a geographical or historical variable to explain outcomes; and (e) for which data is available in at least 20 alternative years. This filtering leaves us with a reduced sample of 28 papers, collectively including 43 determinants of economic performance. Another 11 studies meet all criteria except that we have not been able to obtain sufficient time-variant data on outcome variables. This disproportionately applies to studies using regional rather than national data (e.g. [Acemoglu et al. 2011](#); [Bleakley and Lin 2012](#); [Bruhn and Gallego 2012](#); [Tabellini 2010](#)), so that our final sample is somewhat biased towards country-level comparisons. We do not see any reasons why this feature might be related to our findings. Nevertheless, we cannot entirely exclude the possibility that our results are somehow specific to inter-country comparisons.

Our selection procedure results in a sample of 43 of some of the most widely accepted deep determinants of economic development (collectively responsible for 10452 citations according to ISI Web of Knowledge³). A few equally influential papers do not make it into the sample due to the selection criteria used.⁴ [Table 2](#) presents a full overview of the determinants included in this study and the models selected. The table is split according to outcome variables. While most determinants have been related to income ([Table 2a](#)), some have been linked to productivity, growth, population density of other outcome variables ([Tables 2b-2e](#)).

3.3.1. Methodology: repeated regressions

We replicate selected studies where possible on basis of replication data and syntax files provided by the authors. Where such files are not provided, we reconstruct them on basis of the information about sources and methods provided in the text. In order to replicate results on a year-by-year basis, we first need to expand the datasets over time. When expanding the time range of the dependent variable, we use the same source as indicated in the original study where possible. However, we use updated versions of such datasets. Given the small differences between updated and originally used data on the outcome variables, we are not always able to fully replicate the original results. We use the available data as fully as possible. However, for some analyses, we adapt the starting year of the replication range from the earliest year for which

there are any observations to a later year if that results in a more constant or sufficiently large sample. The threshold criterion is at least 40 observations per year. Where this criterion cannot be met due to the small size of the original sample, we include determinant-years as long they cover at least 85% of the original sample. One study—about Inherited Trust ([Algan and Cahuc 2010](#))—enters because of this latter criterion. We explicitly mark it to caution against over-interpretation of these particular results.

For each study, we select the core model showing the effect of the introduced determinant on economic outcomes as presented in the paper. When discussing 2SLS-analyses, we focus on the model most relevant to the argument the authors are making. If the paper's contribution lies in showing the importance of deep determinants underlying proximate causes of economic performance, we present results for the reduced form of the underlying variables on economic performance. If the paper's main contribution is showing that the second stage variables matter and instruments are mainly introduced to address endogeneity, we present results for the second stage of the 2SLS model. We re-estimate the selected model for each year, saving the coefficients, 95% confidence intervals, and p-values. We then plot the coefficients and confidence intervals against time, setting the year of outcome variable measurement in the original study to zero. Details on the specific models and data sources are presented in Online [Appendix A1](#).

3.4. Results: evolution of impact

Columns 2–3 in [Table 2](#) present the results. Column 2 depicts the evolution of coefficients and their confidence interval over time, for each determinant separately. For the sake of readability, [Table 2](#) is split up according to dependent variables. [Table 2a](#) presents all determinants related to per capita income levels, presents determinants for labor productivity levels, income growth, population density, and other outcome variables respectively.

Looking at these graphs, our first observation is that all determinants behave as expected. They enter with the expected sign and are significant at least some of the time. This confirms the relevance of initial conditions on contemporary outcomes.

At the same time, our results suggest that the impact of deep determinants is not constant, but follows systematic evolutionary patterns. Visual inspection of the graphs in Column 2 reveals that the majority of determinants portrays a pattern of increasing significance. For all but 6 determinants, this pattern is strong enough to render the effects of deep determinants insignificant at the start of our sample. It may be noted that there appears to be no systematic difference between geographical and non-geographical variables in these patterns, confirming the argument that the impacts of these two categories follow similar processes ([Spolaore and Wacziarg 2013](#)). Any potential direct effects of geographical variables does not seem to generate different results. Except for growth, where a fluctuating pattern dominates, no notable differences between outcome variables appear either.

What is more, results suggest that for a high number of determinants, this increase is non-linear, with significance of impacts first increasing and then weakening. For 13 determinants, results even turn insignificant again within our period of analysis. Effects spike around the turn of the century, being neither significant before nor significant afterwards. This category includes highly cited studies such as [Ashraf and Galor \(2013\)](#). We stress that the absence of significance of determinants in certain years should not be read as evidence of an absence of effects. What it indicates, however, is that effects become much less pronounced when moving further away in either direction from the turn of the century.

To assess the veracity of this interpretation, Column 3 introduces the results of a regression of outcome variables on each determinant, including interactions with time variables. Specifically, we estimate:

$$Y_{i,t} = \alpha + \beta_1 D_i + \beta_2 t + \beta_3 X'_{i,t} + \beta_4 D_i \times t + \beta_5 X'_{i,t} \times t + \varepsilon_{i,t} \quad (1)$$

³ Accessed 25-11-2019.

⁴ Examples include [Nunn and Wantchekon, 2011](#), which does not use an economic performance outcome variable, and for which at least 20 years of outcome data is not available; or [Acemoglu et al. \(2005\)](#), which does not use contemporary outcome variables.

Table 2a

Overview of included determinants and results, (Outcome = GDP/Capita).

