GGDC RESEARCH MEMORANDUM *173*

Understanding the Ability to Sustain Growth

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November 2017

university of groningen

groningen growth and development centre

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by

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Paper prepared for the GGDC Anniversary Conference, Groningen, 28-30 June 2017

UNU-MERIT

Version 26-11-2017

Abstract

Rather than focusing on average growth rates of GDP per capita, this paper analyses growth episodes. Using simple filters, the growth experiences of 152 countries between 1950 and 2015 are decomposed into three types of episodes: positive growth episodes, contractions and recoveries. Each of these episodes is characterised by duration and within episode growth rates. The analysis opens with a descriptive analysis of the relationships between long-run relative growth performance – catch up, stagnation or falling behind - and the characteristics of growth episodes. The analysis shows that differences between economic success and failure depend primarily on the duration of the positive growth episodes i.e. the ability to sustain growth. Differences in within episode growth rates are far less important.

Subsequently the econometric analysis focuses on the determinants of episode duration. Three kinds of variables are distinguished: institutional variables, structural variables (sector shares in GDP) and standard economic variables such as trade openness and inflation. The structural variables derive from a novel dataset on sector shares in GDP for 152 countries and 65 years. The inclusion of institutional and structural variables allows us to assess the relative importance of institutions and structure for growth performance. The econometric analysis is of two kinds: probit analysis focusing on explanations of the chances of being in an episode and survival analysis which looks at the factors which determine the risk of an episode coming to an end.

JEL codes: O4, O14, 047, L16

Key words: duration of growth, specialisation, diversification, structure, structural change, structural transformation

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1 Introduction

What determines whether economies are able to sustain economic growth over longer periods of time? This is the key topic of this paper. What are the factors affecting this ability? Are they primarily structural in nature or are they primarily institutional or political? In attempting to answer such questions this paper focuses on growth episodes, rather than on average growth rates. It argues that analysing the determinants of average growth of income per capita may obscure the fact that different types of growth episodes are driven by different factors. Thus, analysing growth episodes may contribute to a better understanding of success and failure in long-run growth processes. In particular, the paper focuses on the duration of growth episodes. The paper hopes to show that rich and poor countries and catch-up and non-catch up countries typically differ in their abilities to sustain their growth over longer periods of time. We know that poor countries can grow very rapidly (Hausmann *et al.*, 2005), but they are less able to sustain this growth.

The paper will distinguish three types of growth episodes: positive growth episodes, contractions and recoveries. It is important to distinguish recoveries from positive growth episodes, because many so-called growth accelerations include a recovery component (Bluhm *et al.*, 2013). This is misleading. Growth only contributes to long-run growth performance if it continues beyond pre-contraction peaks. In this paper, besides analysing the duration of positive growth, we will also pay attention to the duration of contractions. The ability to respond effectively to contractions and crises is one of the defining characteristics of more successful economies (North *et al*., 2009, Bluhm *et al*., 2013).

After distinguishing different kinds of episodes the paper identifies the determinants of their duration, one of the important characteristic of episodes. For this we use a variety of econometric methods. One of the interesting debates concerns the relative importance of institutional and structural factors in explaining growth. In the burgeoning literature on growth episodes since 1998 (Pritchett, 1998), institutional variables play a prominent role. Factors that have been discussed include constraints on the executive, indicators of democracy, the rule of law, protection of private property, ethnic fractionalisation and so forth. The importance of these factors is compared with that of traditional economic indicators such as investment, inflation, openness and so forth.

What is typically missing from the episodes literature are measures of economic structure.[1] There is a second strand of literature where structure takes the pride of place in explaining growth. This is the structural change literature going back to classical authors such as Lewis, Kuznets, Kaldor or Chenery, and which examines the contributions of structure, structural change and industrialisation to growth. Recent examples of this literature include Szirmai, 2012, Szirmai and Verspagen, 2015, Lavopa and Szirmai, 2014). Foster, Kaba and Szirmai (2015) is a first attempt to relate structural variables to growth episodes, arguing that, other

[1] Some papers do take into account the structure of exports, but so far there has been no discussion of the role of the structure of GDP in this literature.

things equal, the higher the share of manufacturing in GDP, the longer the duration of positive growth episodes. One of the criticisms of this strand of research is that it pays insufficient attention to possible root causes of growth and development, such as institutional characteristics.

This paper attempts to combine variables from both of these traditions in the econometric analysis. It makes use of existing data sets on constraints on the executive, ethnic fractionalisation and political conflict. It also makes use of a novel dataset on sectoral shares in GDP for 152 countries going back to 1950. The episode data derive from a newly constructed episode database, deriving primarily from the Maddison database. We do not claim that we can answer the question of the primacy of structure over institutions or vice versa (a la Rodrik *et al.,* 2004), but we have succeeded in the first step of combining such variables in the econometric analysis.

This paper is structured as follows. Section 2 discusses theoretical considerations. Section 3 presents a first descriptive analysis of growth episodes and their relationship with long-run growth dynamics. Section 4 focuses on the econometric methodology. A discussion of the variables and data used in the econometric analysis is to be found in section 5. The results of the analysis are presented in section 6. Section 7 concludes.

2 Theoretical considerations

2.1 Growth episodes and duration

Growth is often not steady. It is characterised by switching among growth regimes (Pritchett, 1998, 2000; Berg *et al.,* 2012; Bluhm *et al.,* 2013; Kar *et al.,* 2013, Pritchett *et al.,* 2016). Pritchett (1998) has argued that attempting to explain differences in average growth rates may be misleading. According to Jones and Olken (2008) long-run averages for a country may hide distinctive periods of success and failure. It is more promising to find out what initiates or halts episodes of growth, or what influences the characteristics of growth episodes (Aizenman and Spiegel, 2010; Rodrik, 2003; Rodrik *et al.,* 2004; Hausmann *et al*., 2006; Jerzmanowski, 2006; Kar *et al*., 2013). The various growth episodes (slumps, recoveries, steady growth episodes, accelerations, take-offs, plateaus) are the building blocks of the long-run growth process.

Different papers have examined the characteristics and determinants of different types of growth episodes: growth accelerations, slumps and crises, recoveries. For instance, Hausmann *et al*. (2005, 2008) focus on growth accelerations. They find that growth accelerations are fairly easy to realise, also in low-income economies. Unleashing a growth acceleration does not always require a comprehensive set of economic reforms. Even limited reforms, removing the most binding constraints to growth, can result in accelerations. What is more difficult and demanding, however, is to sustain the growth process beyond the initial acceleration (Rodrik, 2003, 2006). A shortcoming of the Hausmann and Rodrik approach is that their growth accelerations also include recoveries. From a long-term perspective growth will only contribute to secular increases in GDP per capita when growth continues beyond pre-crisis peaks. In our approach, growth episodes will exclude recoveries.

Short term fluctuations, extreme volatility, abrupt shocks – whether internal or external, political or economic, natural or man-made – all have the potential to hinder economic growth in the long term (Loayza *et al*., 2007; Ramey and Ramey, 1995). But countries differ greatly in how they respond to shocks. An important strand of the new institutionalist literature argues that developing countries are more vulnerable to interruptions of growth, in part due to their institutional characteristics, and that it is this very vulnerability that determines long-run differences in growth performance (Acemoglu *et al*., 2001, 2003, Acemoglu and Robinson, 2012; Agénor *et al*., 1999; Besley and Persson, 2011; Bluhm and Szirmai, 2013; North *et al.*, 2009). In previous work we have examined the determinants of the onset and duration of crises (Bluhm *et al*., 2013; Bluhm *et al.*, 2016). Bluhm *et al*. (2013) conclude that the key factors influencing the duration of economic crises are the lack of constraints on the executive and high degrees of ethnic fractionalisation.