1.	2.	3.	4.
Determinant/Dependent/Replicated Model	Medium-Term Evolution of Effects	Time*Determinant/Time*Determinant + Time sqrd* Determinant	Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Absolute latitude ¹		0.0300** (0.0140)	0.0300** (0.0140)
GDP/capita		0.0988*** (0.0296)	0.0988*** (0.0296)
Table 2 (Easterly and Levine 2003)		−0.00146*** (0.000448)	−0.00146*** (0.000448)
Continental Axis ¹		1.15e-05*** (3.37e-06)	1.25e-05*** (3.28e-06)
GDP/capita		9.93e-06 (8.41e-06)	1.69e-05** (6.64e-06)
Table 5 (Olsson and Hibbs 2005)		3.19e-08 (1.46e-07)	−9.39e-08 (1.16e-07)
Coastal Population ¹		0.00553 (0.00405)	0.00409 (0.00386)
GDP/capita		0.0247** (0.00961)	0.0175** (0.00727)
Table 1 (Gallup and Sachs 2001)		−0.000400** (0.000164)	−0.0257*** (0.00621)

1. Determinant/Dependent/Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
<p><i>Climatic suitability for agriculture</i>¹</p> <p>GDP/capita</p> <p>Table 5 (Olsson and Hibbs 2005)</p>		<p>0.00319 (0.00252) 0.00665 (0.00556) -7.37e-05 (9.86e-05)</p>	<p>0.00219 (0.00272) 0.00337 (0.00541) -2.51e-05 (9.96e-05)</p>
<p><i>Continent Size</i>¹</p> <p>GDP/capita</p> <p>Table 5 (Olsson and Hibbs 2005)</p>		<p>-3.77e-07*** 1.14e-07 -1.04e-06*** (2.59e-07) 1.40e-08*** (4.86e-09)</p>	<p>-3.29e-07*** (1.23e-07) -9.05e-07*** (2.25e-07) 1.22e-08*** (4.12e-09)</p>
<p><i>Crops/Minerals supporting extractive institutions</i>¹</p> <p>GDP/capita</p> <p>Table 2 (Easterly and Levine 2003)</p>		<p>F: 4.46 (p 0.0002) F:6.97 (p 0.000) F: 4.53 (p 0.0002)</p>	<p>F: 4.46 (p 0.0002) F:6.97 (p 0.000) F: 4.53 (p 0.0002)</p>

1. <i>Determinant/Dependent/Replicated Model</i>	2. <i>Medium-Term Evolution of Effects</i>	3. <i>Time*Determinant/Time*Determinant + Time sqrd* Determinant</i>	4. <i>Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)</i>
<p><i>Crops/Minerals supporting inclusive institutions¹</i></p> <p>GDP/capita</p> <p>Table 2 (Easterly and Levine 2003)</p>		<p>F: 15.00 (p:0.000) F: 19.14 (p 0.0000) F: 3.12 (p. 0.0316)</p>	<p>F: 15.00 (p:0.000) F: 19.14 (p 0.0000) F: 3.12 (p. 0.0316)</p>
<p><i>Domesticable Plants and Animals¹</i></p> <p>GDP/capita</p> <p>Table 5 (Olsson and Hibbs 2005)</p>		<p>0.00857*** (0.00197) 0.00466 (0.00499) 6.80e-05 (6.40e-05)</p>	<p>0.00857*** (0.00197) 0.00466 (0.00499) 6.80e-05 (6.40e-05)</p>
<p><i>Duration of colonialism¹</i></p> <p>GDP/capita</p> <p>Table 2 (Feyrer and Sacerdote 2009)</p>		<p>4.03e-05* (2.44e-05) 0.000114 (8.45e-05) -1.64e-06 (1.82e-06)</p>	<p>5.40e-05*** (1.96e-05) 9.01e-05 (7.91e-05) -8.30e-07 (1.55e-06)</p>

1. Determinant/Dependent/Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
European population share ¹ GDP/capita Table 6 (Easterly and Levine 2016)		−0.0458 (0.0555) 0.248 (0.151) −0.00623** (0.00263)	−0.0461 (0.0559) 0.236 (0.150) −0.00600** (0.00262)
Early Technology Development (1000BC) ¹ GDP/capita Table 8 (Comin et al. 2010)		0.0159*** (0.00504) 0.0111 (0.0132) 8.97e-05 (0.000265)	0.0138*** (0.00361) 0.0138 (0.0121) −6.10e-07 (0.000254)
Genetic Distance to USA GDP/capita Table 1 (Spolaore and Wacziarg 2009)		−9.59e-06*** (3.65e-06) −1.60e-05*** (6.09e-06) 1.41e-07 (1.17e-07)	−1.09e-05*** (3.86e-06) −1.77e-05*** (5.81e-06) 1.47e-07 (1.11e-07)

1. Determinant/Dependent/Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Genetic Diversity		0.310 (1.778) 6.925** (3.297) -0.138** (0.0577)	-0.229 (1.697) 7.589** (3.213) -0.166*** (0.0579)
GDP/capita		-0.325 (1.263) -5.142** (2.363) 0.100** (0.0415)	0.0793 (1.207) -5.530** (2.304) 0.119*** (0.0416)
Genetic Diversity squared		0.0207* (0.0118) -0.00527 (0.0161) 0.000596 (0.000553)	0.0218* (0.0125) -0.00650 (0.0169) 0.000652 (0.000595)
GDP/capita			

Table 6 (Ashraf and Galor 2013)

Genetic Diversity squared

GDP/capita

Table 6 (Ashraf and Galor 2013)

Institutional Quality (IV Settler Mortality)

GDP/capita

Table 4 (Acemoglu, Johnson & Robinson 2001)