Therefore, in this paper we argue that the ability to sustain positive growth rates over longer periods of time is one of the key characteristics of successful economies. A major contribution to this part of the literature is the outstanding article by Berg *et al*. (2012): *What makes growth sustained?* This article will be discussed in more detail below. In the present paper, the main focus is also on the duration of positive growth episodes (for a definition see section 4). We will show that breaking down average growth rates into growth episodes can provide new insights into the growth process. In addition to the duration of positive growth episodes, we will also pay attention to the duration of contractions.

2.2 Breaking down the long-run growth process into episodes

Understanding long-run processes of growth catch up and falling behind requires breaking down the growth process into a set of distinctive episodes. We need to find out whether countries that have high growth rates over long periods have different sequences of episodes (one could refer to this as the 'genetic code' of growth) to countries that experience long-run stagnation. There are indications that this is indeed the case. Countries that are trapped in poverty show more volatility in their growth patterns, with shorter growth episodes alternating with contractions that undo previous gains. Countries that achieve catch up typically have longer and smoother positive growth episodes. A first exploration of such patterns will be given in section 3 of this paper. Here, episodes are characterised by their duration and their within-episode growth rates. After breaking down long-run growth into a comprehensive set of episodes, the next question is what are the key factors determine the episode characteristics (i.e. duration and growth).

2.3 Filters versus break analysis

In the literature there are two alternative approaches to identifying growth episodes and the breaks between the episodes. The first approach used to classify growth episodes is through defining a set of economic criteria (Aizenman and Spiegel, 2010; Calvo *et al*., 2006; Hausmann *et al*., 2005, 2008; Reddy and Minoiu, 2009). Following Kar *et al*. (2013) we refer to this as the filter approach. A second alternative is to use econometric and statistical methods to identify the timing of breaks. Trend breaks in growth rates (between different growth regimes) are selected in such a way that the deviations from mean growth rates are minimised (Bai and Perron, 1998, 2006; Berg *et al*., 2012; Bluhm, *et al*., 2013; Jones and Olken, 2008; Papell and Prodan, 2012).

Kar *et al*. (2013) provide a good discussion of the pros and cons of the different approaches. The obvious limitation of filter approaches is that they are ad hoc. This leads to a lack of consistency in the identification of breaks across papers that use filter based approaches. Also, when the underlying series are volatile, deterministic filters may risk identifying too many spurious breaks (Berg *et al.*, 2012). An important shortcoming of break analysis is that it is limited by the low power of the Bai-Perron test, which may lead to the rejection of genuine breaks. They therefore argue for a combination of the two methods, starting with the econometric approach and then using economic criteria to test the plausibility of the breaks and sometimes adding additional ones.

According to Kar *et al*. (2013) a second shortcoming of the filter approach is that there is a lack of a single unified framework to identify all types of transitions. Each contribution tends to study a single type of growth transition characterised by given filter rules. We disagree with Kar *et al*. on this issue. Papers on episodes, whether using filters or statistical methods, usually tend to focus on one type of episode or one type of transition. Papers hardly ever focus on a breakdown of a whole period into different types of episodes. The connection with long-run growth performance is seldom made. Also, there is no reason why a filter approach cannot provide the unified framework that the authors call for. In fact, this is what we attempt to do in the current paper.

In this paper we opt for a filter approach. Using very simple rules – see section 3 – we break down the whole period 1950-2015, distinguishing episodes of growth and slump episodes. Slumps are subsequently broken down into contractions and recoveries. Subsequently we zoom in on the determinants of the duration of the growth episodes and the contraction episodes. Thus, a long-run growth experience will be decomposed into positive growth episodes, contractions and recoveries. We do not attempt to distinguish between business cycles and other cycles. If a business cycle is so extreme that it results in a contraction of GDP per capita, this is interpreted as the beginning of a shorter or longer contraction.

2.4 Berg et al. on the duration of growth

One of the best contributions to the literature is the paper by Berg, Ostry and Zettelmeyer (2012) on *What makes growth sustained?* Their point of departure is similar to that of this paper, namely what sets poor performing countries in sub-Saharan Africa and Latin America apart is that their growth spells have tended to end relatively quickly compared to East Asian or industrial countries. The paper then enquires what factors contribute to the duration of growth spells.

The authors define growth spells as periods of high growth preceded by an up break and ending with a down break or the end of the sample. To identify the breaks their paper uses a combination of statistical break analysis and economic filters. The authors use proportional

Hazard models to estimate which factors significantly influence the duration of the growth spells.

Summarising the results, the factors that predict sustained growth are a more equal income distribution, democratic institutions, openness to trade, foreign direct investment and an export structure that favours more sophisticated products. Also of importance are stable macro-economic environments with lower inflation rates, less exchange rate depreciation and slower accumulation of debt.

One of the factors conspicuously missing in this otherwise excellent paper is structural change. In the present paper we have included most of the variables of Berg *et al.*, but have added a variety of measures on the structure of the economy, as indicated by sector shares in GDP.[2] Our statistical approach – duration analysis – is the same as used in the Berg paper. But there are also important differences. We have opted for a filter approach which allows us to make a complete breakdown of a long period of growth into growth (whether rapid or slow), contractions and recoveries. We have made some adjustments to rule out the shortest cyclical variations, but in principle we simply want to distinguish between growth and non-growth. As a result we have a larger set of positive growth episodes (546) than Berg *et al*. Berg *at al*. have a minimum length of growth spells of either five or eight years (with respectively 424 and 128 spells). Next, as with most episode papers, Berg *et al*. focus primarily on a single type of growth episode. They do not have much to say about the episodes before or after the growth episode.[3] In this paper, we analyse both the duration of growth episodes and the duration of contractions.

2.5 Structure and structural change

One of the most glaring omissions of the institutionalist literature is the neglect of factors such as structural change, technology and innovation, which are so prominent in other strands of development economics. Since Lewis (1954), Kuznets (1966) and Fei and Ranis (1964, 1976), structural change and industrialisation are seen as the *conditio sine qua non* for economic development. Structural change is entwined with innovation and technological change because some sectors are seen as the key locations where technological change takes place, while others are not. Technology diffuses from key sectors to the rest of the economy (Cornwall, 1977; Kaldor, 1967). Technological innovations are also drivers of structural change, giving rise to the emergence of new methods of production and new sectors. As mentioned above, much work on growth episodes tends to focus on the institutional and political economy determinants of growth episodes and tends to disregard variables measuring structure or structural change that are much more prominent in studies dealing with average growth rates (for an overview see Szirmai and Verspagen, 2015).

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[2] Two measures which figure prominently in the Berg paper, namely income inequality and terms of trade still have to be included in our regressions.

[3] They do discuss growth rates before and after an episode.

A defining characteristic of the current paper, therefore, is that we zoom in on the relationship between structural characteristics of an economy and the duration of positive growth episodes. We will include variables measuring structure at the beginning of each episode as well as variables reflecting structural change in the course of an episode.

2.6 Which sectors act as the engines of growth and duration?

What all structuralist theories have in common is that the structure of the economy is important for economic growth, because some sectors have more growth potential than others. This means that when an economy succeeds in increasing the share of sectors with high growth potential in a given period, this will enhance the growth of the economy, while if the share of sectors with low growth potential increases, this will reduce the growth of the economy. This opens the search for the structural shifts which are growth enhancing or reducing (e.g. McMillan and Rodrik, 2011; Timmer and Szirmai, 2000). In this context, there are debates on the respective roles of agriculture and industry, mining and manufacturing, or the respective roles of industry and the service sector. Also, there is a search for specific sectors that can act as engines of growth such as ICT hardware, ICT software services, financial services, the automobile industry, capital goods sectors or high-tech manufacturing sectors. Since 1950, one of the classic hypotheses in development economies is that the manufacturing sector has a key role to play as an engine of growth in low-income economies.

One should realise that the role of sectors may change over time in the light of technological change and changes in the structure of global production (Lavopa and Szirmai, 2015). Also the engines of growth may differ in different types of economies (large versus small, resource rich versus resource poor, rich versus poor). One of the important stylised facts of economic development is that the share of manufacturing in value added and employment tends to increase when developing countries start growing at low levels of development. It peaks at intermediate levels of per capita income and subsequently declines as the service sector becomes more important at high levels of per capita income (Szirmai, 2012; Tregenna, 2013, 2015). The interpretation of the increase in the manufacturing share is that manufacturing plays a special role as engine of growth and catch up at lower levels of economic development. Even when its share starts to decline at higher levels, it remains important as a driver of growth, though perhaps less exclusively so.

A substantial part of the literature, as summarised in Szirmai (2012), Szirmai and Verspagen (2015), Lavopa (2015) and Tregenna (2015), provides a measure of support for the engine of growth hypothesis. But the hypothesis is also fiercely contested. Critics argue that several modern service sectors such as ICT services, financial services, or transport and logistics can and do play the role of engine of growth in a manner very similar to that of manufacturing in the past (Dasgupta and Sing, 2006; Eichengreen, 2009; Timmer and De Vries, 2009; Van Ark *et al.*, 2003). The example of India is often mentioned as a case of service-led growth since the 1990s. In this paper we will empirically examine the relationship between (changes in the) the share of manufacturing and the duration of positive growth episodes and contractions to contribute to the debate of sectoral sources of growth.

One of the arguments of critics of the engine of growth hypothesis is that some modern service sectors such as software, financial services or logistics have many of the same characteristics of dynamic manufacturing sectors and can also act as engines of growth. In the current analysis we examine the effects of three variables: the share of manufacturing in GDP at the beginning of an episode, the share of mining, and a variable MODSERV, which measures the share of trade plus financial services. These two service sectors are considered to be modern market services which are candidates to replace manufacturing as the engine of growth. Most of the previous empirical analyses have focused on the relation between structure and growth rates. Here we recast the debate to analyse the relationship between structure and duration.[4]

3 Descriptive evidence on growth episodes

3.1 Defining episodes

The data on GDP per capita from 1950 to 2015 are completely broken down into episodes using simple filter methods. The aim is to decompose the complete growth trajectory into its constituent episodes. We start by distinguishing two main types of episodes: positive growth episodes and slumps. Slumps are subsequently broken down into contractions and recoveries.

Positive growth episodes

Positive growth episodes are episodes in which GDP per capita in each year is higher than in the previous year. The decision rules for considering a given year to be part of a positive growth episode are as follows:

1. GDP per capita is higher than previous year;

2. GDP per capita is higher than the previous year for two years in a row. (A single year of growth is not counted as a growth episode);

3. The positive growth episode ends in the last year that GDP is higher than the previous year, except for conditions under point 4;

4. A positive growth episode is not considered to end if the drop in GDP per capita is less than 1 percent of the previous year (t-1) and GDP per capita recovers to the level of year t-1 within one year.

The growth episode is considered to end if either of two conditions hold:

5. The drop in GDP per capita in year t is more than 1 per cent of GDP per capita in t-1;

6. The drop in GDP per capita in year t is less than 1 per cent of GDP per capita in year t-1, but it takes more than one year to recover to the level in year t-1.

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[4] A first attempt to analyse this relationship was provided in an early version of this paper (Foster-McGregor, Kaba and Szirmai, 2015). This paper provided evidence of a positive relationship between the initial degree of industrialisation and the duration of growth episodes.

Using these criteria, positive growth episodes can be distinguished which can be described in terms of two characteristics: the number of years of positive growth (duration) and the average rate of growth of GDP per capita within the episode. We have a dataset of in total 546 positive growth episodes.

Slumps

1. The slump starts in the first year that GDP per capita is lower than the peak year of the previous growth episode;

2. The first year of a slump is preceded by two years of growth;[5]

3. The slump ends in the year before GDP per capita exceeds pre-slump peak GDP per capita.

Contractions

1. The first year of a contraction is the first year of a slump;

2. The end of a contraction is the year within the slump in which GDP per capita reaches its lowest level, i.e. the trough. [6]

We have a dataset of in total 513 contractions.

Recoveries

1. The recovery starts one year after the trough;

2. If the end of a slump coincides with the trough, the recovery starts in the year of the trough;

3. The end of a recovery episode is equal to the end of a slump.

3.2 Episode characteristics and growth dynamics

Table 1 gives a first indication of the importance of the duration of positive growth episodes for economic development and catch up. In the table, we arrange countries according to their relative income positions (quintiles) in 1950 and 2015. We distinguish between countries that remain in the same quintile between 1950 and 2015 (rows 1, 6, 11, 16 and 19), countries that have achieved a relative improvement and countries that have experienced a relative decline.[7]

Some interesting patterns can be discerned. First, countries that remain stuck in the bottom quintile have the shortest durations of growth (7.7 years on average). This indicates that countries staying in the bottom quintile are the countries that are least able to sustain positive growth episodes over longer periods. Countries that have succeeded in maintaining their

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[5] "With the exception of 1951

[6] The trough can coincide with the end of the slump. In these cases the next year is higher than the pre-slump peak.

[7] Improving relative position is based on relative income rankings. It is not exactly the same as catch up, which means reducing the percentage gap in GDP per capita relative to the lead economy. It is possible that a country improves its ranking, while its GDP gap increases. Nevertheless, in table 1, we continue to use catch up as a short-hand term for improvement in relative position.

position in the top quintile have much longer durations (15.2 years on average). Next, countries that climb the income ladder starting from the bottom two quintiles (categories 2, 3, 4, 7, 8, and 9) have much longer positive growth episodes than countries that remain stuck in those quintiles.

Looking at contractions, countries that remain stuck in the bottom quintiles have much longer contractions than countries that maintain their position in higher quintiles (8.7 years in the bottom quintile versus 1.9 years in the top quintile). Countries that realise upward mobility between 1950 and 2015 invariably have much shorter contractions than countries that are stuck at any given level. In countries that experience a relative decline, contractions last much longer than in countries that do not.

In a similar fashion, it takes much longer to recover after a contraction (recovery is the number of years from a trough to the pre-crisis peak GDP per capita) for countries that remain stuck in low quintiles or are experiencing downward mobility than for countries that remain rich or experience upward mobility.

In sum, countries that remain poor or experience relative declines have much shorter positive growth episodes, much longer contractions and find it much hard to recover from crises. Countries that remain rich or are moving upwards have much longer positive growth episodes, much shorter contractions and tend to recover more rapidly from interruptions to growth. **The ability to sustain growth is the key difference between more successful and less successful economies.**

In contrast to duration, differences in growth rates are far less pronounced and the patterns are not always clear. Countries that are trapped in the bottom quintile actually grow more rapidly during their growth episodes than countries in the top quintile. This is in line with the observation of Hausmann *et al*. (2005) that achieving growth in poor countries is fairly easy, but sustaining it more difficult. Poor countries can grow at least as rapidly as rich countries. But they are much more vulnerable to interruptions of the growth process. They find it more difficult to sustain growth over longer periods and this is what really matters.

The average rates of decline during contractions and rates of recovery during recoveries do not show very clear patterns between lower and higher incomes or upward and downward mobile countries. It seems that what matters for long-run economic performance is duration rather than growth. This is reflected in the last column of Table 1, which shows very large and systematic differences in the percentage of time spent in growth. Countries in the top quintile spend twice as much time in growth than countries in the bottom quintile. Countries that experience upward mobility have the highest percentage of time in growth.