1. Determinant/Dependent/Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
<p><i>Historical Urbanization</i></p> <p>GDP/capita</p> <p>Table 3 (Acemoglu, Johnson & Robinson 2002)</p>		<p>−0.000589 (0.000407) −0.00236** (0.000996) 3.77e-05** (1.80e-05)</p>	<p>−0.000589 (0.000407) −0.00236** (0.000996) 3.77e-05** (1.80e-05)</p>
<p><i>Historical Urbanization, ancestry adjusted¹</i></p> <p>GDP/capita</p> <p>Table 4 (Chanda et al. 2014)</p>		<p>−0.000588 (0.000830) 0.00197 (0.00134) −5.44e-05* (2.76e-05)</p>	<p>−0.000588 (0.000830) 0.00197 (0.00134) −5.44e-05* (2.76e-05)</p>
<p><i>Island</i></p> <p>GDP/capita</p> <p>Table 1 (Spolaore and Wacziarg 2013)</p>		<p>0.00849* (0.00457) 0.0250** (0.00980) −0.000347** (0.000168)</p>	<p>0.00682 (0.00477) 0.0186* (0.00984) −0.000250 (0.000164)</p>

1.	2.	3.	4.
Determinant/Dependent/Replicated Model	Medium-Term Evolution of Effects	Time*Determinant/Time*Determinant + Time sqrd* Determinant	Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Landlocked		0.00145 (0.00452)	0.000420 (0.00431)
GDP/capita		0.00750 (0.0101)	0.00998 (0.00903)
Table 1 (Spolaore and Wacziarg 2013)		-0.000138 (0.000162)	-0.000203 (0.000170)
Malaria ¹		-0.0256*** (0.00621)	-0.0267*** (0.00622)
GDP/capita		-0.0148 (0.0162)	-0.0257*** (0.00621)
Table 1 (Gallup and Sachs, 2001)		2.02e-05 (0.000276)	-0.000284** (0.000130)
Neolithic Transition ¹		0.00384*** (0.000800)	0.00409*** (0.000774)
GDP/capita		0.00666*** (0.00156)	0.00737*** (0.00147)
Table 3 (Hibbs and Olsson 2004)		-6.02e-05** (2.90e-05)	-6.98e-05** (2.85e-05)

1. Determinant/Dependent/Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Neolithic transition, ancestry adjusted		1.67e-06 (1.02e-06) -1.47e-06 (3.13e-06) 6.65e-08 (5.27e-08)	1.56e-06 (1.01e-06) -1.85e-06 (3.09e-06) 7.27e-08 (5.26e-08)
GDP/capita			
Table 4 (Putterman and Weil 2010)			
Settler Mortality ¹		-0.117** (0.0573) -0.0773 (0.0607) 0.000111 (8.36e-05)	-0.00394** (0.00182) -0.00917** (0.00441) 0.000111 (8.36e-05)
GDP/capita			
Table 2 (Easterly and Levine 2003)			
Slave Trade		0.0323*** (0) 0.0860*** (0) -0.00154*** (0)	0.0323*** (0) 0.0860*** (0) -0.00154*** (0)
GDP/capita			
Table 3 (Nunn 2008)			

1. Determinant/Dependent/Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
State History ¹ GDP/capita Table 3 (Bockstette et al. 2002)		3.69e-07 (2.73e-07) 5.67e-07 (1.26e-06) -1.66e-09 (2.65e-08)	-1.53e-07 (2.72e-07) -5.82e-07 (1.19e-06) 9.36e-09 (2.33e-08)
State History, ancestry adjusted GDP/capita Table 4 (Putterman and Weil 2010)		0.0131** (0.00603) 0.0288* (0.0165) -0.000323 (0.000269)	0.0127** (0.00510) 0.0209 (0.0149) -0.000176 (0.000271)
Tropical area GDP/capita Table 1 (Spolaore and Wacziarg 2013)		-0.0176*** (0.00604) -0.0486** (0.0188) 0.000531* (0.000295)	-0.0198*** (0.00646) -0.0501** (0.0238) 0.000427 (0.000288)

1. Determinant/Dependent/Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Terrain Ruggedness outside Africa GDP/capita Table 1 (Nunn and Puga 2012)		-0.00155 (0.00161) 0.00258 (0.00408) -8.67e-05 (6.03e-05)	0.000273 (0.00126) 0.00360 (0.00314) -7.22e-05 (5.30e-05)
Terrain Ruggedness within Africa GDP/capita Table 1 (Nunn and Puga 2012)		0.00411* (0.00221) 0.00630 (0.00523) -5.06e-05 (8.15e-05)	0.00234 (0.00197) 0.00513 (0.00454) -6.08e-05 (7.62e-05)
Inherited Trust ² GDP/Capita Table 5 (Algan and Cahuc 2010)		2067** (856.0) 191.4 (598.4) 46.77 (29.20)	2067** (856.0) 191.4 (598.4) 46.77 (29.20)

Notes: This table presents an overview of the models included in the analysis, with the determinant, outcome variable, selected model (Column 1). Column 2 depicts the intertemporal pattern of effects graphically. It presents the evolution of coefficients and 95% confidence intervals over time, repeating specifications from the original publications. Column 3 presents the coefficients of an interaction of the determinant and time (top)/time and time squared (bottom). Column 4 repeats this for a constant 1970 sample. For the Crops/Minerals variables, the F-statistics of joint significance tests are presented rather than all coefficients separately, conform the original publication.

¹ Published outside the top general interest economics journals (*Quarterly Journal of Economics*, *American Economic Review*, *Econometrica*, *Journal of Economic Literature*, *Journal of Political Economy*, *Review of Economic Studies*, and *Review of Economics and Statistics*).

² Cross-sectional sample size < 40.

in which $Y_{i,t}$ is the outcome variable, D_i is the determinant, i is the unit of observation, and t is time. $X'_{i,t}$ presents a vector of control variables, depending on the specification in the original publication (see Online Appendix A1 for details). The error term $\varepsilon_{i,t}$ is clustered at the level of the unit of observation. The top half of each cell presents the coefficient of the interaction term β_4 . In order to check whether the trend is linear, we also run a second regression adding a squared time variable:

$$Y_{i,t} = \alpha + \beta_1 D_i + \beta_2 t + \beta_3 X'_{i,t} + \beta_4 D_i \times t + \beta_5 X'_{i,t} \times t + \beta_6 t^2 + \beta_7 D_i \times t^2 + \beta_8 X'_{i,t} \times t^2 + \varepsilon_{i,t} \quad (2)$$

The bottom half of each cell presents the results of the time-determinant interactions in this specification, β_4 and β_7 . Results confirm that for the majority of determinants, there is an increase in impact. For most of this group, however, this increase appears to be weakening and eventually reversing over time. Our analysis thus strongly suggests that the impact of deep determinants follows a pattern of increases, frequently followed by a decrease.

3.4.1. Robustness

3.4.1.1. Sample and data quality. A possible problem with these results is

that the quality of underlying data is not constant over time. For one thing, there is information about more countries in later years than in earlier years, if only because some countries did not exist as independent states yet at the start of the period we study. It is therefore possible that the observed variation in coefficients and significance may be due to temporal variation in sample size. To show that the patterns in Table 2 are not driven by increasing sample sizes, we repeat the analysis keeping sample sizes constant (Column 4). Results are qualitatively unaffected.

Going back in time, not only do sample sizes become smaller, but the quality of the available data is also likely to worsen. This would translate in less reliable estimates in earlier years, potentially driving an overall pattern of emerging statistical significance.

In assessing this possibility, we distinguish between classical and non-classical measurement error. For the first, we note that it is only the dependent variable that is time-variant in our analyses. Independent variables are deep-rooted, historical or geographical determinants for which data quality does not vary over time. If measurement error is classical, it only affects confidence bands and not the coefficients. We can use this to check to what extent changes in data quality are driving our results. To do so, we assess to what extent changes in significance are caused by changes in estimates relative to changes in confidence intervals.

Table 2b

Overview of included determinants and results (Outcome = Productivity).

1. Determinant/Dependent/ Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Individualism (IV genetic distance to UK) Productivity Table 1 (Gorodnichenko and Roland, 2017)		−9.01e-05 (0.000139) 0.000883** (0.000450) −2.04e-05** (8.67e-06)	−7.88e-05 (0.000116) 0.000793** (0.000324) −1.85e-05*** (6.21e-06)
Islam Productivity Table 1 Gorodnichenko and Roland, 2017)		−0.00920* (0.00486) −0.0444*** (0.0159) 0.000756** (0.000299)	1.87e-05 (0.00542) −0.0300* (0.0179) 0.000638* (0.000366)
Eastern Religions Productivity Table 1 Gorodnichenko and Roland, 2017)		0.0698*** (0.0197) 0.209*** (0.0352) −0.00294*** (0.000552)	0.0589*** (0.0150) 0.193*** (0.0302) −0.00285*** (0.000477)

Visual inspection of Table 2 reveals that in most cases, changes in statistical significance can be attributed to changes in coefficients rather than in confidence bands. To check this more carefully, we calculate the ratio of the changes in coefficients to the changes in the distance of the confidence interval to zero for each determinant, averaged over the entire period of analysis (Table 3). It reveals that except for the cases of seasonal frost, ancestry-adjusted historical urbanization, landlockedness and pronoun drop, the change in statistical significance is predominantly driven by increasing effect sizes. For 13 determinants, the increase in statistical significance occurs in spite of confidence intervals widening over time.

If measurement error is not classical, it may bias coefficients and confidence intervals alike. Such bias occurs to the extent to which measurement error is (a) present, it is (b) heteroscedastic, and (c) it has a non-zero mean. It follows that any changes in coefficients over time may be caused by changes in the size, changes in the heteroscedasticity, or changes in the mean of the measurement error. If measurement error of GDP is especially prevalent among low income countries, for example, and the direction of measurement error is by and large upwards, this reduces the impact of any deep determinant on per capita income. If statistical capacity subsequently disproportionately improves among poor countries, these observations edge closer to their true value, boosting the observed impact of deep determinants. The above results already indicate that confidence intervals are fairly constant, if not increasing over time, ruling out the first option. To check the second option, Column 2 in Table 3 reports the changes in heteroscedasticity between 1970 and 2000 for each determinant. Results are mixed, but reveal no clear common downward trend in heteroscedasticity. While for some determinants heteroscedasticity reduces over time, the majority either increases or shows no significant trend. That only leaves the possibility that measurement error across the board grows more neutral over time. A decreasing tendency to err upwards may be expected as part of a general pattern of improving statistical capacity, but that should coincide with a general reduction in both the size and heteroscedasticity of the error. While we cannot rule out the possibility that the observed results

are reflecting changes in the means of measurement errors, the absence of reductions in size and heteroscedasticity of measurement errors renders this scenario unlikely. Table 3 strongly suggests that the evolutionary patterns we observe are true patterns, and not an artefact of diminishing measurement error.

We also check the possibility that the pattern is generated by a subset of papers that is of lower scientific quality. We note that all papers under considerations are published in either the top general economics journals, top field journals (e.g. Journal of Economic Growth, Journal of Monetary Economics), or top general interest journals outside economics (e.g. Nature, Proceedings of the National Academy of Sciences). We do not consider any of the outlets in the latter two groups to be likely to maintain lower standards of scientific rigor than the top general interest economics journals. Nevertheless, we check the possibility that outlet quality is responsible for our findings by comparing the results for the 22 determinants published in the top-6 with the results of the 21 determinants published elsewhere (denoted with superscript ¹ in Table 2). Results are highly similar. If anything, the ratio of determinants exhibiting statistically significant temporal patterns is marginally higher in the top-6 group (17:5 versus 15:6). We conclude that the patterns we observe seem to be real.