Finally, Table 1 also has a column on volatility, measured as the coefficient of variation of growth (measured by the absolute value of the coefficient of variation of growth between 1950 and 2015). Here the patterns are extremely pronounced. In countries stuck in bottom quintiles volatility of growth is very high, while in top quintile countries it is very low. Volatility in upwardly mobile countries is also very low. Improvements in relative income position are characterised by sustained and stable patterns of growth.

Table 1: Episode characteristics and growth dynamics 1950-2015

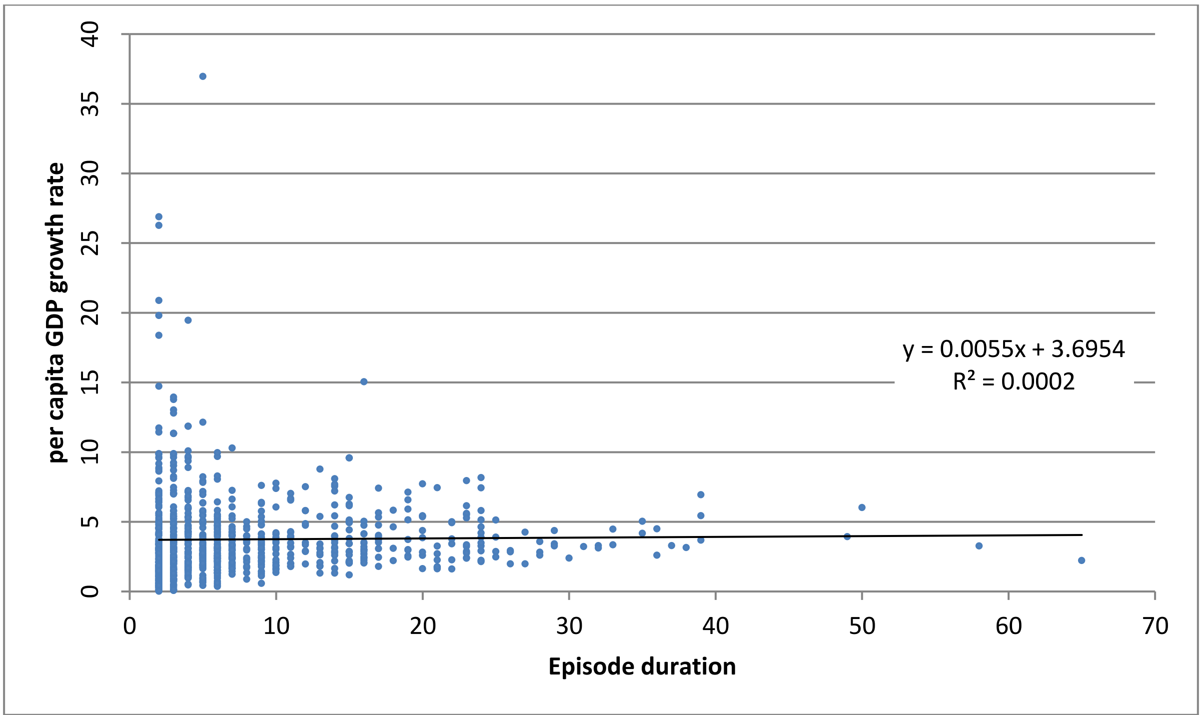
Growth Dynamics	Duration of positive episodes	Duration of slumps	Duration of contractions	Duration of recoveries	Average growth during positive episode	Average decline during contractions	Average growth during recoveries	Volatility	% of total period spent in growth	N
category 1: remains in bottom quintile	**7.7**	**16.7**	**8.7**	**8.3**	**3.8**	**-2.8**	**2.2**	**8.3**	**39.3**	**14**
category 2: catch up from quintile 1 to 2	10.4	10.2	5.7	4.8	4.0	-2.8	3.5	2.0	61.3	6
category 3: catch up from quintile 1 to 3	11.1	3.6	1.5	2.6	4.9	-4.2	3.2	1.2	82.1	3
category 4: catch up from quintile 1 to 4	9.9	4.5	2.1	2.6	7.0	-4.1	5.6	1.7	75.4	2
category 5: decline from quintile 2 to 1	9.3	23.2	15.7	7.9	4.5	-3.0	2.8	19.3	28.0	11
category 6 remains in quintile 2	**9.4**	**10.8**	**5.8**	**5.4**	**3.7**	**-3.6**	**3.2**	**4.5**	**49.7**	**6**
category 7: catch up from quintile 2 to 3	11.6	8.9	2.7	6.4	4.2	-3.4	2.5	1.4	71.5	4
category 8: catch up from quintile 2 to 4	13.8	4.3	2.3	2.7	4.9	-2.4	2.5	0.9	84.6	1
category 9: catch up from quintile 2 to 5	16.4	2.1	1.0	2.0	5.9	-3.3	3.3	0.8	93.8	2
category 10: decline from quintile 3 to quintile 2	7.1	16.6	7.7	9.3	4.2	-3.5	2.0	5.2	34.5	11
category 11: remains in quintile 3	**9.5**	**9.3**	**4.0**	**5.8**	**4.3**	**-2.8**	**2.3**	**2.1**	**56.6**	**9**
category 12: catch up from quintile 3 to 4	8.7	5.0	2.7	2.7	4.6	-3.1	3.0	1.6	69.2	5
category 13: catch up from quintile 3 to 5										
category 14: decline from quintile 4 to 3	7.5	11.0	4.2	7.2	3.8	-3.5	2.2	3.5	46.4	9
category 15 decline from quintile 4 to 2	7.7	22.0	7.5	14.5	3.1	-3.4	2.0	3.1	35.4	1
category 16: remains in quintile 4	**12.8**	**6.7**	**2.9**	**4.2**	**4.0**	**-2.7**	**2.0**	**1.3**	**73.9**	**10**
category 17: catch up from quintile 4 to 5	12.2	4.3	2.0	2.6	4.7	-2.3	3.6	1.1	80.3	5
category 18: decline from quintile 5 to 4	4.6	20.8	11.9	8.8	4.4	-3.8	2.9	13.3	27.7	7
category 19: remains in quintile 5	**15.2**	**4.5**	**1.9**	**3.0**	**3.0**	**-2.1**	**1.6**	**1.1**	**79.3**	**18**

Sources: 1950-2015: Maddison project growth rates, supplemented and updated to 2016 with Conference Board, 2015 and WDI 2016

Notes: Sample: 125 countries. These are the 152 countries of our new database, minus former Soviet countries and other countries for which no growth rates are available prior to 1989. Volatility measured by the absolute value of the coefficient of variation of growth rates

Further confirmation of the importance of duration is found in Figure 1. Here we plot the duration of each episode against its growth rate. There turns out to be no significant relationship between the length of an episode and the rate of growth within the episode. Growth during longer episodes is not typically faster or slower than during shorter episodes. This means that duration itself has an independent influence on the average growth rate between 1950 and 2015. It is also worth noting that the variation in within-episode growth rates is very much higher in shorter episodes than in longer ones. [8]

Figure 1: Growth of Per Capita GDP within Episodes by Duration of Episode, 1950-2015



Source: Maddison project database.

4 Methodology

In this section we describe the empirical approaches that are adopted to examine the factors determining the duration of growth episodes and contraction episodes. To do this we adopt three complementary approaches.

[8] This pattern remains visible, even if we remove the shortest episodes and only plot the episodes of three years and longer (figure available on request).