3.4.2. Additional variables

To what extent are the patterns of increasing significance dependent on the specifications used? In our analyses thus far, we have followed the specifications of the original contributions. It may be, however, that our results are a consequence of omitted variables common to all of these. These variables may influence the observed impact of deep determinants.

To check this possibility more carefully, we include observation unit-fixed effects to our regressions (cf. Acemoglu et al. 2005; Nunn and Qian 2011). Table A18 in the Online Appendix 2 presents the results.

We start with models including just fixed effects and time interactions. This addresses any biases caused by time-invariant omitted variables. We find that the qualitative results remain unchanged. There is still an increase in effects across the board. Results also confirm the non-

Table 2c
Overview of included determinants and results (Outcome = Growth).

1. Determinant/Dependent/ Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Trust		24.86 (172.1)	156.9 (138.7)
GDP/capita Growth		333.4 (294.9)	249.5 (263.8)
Table 1 (Zak and Knack 2001)		-6.861 (7.230)	
Seasonal Frost ¹		-7.33e-06 (1.13e-05)	-1.47e-05 (1.02e-05)
GDP/capita Growth		3.50e-05 (3.31e-05)	6.53e-05 (4.21e-05)
Table 2 (Masters and McMillan 2001)		-6.45e-07 (6.98e-07)	-1.41e-06 (9.12e-07)

Table 2d

Overview of included determinants and results (Outcome = Population density).

1. Determinant/Dependent/ Replicated Model	2. Medium-Term Evolution of Effects	3. Time*Determinant/Time*Determinant + Time sqrd* Determinant	4. Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
<i>Lake Coast</i> ¹		0.00412*** (0.000830)	0.00412*** (0.000830)
Population Density		0.00733*** (0.00152)	0.00733*** (0.00152)
Table 3 (Rappaport and Sachs 2003)		–2.92e-05*** (1.01e-05)	–2.92e-05*** (1.01e-05)
<i>Ocean Coast</i> ¹		0.00720*** (0.000722)	0.00720*** (0.000722)
Population Density		0.00693*** (0.00153)	0.00693*** (0.00153)
Table 3 (Rappaport and Sachs 2003)		2.50e-06 (1.07e-05)	2.50e-06 (1.07e-05)
<i>River Coast</i> ¹		–0.000342 (0.000408)	–0.000342 (0.000408)
Population Density		4.85e-05 (0.000739)	4.85e-05 (0.000739)
Table 3 (Rappaport and Sachs 2003)		–3.55e-06 (5.42e-06)	–3.55e-06 (5.42e-06)

linear nature of this increase, as the interactions with time and time-squared consistently produce opposite coefficients.

Next, we consider time-variant variables. Deep determinants may determine economic performance not directly, but set countries' specialization patterns, for example. It is not unlikely that climatic conditions push some societies towards industrial production and others towards primary commodities. Any changes in the relative prices between these classes of goods then translates in a change in impact of deep determinants on economic performance. To check such possibilities, we add the shares of agriculture (World Bank 2020), the commodity price index (UNSTAT 2020), and the terms of trade to the model (World Bank 2020). Results indicate patterns similar to the ones before.

We also check whether changes in trade openness are responsible for the patterns observed before. Trade openness is measured as the ratio of imports and exports to GDP (World Bank 2020). Results do not indicate any qualitative change. The pattern of (non-linear) increases in impact remains.

Likewise, the patterns we observe may be driven by changes in the global political economy. Any root variables that associate a society with China, for example, may acquire a more positive effect on economic performance with the growing economic clout of China. The declining global role of former colonial powers or the change in economic orientation from the former Soviet Union towards Western economies may

have similar effects. To assess such possibilities, we include countries' share of trade that is oriented towards China, the US, France and Britain, and Russia. Again, results remain qualitatively the same.

Although we cannot rule out that other time-variant omitted variables are behind the pattern we observe, we believe that we have considered the most obvious candidates. We therefore conclude that the pattern of (non-linear) increases in the impact is real, and can be ascribed to the dynamics of the mechanism linking determinants to performance.

3.5. C. Which countries drive these patterns?

The third aspect of the evolution we address is the influence of individual units of observation. The three scenarios presented in Table 1 each suggest different patterns in the evolution of impacts. In each case, different sub-sets of observations are likely to be responsible for these patterns.

In order to assess the role of individual countries in establishing the observed patterns, we estimate the effect of deep determinants on outcomes in the year 1995, following the original specification. We repeat this while replacing the value of the outcome variable with the one of 1970, country by country. We subsequently compute the differences between the variable's coefficients in the original and the adapted estimations, divided by the standard errors. This results in a measure of

Table 2e
Overview of Included Determinants and Results, other outcomes.

1.	2.	3.	4.
Determinant/Dependent/Replicated Model	Medium-Term Evolution of Effects	Time*Determinant/Time*Determinant + Time sqrd* Determinant	Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Pronoun drop ¹		0.000698 (0.00176)	0.000716 (0.00176)
Governance Quality		−0.00322 (0.00710)	−0.00317 (0.00708)
Table 7 (Tabellini 2008b)		6.92e-05 (0.000103)	6.87e-05 (0.000102)
Precolonial Institutions, country-level ¹		0.0809 (0.456)	0.213 (0.493)
Infant mortality		−0.625 (0.937)	−0.359 (0.866)
Table 2 (Gennaioli and Rainer 2007)		0.0146 (0.0146)	0.0111 (0.0171)
Plough Agriculture		−0.390** (0.178)	−0.390** (0.178)
Female labor participation		−0.759* (0.397)	−0.759* (0.397)
Table 4 (Alesina et al. 2013)		0.00839 (0.00895)	0.00839 (0.00895)