First, we estimate the following model that relates the probability of being in an episode to the structure of the economy and other control variables:

$$Episode_{it} = \alpha_i + \beta_j \mathbf{X}_{itj} + \gamma_l \mathbf{Y}_{\text{itk}} + \delta_k \mathbf{Z}_{itl} + \tau_m \mathbf{C}_{itm} + \varphi_t + \varepsilon_{it}$$

Where $Episode$ is a dummy variable taking on the value one if country i is in a growth episode in year t and zero otherwise. In this case we use yearly data within the period 1960-2015, giving us again a panel dataset. The explanatory variables include a vector of structural variables **X**, a vector of institutional and political variables **Y**, a vector of standard economic variables **Z** and a vector of additional control variables **C**. Also included in this model are a set of time fixed effects, with country fixed effects also controlled for in various specifications.

Given the binary nature of the dependent variable we have a number of options to estimate this model, and we report results from a number of alternative estimators. Initially, we impose the restriction that all individual effects are identical and estimate the simple Linear Probit Model (LPM) and the pooled Probit model. In later specifications however we allow for unobserved country specific effects through the use of the random effects Probit model and the Mundlak-Chamberlain. As is well-known the non-linear nature of the Probit and Logit model make it difficult to account for country fixed effects in the Probit model, with the result being that there is no fixed effects Probit model. The Mundlak-Chamberlain model is something of a middle way between a random and a fixed effects model, and proceeds by modelling the fixed effects as a function of the explanatory variables. Essentially, the approach involves including individual means of the explanatory variables as additional controls in a random effects Probit model, which allow for a non-zero correlation between the explanatory variables and the individual fixed effects.

The second approach that we adopt is to simply regress the duration (log length) of an episode on the same economic structure, institutional/political, economic and other control variables used in the Probit analysis:

$$ln\,Duration_i = \alpha_0 + \beta_j \mathbf{X}_{ij} + \gamma_l \mathbf{Y}_{\text{ik}} + \delta_k \mathbf{Z}_{il} + \tau_m \mathbf{C}_{im} + \varepsilon_i$$

Note that in this case we no longer have a panel dataset, but instead one observation per episode.

Thirdly, we consider the relationship between the duration of an episode and the explanatory variables using survival analysis. Initially this involves considering the Kaplan Meier estimator to estimate the survival function, before moving on to relate the duration of an episode to a set of explanatory variables using the Cox proportional hazards model. The survival function gives the probability of surviving past time t, and can be written as: $S(t) = \Pr(T > t)$, with T being the survival time. The cumulative distribution of T is expressed as $\text{P(t)} = \Pr(T \leq t)$, implying that the survival function is the complement of the cumulative distribution function. Related to the survival function is the hazard function, which gives the instantaneous probability of failure (i.e. exit from a growth episode) at time t, conditional upon surviving to that date. This can be written as: $\lambda(t) = \frac{p(t)}{S(t)}$, with $p(t)$ being the probability density function.

The Kaplan-Meier method allows the computation of an estimated survival function in the presence of right censoring and can be written as:

$$\hat{S}(t) = \prod_{t(i)\leq t} \frac{n_i - d_i}{n_i}$$

With n being the number of survivors still at risk just prior to time t and d being the number of deaths at time t.

To relate the survival of a growth episode to explanatory variables we use the Cox Proportional Hazards model[9], which can be written as:

$$\lambda(t; \mathbf{x}) = \kappa(\mathbf{x})\lambda_0(t)$$

With $\kappa(\cdot) > 0$ being a positive function of $\mathbf{x}$ and $\lambda_0(t) > 0$ being the baseline hazard. The baseline hazard is common to all units in the population (i.e. we can think of it as being the hazard if all covariates were equal to zero), with individual hazard functions differing proportionately based on a function $\kappa(\mathbf{x})$ of observed covariates.

The term $\kappa(\cdot)$ is parameterised as $\kappa(\mathbf{x}) = \exp(\mathbf{x}\boldsymbol{\beta})$, such that:

$$\log \lambda(t; \mathbf{x}) = \mathbf{x}\boldsymbol{\beta} + \log \lambda_0(t)$$

With β_j measuring the semi-elasticity of the hazard with respect to x_j. An implication of this setup is that the effect of the covariates is the same at all points of time.

Note that the model is a proportional hazards model, which essentially implies that the ratio of the two hazards (i.e. that for individual i and the baseline) does **not** depend upon time. To see this, assume that we have a two sample problem, with x being a dummy variable taking the value one for group 1 and 0 for group 0. The model can then be written as:

$$\lambda(t; x) = \begin{cases} \lambda_0(t) \\ \lambda_0(t)\exp(\beta) \end{cases}$$

The term $\lambda_0(t)$ represents the risk in time t in group 0, while $\gamma = \exp(\beta)$ represents the ratio of risk in group 1 relative to group 0 at any time t. Note further that if $\gamma = 1$ ($\beta = 0$), then the risks are the same in the two groups. One advantage of the Cox model over other survival models is that we don't have to make any assumptions about the baseline hazard, $\lambda_0(t)$.

For the duration analysis (both the linear regression and the Cox proportional hazards model), we take the values of the explanatory variables at the beginning of each episode. In some cases we also examine the effect of the change of variables from the beginning to the end of the episode. We do this in particular for the structural variables.

The above discussion concentrates on the case of positive growth episodes. In the analysis below we further report results when considering episodes of contractions.

[9] We also use parametric survival models. Results from these models are qualitatively similar to those from the proportional hazards model. But the analysis is primarily based on the non-parametric models.

5 Data, variables and descriptive statistics

Data on per capita GDP levels 1950-2010 are obtained from the Maddison project database (http://www.ggdc.net/maddison/maddison-project/home.htm), supplemented by data from the conference board total economy database for four countries. The TED database is also used to update the Maddison data to 2015. Where this was not possible, we used additional data from the World Bank, World Development Indicators. This dataset was used to construct the episodes. The duration variables are the length of positive growth episodes and the length of contractions.

For the indicators of economic structure we constructed our own database. This database includes data on 156 countries for the period 1950-2016. Full detail about the construction of the database is provided in Annex I. The dataset contains information about sectoral shares in value added at current prices. The sectoral breakdown is in terms of nine major sectors.[10] In our econometric analysis we only use data for the period 1960-2010. For the 1950s there were too many missing values, which made it impossible to include this earlier data. Also, the quality of the data for developing countries was questionable. For quite many countries there were no data for the earlier years because of boundary changes or because the country did not yet exist (e.g. Eritrea, Bangladesh, United Germany, former Soviet Republics, United Vietnam, the Czech and Slovak Republics, The former Yugoslav republics). The total number of observations for sector structure (years for which sector information is available per country) in the final unbalanced dataset was 6077.

The dataset was compiled from a variety of sources, namely: (1) the Groningen Growth and Development Centre, Ten-sector database (http://www.rug.nl/research/ggdc/data/10-sector-database). This database includes 42 countries, ten sectors, 1950-2010; (2) The Groningen Growth and Development Centre, World Input-Output Database (http://www.wiod.org/new_site/home.htm). This database includes 40 countries, 35 sectors for the period since 1995; and (3) *UN national accounts website*, Table 2.1 Value added by industries at current prices (ISIC Rev. 3), http://data.un.org/Data.aspx?d=SNA&f=group_code%3a201, downloaded February 2015. This source contains country data, with different degrees of breakdown going back to 1950, though with lots of missing data in the early years. D. Hard copies of UN National Accounts Statistics: *UN Yearbook of National Accounts, 1967* has data for 1953, 1955, 1957-66; *UN, Yearbook of National Accounts, 1975* which has data for 67-74. This source usually provides a breakdown for 11 sectors. The published yearbooks provide data for more countries before 1975, than source (3).

In our empirical analysis we focus on three measures of economic structure, namely the share of manufacturing in current GDP (MAN), the share of mining in current GDP (MIN) and the

[10] 1.Agriculture; 2. Mining; 3. Manufacturing; 4.Utilities; 5. Construction; 6. Trade, Restaurants and Hotels; 7. Transport, Storage and Communication; 8. Finance, Insurance, Real Estate and Business Services; 9. Government Services, Community, Social and Personal Services.

share of modern services (transport, storage and communication and finance, insurance, real estate and business services) in GDP (MODSERVE).