1.	2.	3.	4.
Determinant/Dependent/Replicated Model	Medium-Term Evolution of Effects	Time*Determinant/Time*Determinant + Time sqrd*	Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample)
Genetic Distance, Bilateral		Time*Determinant 7.04e-06** (1.69e-06) 4.63e-06 (3.66e-06) 5.12e-08 (7.49e-08)	Time*Determinant/Time*Determinant + Time sqrd* Determinant (constant sample) 7.04e-06** (1.69e-06) 4.63e-06 (3.66e-06) 5.12e-08 (7.49e-08)
Bilateral difference in GDP/capita			
Table 3 (Spolaore and Wacziarg 2009)
Precolonial Institutions, regional level		-0.000105 (0.00213) 0.00575 (0.00437) -0.000276 (0.000208)	-0.000105 (0.00213) 0.00575 (05) (0.00437) -0.000276 (0.000208)
Nighttime luminosity
Table 2 (Michalopoulos and Papaioannou 2013)			
TseTse		-0.00347 (0.00357) -0.0125* (0.00741) 0.000431 (0.000394)	-0.00347 (0.00357) -0.0125* (0.00741) 0.000431 (0.000394)
Nighttime luminosity
Table 7 (Alsan 2015)			

Notes: see Table 2a.

Table 3
Are Patterns driven by Measurement Error?

Determinant	(1) Share of change in significance driven by change in coefficient	(2) Time trend in heteroskedasticity 1970–2000
Climatic suitability for Agriculture	.8053477	.9559491 (.0413334)
Colonial duration	.6316957	.0054872 (.0167391)
Continent Size	1.186526	.9559491 (.0413334)
Continental Axis	1.168452	.9559491 (.0413334)
Coastal population (national)	1.059019	.2290551 (.064164)
Distance to Lakes (USA)	1.214548	–1.371086 ^a (.6586832)
Distance to Oceans (USA)	.5470486	–1.371086 ^a (.6586832)
Distance to Rivers (USA)	4.833324	–1.371086 ^a (.6586832)
Domesticable Plants and Animals	.9946751	.0622198 (.0215453)
Seasonal Frost	.2667257	–.4326791 (.1210325)
Genetic distance to the USA	1.306845	–.328806 (.1237679)
Bilateral genetic distance	.8901709	–
Genetic diversity	2.384638	–.2369623 (.0653413)
Genetic diversity squared	.9092231	–.2369623 (.0653413)
Historical urbanization	1.411211	.0381595 (.0313982)
Historical urbanization (ancestry-adjusted)	.3087623	–.04269 (.0086257)
Individualism	.7133408	–.1658132 (.0562131)
Inherited trust	1.718422	–.016271 (.0062606)
Institutional Quality (IV=Settler Mortality)	1.176522	.0229724 (.0153446)
Malaria	.9903665	–1.202746 (.111814)
Neolithic transition	.9919101	–.3770727 (.0141034)
Neolithic transition (ancestry-adjusted)	.8590901	–.0123923 (.0432721)
Plough agriculture	.8353907	–.0704054 (.081986)
Pre-colonial institutions (national)	.6984313	.0911547 (.0241725)
Pre-colonial institutions (regional)	.9180815	.6037942 (.53702)
Pronoun drop	.4417164	–.3622125 ^b (.2120986)
Ruggedness	.520136	–.001273 (.0237306)
Ruggedness in Africa	.9340508	–.001273 (.0237306)
Settler Mortality	1.379526	.094368 (.0167132)
Share of European population	.5222749	.184805 (.0051156)
Slave exports	1.136285	.0262097 (.0071291)
State History	.9132779	–.3061679 (.1851835)
State History (ancestry-adjusted)	.6373799	–.4630415 (.0425164)
Technology 1000 BC	.9660754	–.0374526 (.0099889)

Table 3 (continued)

Determinant	(1) Share of change in significance driven by change in coefficient	(2) Time trend in heteroskedasticity 1970–2000
Trust	1.42781	–.1215877 (.2303729)
Tse-tse fly	1.581815	.0990126 (.0444764)
Islam	.6191452	–.1658132 (.0562131)
Eastern Religions	.8670404	–.1658132 (.0562131)
Island	1.675748	–.1440042 (.0709339)
Landlocked	.4484071	–.1440042 (.0709339)
Tropical Area	.7959815	–.1440042 (.0709339)
Absolute Latitude	1.282803	.094368 (.0167132)

Notes: Column 1 presents the ratio of the change in coefficient to the change in the distance of the confidence interval to zero per determinant, averaged over the entire period of analysis. All but three determinants portray a ratio of over 0.5, indicating that changes in significance are predominantly driven by changes in estimates rather than by changes in the width of confidence intervals. Column 2 presents the time trend in heteroskedasticity. Combined with lack of neutrality in measurement error, a decline in heteroskedasticity may cause coefficients to increase. Overall, results do not indicate measurement error drives the observed trends.

^a Decadal data 1900–2000.

^b 1984–2000.

influence for each country and each determinant. This procedure allows us to assess for which countries the change in performance between 1970 and 1995 is most strongly responsible for any increase in impact of determinants over this period. We do the same for the period between 1995 and 2015, also assessing which countries have the strongest impact on the decline in effects over this period. We restrict ourselves to specifications with countries as units of analysis.

Table A19 (Online Appendix 3) presents, for each determinant, the top 5 observations that were most influential in increasing the impact between 1970 and 1995. It also present the top 5 countries that contributed most to a decline in impact for the period of 1995 and 2015. This information is summarized in Fig. 2, which depicts the geographical distribution of the most influential countries over the world in the first period. The full set of results for all country-determinant combination is available on request.

Two things stand out. First, from 1970 to 1995, a small set of countries shows up repeatedly across variables. The most common ones, in the top-5 of influential observations for >6 determinants, are Argentina, China, Egypt, Indonesia, Hong Kong, Malta, Malaysia, Nigeria, Singapore, South Korea and Taiwan. This is in spite of the fact that we consider a highly diverse set of determinants over different samples. Second, this list is highly specific. The list includes all of the four so-called Asian Tigers, as well as Malaysia, Indonesia and China. All these are East Asian economies characterized by sustained, rapid growth and industrialization.

This pattern fits the restoration of equilibrium-interpretation rather well. East Asia's role in the global economy in the mid-20th century was, due to the combined impact of colonialism, the Pacific War, and civil strife, significantly below its long-term historical trend. The spectacular growth in the region in the second half of the 20th century has therefore often been interpreted as a 'renaissance' (Gill and Kharas 2007), returning these societies to their historical positions. The idea of a strong, common shock after which equilibrium is restored appears to fit this history.

This map depicts the number of determinants for which countries are in the top-5 of influential observations. Influential observations are defined as observations for which the difference of their 1970 and 1995 values contributes most to the increase in impact over this period.

Fig. 2. Top-5 Most influential countries, number of determinants. This map depicts the number of determinants for which countries are in the top-5 of influential observations. Influential observations are defined as observations for which the difference of their 1970 and 1995 values contributes most to the increase in impact over this period.

On the other hand, the list of most influential observations includes countries such as Nigeria, Egypt, and Argentina that experienced significant institutional and economic backsliding in this period. If what is going on is a restoration of equilibrium, these countries would need to have started the period of analysis at a historically unusually high level of performance. While possible, there is no obvious reason why this would be so.

The period from 1995 to 2015 offers a different picture. Again, a small subset of countries appears most strongly responsible for any decline in impacts after 1995. The pattern is a different one, however. Again, Nigeria is in the top-5 of influential observations for >6 determinants, but it is now joined by Peru, Zambia, Liberia, Equatorial Guinea, Ethiopia, and Chile. A common element in this list appears that it concerns economies that benefited strongly from a China-fueled investment and commodity boom in the 2000s, many of them in Africa. In contrast to the list of countries for 1970–1995, the resulting rise in incomes for these countries did not coincide with a process of industrialization and structural change (Rodrik 2016). While little conclusive can be said about this, this pattern is compatible with an interpretation in which countries are elevated above their long-run equilibrium place in the global income distribution due to (temporary) positive circumstances.

Table 4
Persistence mechanisms and empirical findings.

	Long-run pattern	Medium-run impact of DD	Class of countries driving changes in impact
<i>Persistence</i>	Prediction: Consistent differences Observation: No	Prediction: Slowly dissipating Observation: No	Prediction: Any
<i>Path-dependence/ Multiple Equilibria</i>	Prediction: Fluctuations around consistent trend Observation: No	Prediction: Stable or increasing Observation: Yes (often followed by decrease)	Prediction: Countries subject to recent shocks Observation: Yes
<i>Growth Regimes</i>	Prediction: Limited differences followed by temporary divergence. Observation: Yes	Prediction: Temporary increase followed by decrease Observation: Yes	Prediction: Increasing phase-leading economies Decreasing phase-lagging economies Observation: No

4. Interpretation

How to interpret our findings? First, we would like to stress how not to interpret them. The patterns observed do not indicate that the results of the deep determinants literature are wrong in any way. While the limitations of using country-level cross-sectional approaches to study deep determinants have increasingly been recognized by researchers in the field (e.g. d'Alpoim-Guedes et al., 2013; Austin, 2008; Kelly 2019), our paper does not provide any arguments for or against such methods. Explaining the evolutionary patterns we observe here requires more than the underlying results being wrong. We would need a mechanism through which methodological limitations translate into *increasingly and then decreasingly* false positives. We cannot think of any plausible mechanisms that would result in such a time-variant systematic error. That raises the question what can account for the observed patterns.

Our first class of explanations for the current role of deep determinants most clearly cannot. Its prediction of enduring differences in performance is contradicted by long-run history, in which different economies are at the top at different moments. In addition, its prediction of a stable if slowly declining impact of deep determinants is at odds with the increasing impact we observe in the medium-run. Comparative economic history does not seem to be described well by pure persistence arguments.

The second class of explanations interprets the patterns identified in this paper as movements towards equilibrium. In this line of argument, historical deep determinants provide a shock to the economy, setting it off on a slow course towards a new equilibrium (e.g. Nunn 2007). Alternatively, deep determinants define a stable equilibrium that is gradually being restored when major one-time shocks, such as wars or pandemics, wear off. In a context of no new shocks or obstacles preventing countries to move to their equilibrium states, the gradual movement towards an equilibrium determined by root variables generates the patterns of increasing significance observed here. The challenge for this argument is that it requires a shock slightly before the start of our period of analysis that is common and dominant enough to generate an overall movement towards equilibrium. Analysis of country contributions to this trend reveals that the countries most responsible for a rise in impacts are fast-growing economies located in East Asia. This pattern is compatible with an interpretation of increasing impacts as a restoration of long-run equilibrium.

Going against this line of argument is the non-linearity of the increase in impacts of most deep determinants. After rising until around the turn

of the century, impacts appear to fall again since the mid-1990s. This is not conform the long-run equilibrium scenario. However, the pattern points to another possibility. Analysis of the list of countries driving the pattern suggests that a commodity boom in Sub-Saharan Africa and Latin-America, fueled by the resurgence of resource-hungry East Asia is behind the results. If so, the rise in impact of deep determinants in the last decades of the 20th century and the subsequent decline in their impacts since the 1990s may be part of the same historical development. The East Asian renaissance might drive the patterns we observe, including the decline in impact of determinants after 1995.