Data on many of the economic variables are from the World Bank's *World Development Indicators database*. Variables taken from this database include population (pop), the ratio of gross capital formation to GDP (gfcf), the ratio of exports to GDP (*expgdp*), inflation measured as the growth of the consumer price index (dlcpi), the ratio of general government final consumption to GDP (ggfc).

Average years of schooling (yr_sch) in the population over 15 are obtained from the Barro and Lee database (www.barrolee.com).

Data on political constraints (polcon) is from the dataset of Heinisz (https://mgmt.wharton.upenn.edu/profile/henisz/) and ranges between zero and one, with higher numbers indicating increasing constraints on the executive.

The two variables inttot and civtot are indicators of external and internal conflict and are from the Major Episodes of Political Violence and Conflict Regions database (www.systemicpeace.org/inscr/MEPVcodebook2015.pdf). The former variable is a variable capturing international violence/warfare that the country was involved in, while the latter captures the extent of civil violence/warfare in the country, with higher numbers indicating greater violence/warfare.

Table 2: Summary Statistics for Probit Analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
growth episode dummy	9702	0.489	0.500	0.000	1.000
growth contraction dummy	9702	0.219	0.414	0.000	1.000
MAN	6100	0.172	0.089	0.000	0.737
MIN	6062	0.074	0.129	-0.087	0.831
MODSERV	6087	0.181	0.082	0.000	0.613
expgdp	6610	0.342	0.263	0.000	2.30.3
relus	9002	0.277	0.317	0.007	3.205
ggfc	6527	0.152	0.062	0.000	0.762
gfcf	5978	0.213	0.072	-2.424	0.656
yr_sch	8334	5.429	3.195	0.010	14.142
elf_15	9636	0.461	0.296	0.001	0.965
polcon	7902	0.217	0.217	0.000	0.720
dlcpi	5573	0.113	0.267	-0.176	5.475
inttot	8069	0.108	0.643	0.000	9.000
civtot	8072	0.629	1.579	0.000	10.000
Length	9702	4.450	7.755	0	65
Length_sq	9702	79.930	266.04	0	4225

Data on ethnolinguistic fractionalisation (elf_15) is from the paper of Desmet *et al* (2012), and does not vary across time.

In the Probit model we further include the length to date of the growth episode (along with its squared term) (length and length_2) to capture the notion that the probability of remaining in an episode is likely to diminish over time.

Table 2 reports descriptive statistics for the data used in the probit analysis, table 3 for the duration analysis.

Table 3: Summary Statistics for the Duration Analysis

Panel 3A Growth episodes

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
lduration	Log duration	367	1.758	0.739	0.693	3.664
MAN	share of manufacturing in GDP	366	0.164	0.081	0.002	0.446
ΔMAN	change in share of man during episode	366	-0.005	0.035	-0.197	0.155
MIN	share of mining in GDP	366	0.072	0.128	0.000	0.687
ΔMIN	change in share of mining during episode	366	0.005	0.043	-0.253	0.260
MODSERV	share of modern services	366	0.187	0.088	0.000	0.440
ΔMODSERV	change in share of modern services	366	0.016	0.051	-0.133	0.430
MANREL	interaction term manufacturing and relus	366	0.053	0.059	0.000	0.253
MINREL	interaction term mining and relus	366	0.024	0.127	0.000	1.683
MODSREL	interaction term modern services and relus	366	0.062	0.076	0.000	0.440
expgdp	share of exports in GDP	316	0.352	0.282	0.025	2.194
relus	income as percentage of USA	367	0.285	0.301	0.017	2.449
ggfc	Government consumption as % of GDP	314	0.154	0.057	0.038	0.453
gfcf	Gross fixed capital formation as % of GDP	294	0.212	0.063	0.040	0.529
yr_sch	Years of schooling, 15+	324	5.845	3.335	0.224	12.550
elf_15	ethnic fractionalisation	364	0.418	0.303	0.001	0.965
polcon	constraints on the executive	342	0.238	0.222	0.000	0.708
dlcpi	Inflation	277	0.075	0.104	-0.101	0.905
inttot	interstate warfare	349	0.072	0.600	0.000	7.000
civtot	civil conflict	349	0.481	1.334	0.000	9.000

Panel 3B: Contractions

Variable	Description	Obs	Mean	Std. Dev.	Min	Max
lduration	Log duration	247	1.488	0.846	0.693	3.970
MAN	share of manufacturing in GDP	246	0.165	0.098	0.002	0.737
∆MAN	change in share of manufacturing during episode	246	-0.032	0.099	-0.371	0.282
MIN	share of mining in GDP	246	0.080	0.143	0.000	0.687
∆MIN	change in share of mining during episode	246	0.005	0.122	-0.486	0.435
MODSERV	share of modern services	246	0.184	0.095	0.012	0.613
∆MODSERV	change in share of modern services	246	0.072	0.079	-0.105	0.433
MANREL	interaction term manufacturing and RELUS	246	0.056	0.058	0.000	0.265
MINREL	interaction term mining and RELUS	246	0.035	0.161	0.000	1.598
MODREL	interaction term modern services and RELUS	246	0.071	0.093	0.001	0.752
expgdp	share of exports in GDP	203	0.314	0.253	0.021	2.303
relus	income as percentage of USA	246	0.319	0.335	0.020	2.324
ggfc	Government consumption as % of GDP	198	0.163	0.062	0.027	0.482
gfcf	Gross fixed capital formation as % of GDP	176	0.225	0.070	0.055	0.491
yr_sch	Years of schooling, 15+	220	5.638	3.649	0.043	13.052
elf_15	ethnic fractionalisation	246	0.429	0.306	0.001	0.965
polcon	constraints on the executive	220	0.202	0.226	0.000	0.684
dlcpi	Inflation	153	0.124	0.201	-0.032	1.987
inttot	interstate warfare	223	0.202	0.875	0.000	6.000
civtot	civil conflict	224	0.661	1.676	0.000	9.000

6 Econometric Results

In this section we report results from estimating the models described above.

6.1 Probit analysis

The probit analysis that is discussed in the following sections considers the probability that a country will be in a positive growth episode (or a growth contraction episode) in a particular year as the dependent variable. The questions to be answered are: what kind of variables affect the chances of being in growth? What kind of variables affect the chances of being in contraction? Are the determinants of being growth the same as the determinants of being in contraction?

6.1.1 Positive growth episodes

As mentioned above, we examine the effects of four types of explanatory variables:

1. Structural variables, captured here by the share of manufacturing in GDP (MAN), as well as the share of mining (MIN) and modern services (MODSERV) in GDP.[11]
2. Economic policy variables represented by Openness (expgdp), Government consumption (ggfc), gross fixed capital formation (gfcf) and inflation (dlcpi)
3. Political and institutional variables: constraints on the executive (polcon), ethnic fractionalisation (elf-15), interstate wars (inttot) and civil wars (civtot).
4. Control variables include GDP per capita as percentage of the US (relus), years of schooling (yr-sch) and logged population (lpop).

Our main results are presented in tables 4 and 5. Table 4 presents the base regressions. The structural variable in this table is the share of manufacturing in GDP (MAN) In columns 1-4 of this table, four specifications are compared: linear probit model, pooled probit, random effects probit and the Mundlak Chamberlain probit accounting for fixed effects. In all cases, the tables report the marginal effects.

The linear probit and pooled probit specifications are included to get a general idea of the relationships. Our preferred specifications are the random and fixed effect probit, which exploit the panel nature of the data set to the full.[12]

In columns 5-6 of table 4, we examine the effects of time dependence by entering the time from the beginning of the episode to the year being examined (L.length) as well as the square of time (L.length-2) to account for non-linearities. These terms are highly significant. This implies that the longer a country is experiencing a positive growth spell, the greater the chances of being in a growth episode in the current year. But the negative coefficient on the square term indicates that beyond some optimum the chances of remaining in growth start

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[11] The variable MODSERV derives from Lavopa and Szirmai (2014). That paper argues that modern market services could play a similar role as engine of growth as manufacturing has done in the past.

[12] Unfortunately there is no clear test in probit analysis to choose between the random effects and Mundlak Chamberlain specifications.

declining. Growth is not self-perpetuating. After 18.7 years (column 5) and 15.7 years (col. 6), the chances of continuing to be in growth start declining.[13]

In Annex II, we reproduce a set of background tables with a far larger number of alternative specifications. To simplify the exposition, we only discussed preferred specifications in the main text. In the preferred specifications of table 4 and 5, we have dropped population as a control variable, have chosen for the time dependence variables L.length and L.length_2 and have not included any interaction terms. The main patterns in tables 4 and 5 turn out to be consistent across a large number of specifications, though the significance of the specific coefficients vary depending on the type of regression, the variables included or dropped, the way time dependence is handled and the inclusion or non-inclusion of interaction terms.

Table 4: Probability of being in a positive growth episode

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	LPM	PP	RE	MCM	RE	MCM
MAN	0.848***	1.096***	0.335*	0.0674	0.442**	0.187
	(0.311)	(0.298)	(0.192)	(0.193)	(0.188)	(0.175)
Expgdp	-0.135**	-0.184***	-0.0637	0.0280	0.0317	0.118
	(0.0623)	(0.0622)	(0.0751)	(0.0863)	(0.0752)	(0.0757)
Relus	0.556***	0.514***	0.728***	0.733***	0.402***	0.291**
	(0.0978)	(0.0900)	(0.0783)	(0.140)	(0.0854)	(0.122)
ggfc	-1.526***	-1.549***	-2.352***	-2.278***	-1.558***	-1.291***
	(0.381)	(0.392)	(0.260)	(0.274)	(0.250)	(0.230)
gfcf	1.901***	1.890***	2.275***	2.185***	1.513***	1.338***
	(0.302)	(0.279)	(0.169)	(0.181)	(0.161)	(0.144)
yr_sch	-0.0173**	-0.0194**	-.0304***	-.0329***	-0.0206***	-0.0227***
	(0.00822)	(0.00803)	(0.00569)	(0.00592)	(0.00558)	(0.00514)
elf_15	-0.0611	-0.0815	-0.259**	-0.131	-0.185*	-0.0912
	(0.0735)	(0.0673)	(0.100)	(0.0957)	(0.101)	(0.0659)
polcon	0.148	0.109	-0.104*	-0.139***	-0.0736	-0.0830*
	(0.0974)	(0.0899)	(0.0537)	(0.0530)	(0.0518)	(0.0462)
dlcpi	-0.325***	-0.896***	-1.125***	-1.059***	-0.969***	-0.780***
	(0.0504)	(0.139)	(0.0946)	(0.0989)	(0.0895)	(0.0802)
inttot	-0.0423*	-0.0657***	-0.0538***	-0.0519***	-0.0544***	-0.0483***
	(0.0242)	(0.0250)	(0.0183)	(0.0177)	(0.0183)	(0.0160)
civtot	0.00427	0.00425	-0.0170**	-0.0200***	-0.0210***	-0.0204***
	(0.0146)	(0.0124)	(0.00673)	(0.00666)	(0.00673)	(0.00600)
L.length					0.0400***	0.0448***
					(0.00268)	(0.00282)
L.length_2					-.00107***	-.00143***
					(0.000102)	(0.000105)
Observations	3,607	3,607	3,607	3,607	3,630	3,630

Note: Standard errors in parentheses. LPM is linear probit model, PP is pooled probit, RE is random effects probit, MCM is Mundlak Chamberlain probit accounting for fixed effects. *** p<0.01, ** p<0.05, * p<0.1

[13] The turning points are calculated as: the coefficient of length/(2*coefficient of length squared)

Table 5 takes the preferred specifications in columns 5 and (6) of table 4 as the point of departure and compares the effects of including three different structural variables: the share of manufacturing in GDP (MAN), the share of mining in GDP (MIN) and the share of modern services (transport and financial services, MODSERV).

Table 5: Probability of being in a growth episode: Effect of Structural Variables

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	RE	MCM	RE	MCM	RE	MCM
MAN	0.442**	0.187				
	(0.188)	(0.175)				
MIN			-0.299*	-0.0463		
			(0.168)	(0.176)		
MODSERV					0.214	0.235*
					(0.155)	(0.138)
expgdp	0.0317	0.118	0.0698	0.139*	0.0293	0.106
	(0.0752)	(0.0757)	(0.0772)	(0.0777)	(0.0782)	(0.0766)
relus	0.402***	0.291**	0.429***	0.277**	0.433***	0.282**
	(0.0854)	(0.122)	(0.0848)	(0.124)	(0.0883)	(0.122)
ggfc	-1.558***	-1.291***	-1.675***	-1.322***	-1.716***	-1.368***
	(0.250)	(0.230)	(0.245)	(0.226)	(0.252)	(0.228)
gfcf	1.513***	1.338***	1.560***	1.341***	1.591***	1.364***
	(0.161)	(0.144)	(0.161)	(0.142)	(0.163)	(0.143)
yr_sch	-0.0206***	-0.0227***	-0.0214***	-0.0229***	-0.0248***	-0.0268***
	(0.00558)	(0.00514)	(0.00558)	(0.00510)	(0.00621)	(0.00561)
elf_15	-0.185*	-0.0912	-0.198**	-0.104	-0.221**	-0.117*
	(0.101)	(0.0659)	(0.101)	(0.0633)	(0.106)	(0.0653)
polcon	-0.0736	-0.0830*	-0.0844	-0.0913**	-0.0893*	-0.0951**
	(0.0518)	(0.0462)	(0.0521)	(0.0460)	(0.0531)	(0.0466)
dlcpi	-0.969***	-0.780***	-0.922***	-0.751***	-0.920***	-0.744***
	(0.0895)	(0.0802)	(0.0884)	(0.0771)	(0.0899)	(0.0787)
inttot	-0.0544***	-0.0483***	-0.0525***	-0.0477***	-0.0530***	-0.0492***
	(0.0183)	(0.0160)	(0.0181)	(0.0160)	(0.0183)	(0.0159)
civtot	-0.0210***	-0.0204***	-0.0201***	-0.0202***	-0.0207***	-0.0198***
	(0.00673)	(0.00600)	(0.00672)	(0.00597)	(0.00679)	(0.00601)
L.length	0.0400***	0.0448***	0.0398***	0.0444***	0.0404***	0.0446***
	(0.00268)	(0.00282)	(0.00272)	(0.00279)	(0.00277)	(0.00282)
L.length_2	-.00107***	-.00143***	-.00107***	-.00142***	-.00111***	-.00143***
	(0.000102)	(0.000105)	(0.000104)	(0.000104)	(0.000105)	(0.000105)
Observations	3630	3630	3,629	3,629	3,629	3,629

Standard errors in parentheses. RE is random effects probit, MCM is Mundlak Chamberlain Model. MAN is manufacturing, MIN is mining, MODSERV is modern services. *** p<0.01, ** p<0.05, * p<0.1

The summary of findings will be based on table 5.

Effects of structure

In the random effects specification (1) the coefficient of MAN is positive and significant. This result is found in a wide variety of specifications (see also table 4 and Annex tables 1-3). The larger the share of manufacturing in GDP, the greater the chances of being in a growth episode in any given year. In fixed effects specifications, the sign is also positive, but the coefficient is usually not significant.