What about explanations in terms of transitions between growth regimes? In this class of arguments, deep determinants do not so much determine performance levels, as they set the timing of transitions to new growth regimes. As a result, the economic relevance of deep determinants depends on the stage of development. Around the timing of such a transition, one would first expect strong economic divergence with leading economies leaping ahead of others. This phase would then be followed by convergence, once other economies have reached the new growth regime and have started to catch up.

The very long-run pattern of relative economic development (relative stability followed by strong divergence) fits this set of theories rather well, as does the dominant pattern of a rise and subsequent decline in impact of deep determinants in the medium run. Yet, in this interpretation, increasing impacts ought to be driven by leading economies, and subsequent declining effects by emerging economies catching up with them. This is at odds with what we observe in reality. If anything, the increasing impact phase seems driven by emerging markets, and the declining impact phase by countries at the bottom end of the income distribution.

Table 4 summarizes the results and confronts them with the three categories of persistence mechanisms. Altogether, we can draw two conclusions. First, we find that empirical patterns are most compatible with the scenario of path-dependence, in which deep determinants set an underlying long-run equilibrium. However, results are somewhat mixed, and some of the patterns are more in line with growth regimes-models. It should be noted that growth regimes models and equilibrium-arguments are not mutually exclusive and may very well work in tandem to link past variables to the present. Although results do not allow a definitive verdict on the mechanisms linking past to present, it appears that pure persistence arguments can be ruled out. Second, regardless of the precise mechanism, our results clearly indicate that the practical relevance of deep determinants for present-day outcomes varies considerably over time. It appears that the impact of deep determinants is not a universal law, but contingent on the global political economic context.

5. Conclusions

In this paper, we have assessed the evolution of the effects of deep determinants on economic outcomes, in order to shed light on the mechanisms through which they matter. We find that the contemporary relevance of many of the deep determinants of development identified in the economics literature appears to be a temporary restricted phenomenon. The majority of deep determinants portray a pattern of increasing impacts on development outcomes, mostly driven by East Asian economies. What is more, this trend appears to be non-linear in the majority of cases. After peaking around the turn of the century, the impacts of many deep determinants start to decline or even disappear.

In the very long run, we find little evidence of consistent persistence. Different countries and regions dominate the world economy at different moments in history. The current, strongly uneven global distribution of income is relatively novel and dates back a few centuries, which is about the same order of time previous periods of regional leadership lasted.

We interpret these findings from the perspective of three classes of possible mechanisms that link the past to the present: persistence, multiple equilibria leading to path-dependence, and models highlighting the transitions between growth regimes. Our results are most strongly at

odds with pure persistence. All our results indicate that the current relevance of deep determinants is not a direct function of their relevance in previous times. Even for those determinants not exhibiting a significant time trend in impact, their significance itself is a recent phenomenon. It appears that what matters for development in the year 2000, did not necessarily matter in 1960 and vice versa. The present is not a simple continuation of the past.

The patterns we observe are more compatible with an interpretation in terms of a restoration of equilibria after exogenous shocks. In the process towards their individual equilibria, economies would move along paths that return them to the performance levels dictated by their underlying determinants. Such a process would increase the explanatory power of deep determinants, driven by East Asian fast-growing economies. This interpretation would be in line with explanations featuring multiple equilibria that generate path-dependence. Yet, such a mechanism has more difficulty explaining the often concave nature of this process. While a restoration of equilibrium is an interpretation of the increasing impact we observe that is compatible with path-dependence arguments, on its own, this interpretation fails to account for the subsequent decline of effects.

This last aspect of our observations is more compatible with arguments highlighting growth regimes, in which the effect of deep determinants is mostly felt through the timing at which different countries reach different development stages. In such arguments, relatively small differences between economies due to underlying, deep conditions are temporarily inflated when the most progressive economies first reach a higher growth stage. Over time, as other economies reach the new stage of growth and start to catch-up with the leaders, the impact of initial conditions declines again. The concave evolutionary pattern of the impact of many deep determinants fits this mechanism rather well.

Our results have important implications. First, it sheds a clearer light on the kind of mechanisms that are responsible—and the mechanisms that are apparently *not* responsible—for the impact of historical, deep determinants today. While continuing to trace income differences back to an ever expanding set of remote root causes is important, improving our understanding of *how* root causes are linked to the present is an at least equally important element of a complete theory of long-run development.

Second, our results matter for policy. If historical conditions negatively affect economic performance in some societies today, it is important to know through what mechanisms such root variables reproduce their impact over time. Addressing the quality of institutions in a scenario of institutional path-dependence and multiple equilibria requires something considerably more substantial than doing so in a scenario of mere outcome-persistence. Also, while we confirm the relevance of deep-rooted conditions on differences in development, the patterns exposed in this paper suggest that the strong inequality in performance these conditions generate may be temporary. If we go along with the growth regimes-interpretation, the strength of the impact of deep determinants is contingent on the current phase of global development. As more countries reach the stage of sustained modern growth, the inequality that is attributable to deep determinants is likely to recede. More in general, our results indicate that the impact of deep determinants is not completely consistent over time, nor are patterns of leaders and laggards persistent over the long run. Different factors matter differently over time, leading to different societies coming out on top. This offers hope for societies not blessed with what currently appear to be favorable root conditions. The past may determine the present, but the present is not a simple continuation of the past.

Author statement

This paper and all underlying analyses are produced by Robbert Maseland.

Data availability

All replication data is available from the authors of the original publications. Syntax will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jdeveco.2021.102654>.

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