The standard deviation of the manufacturing share is around 0.09 (i.e. 9 percentage points), which implies that a one standard deviation increase in the manufacturing share is associated with a $(0.09 \times 0.442) \times 100 = 3.98$ percent increase in the probability of being in an episode in the random effects model (Column 1 of Table 5) and a $(0.09 \times 0.187) \times 100 = 1.68$ percent increase in the Mundlak-Chamberlain model (Column 2 of Table 5).

In contrast to manufacturing, the coefficients of mining are invariably negative, as in specifications (3) and (4). It is only significant in the random effects specification. A large mining sector reduces the chances of being in a growth episode, as suggested by the resource curse literature. The more a country is dependent on mining, the less likely it is to be in growth. In a larger set of regressions that we have run, the coefficient of mining is invariably negative, but the significance does vary depending on the set of variables included and the type of regression estimated. The negative effect of mining will be further examined in subsequent research.

Based on the results in Column 3 of Table 5 a one standard deviation increase in the mining share is associated with a $(0.129 \times +0.299) \times 100 = -3.86$ percentage decline in the probability of being in a growth episode.

Modern services have positive coefficients, suggesting that a larger share of the modern sector in GDP increases the chances of being in growth. Thus modern services has an effect similar to that of manufacturing, but opposed to that of mining. In column 6 of table 5, it is the fixed effects specification that has a significant coefficient.

The coefficient on modern services is significant in the fixed effects specification (column 6), which suggests that modern services have a similar effect to manufacturing on the chances of being in a growth episode in any given year. The coefficient however is smaller than that of manufacturing.

Effects of traditional economic variables

Three of the four economic variables are invariably significant in all specifications in table 5. The share of government consumption in national income has a remarkably consistent negative effect on the chances of being in a growth episode, while investment (gfcf) invariably has positive effects. As expected, inflation (dlcpi) reduces the chances of being in a growth episode. The effects of openness are not very robust. The coefficient is only significant in combination with mining (col. 4), but annex tables 1-3 show that the sign is usually non-significant and sometimes even negative.

Effects of political and institutional variables

Most of the political and institutional variables have significant effects on the probability of growth. Ethnic fractionalisation is invariably negative and significant in the random effects specifications. Ethnically divided societies have less chances of being in a growth episode. As expected, interstate (inttot) and within state violence (civtot) are invariably reduce the chances of being in growth.

The results for constraints on the executive (polcon) run counter to expectations. One would expect that societies with stronger checks and balances have better chances for growth. In four out of six specifications in table 5, however, the effects are significantly negative. This would suggest that societies with stronger constraints on the executive have a lower chance of being in a growth episode. These results are less robust than the clear and persistent results for the other political/institutional variables and the economic variables.

Control variables

The results for education are particularly puzzling. The coefficient on the education variable is always significant and always negative. This is counterintuitive. Other things equal, countries with a highly educated population would seem to have greater chances to experience sustained growth. But, so far, the results point in the opposite direction. In table 5, as in all specifications in the annex, the coefficient of education (yr_sch) is significant and negative (similar to what we found in Szirmai and Verspagen, 2015). The higher the level of human capital in a country, the lower the chances of being in a positive growth episode. This finding merits further examination.

The second control variable measuring GDP per capita as a fraction of that of the USA is also always significant. Its coefficient is positive, indicating that the smaller the gap with the USA, the greater the chances of being in growth. This result is consistent with our descriptive analysis of growth episodes in section 3.2.

At this stage, our analysis does not allow us to say which set of variables trumps the other sets. We cannot say that structure is more or less important than political/institutional variables or economic variables. All three types of variables seem to influence the chances of being in growth. Analysing the relationships and possible hierarchies between these different types of variables is one of our priorities for future research.

6.1.2 Contractions

Table 6 presents the base specifications for the contractions model. The approach that we adopt mimics that used above for growth episodes. The LPM and pooled probit models are included to gain a rough impression of the relationships. The random effect probit and the Mundlak Chamberlain specifications, which approximate a fixed effects analysis, exploit the panel nature of the dataset. We find that the fixed effects specifications tend to have more non-significant coefficients. The reason for this is probably that many of the institutional, economic and structural variables are rather stable over time within any given country. To be consistent with the analysis in the previous section we have accounted for time dependence using variables L.length and L.length-2. These turn out to be not significant. In contrast with positive growth episodes, there is no built in mechanism that sooner or later results in an end of a contraction episode. Specifications excluding the non-significant time dependence variables L.length and L.length-2 are reproduced in Annex table 4.

In annex table 4, we also have also examined an alternative type of time dependence. We have included a dummy which takes the value 1 if the previous year was also part of a contraction episode in order to examine the effects of time dependence in a different way. This variable turns out to be significant. The probability of being in a contraction increases when the previous year was also a year of contraction. As it does not affect the significance or sign of any of the other coefficients, we have chosen to retain length and length squared in table 6 (and table 7).

In table 7, we take columns (3) and (4) of table 6 as our point of departure and then compare the effects of the different structural variables. We compare the effects of the share of manufacturing in GDP (MAN), the share of mining in GDP (MIN) and the share of modern services in GDP (transport and financial services, MODSERV).

Table 6: Probability of being in contraction: base runs

	(1) LPM	(2) PP	(3) RE	(4) MCM
MAN	-0.192**	-0.188**	-0.188**	-0.150
	(0.0788)	(0.0757)	(0.0793)	(0.121)
expgdp	-0.0391*	-0.0357	-0.0357	-0.0620
	(0.0216)	(0.0232)	(0.0254)	(0.0571)
relus	0.0568**	0.0716***	0.0716***	0.409***
	(0.0262)	(0.0255)	(0.0259)	(0.0743)
ggfc	0.385***	0.343***	0.343***	0.760***
	(0.148)	(0.130)	(0.0998)	(0.141)
gfcf	-0.0666	-0.0972	-0.0972	-0.107
	(0.0864)	(0.0778)	(0.0825)	(0.103)
yr_sch	-0.584***	-0.602***	-0.602**	-0.290
	(0.197)	(0.205)	(0.246)	(0.410)
lpop	-0.00767*	-0.00641	-0.00641	0.00170
	(0.00437)	(0.00424)	(0.00428)	(0.00528)
elf_15	0.00860	0.00269	0.00269	-0.0194
	(0.0219)	(0.0199)	(0.0182)	(0.0195)
polcon	-0.0661**	-0.0557*	-0.0557**	-0.0752**
	(0.0304)	(0.0286)	(0.0272)	(0.0339)
dlcpi	0.0985***	0.0790***	0.0790***	0.0781***
	(0.0263)	(0.0285)	(0.0203)	(0.0214)
inttot	0.00281	-9.05e-05	-9.05e-05	0.00802
	(0.0148)	(0.0111)	(0.00771)	(0.00851)
civtot	0.00401	0.00443*	0.00443	0.00734*
	(0.00278)	(0.00265)	(0.00350)	(0.00434)
L.length	0.00154	0.000195	0.000195	0.000570
	(0.00209)	(0.000973)	(0.000754)	(0.000798)
L.length_2	-6.15e-07	-1.79e-08	-1.79e-08	-2.16e-07
	(1.05e-06)	(4.89e-07)	(3.79e-07)	(4.01e-07)
Observations	3,607	3,607	3,607	3,607

Note: Standard errors in parentheses. LPM is linear probit model, PP is pooled probit, RE is random effects probit, MCM is Mundlak Chamberlain probit accounting for fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Probability of being in contraction: the effects of structure

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	RE	MCM	RE	MCM	RE	MCM
MAN	-0.188**	-0.150				
	(0.0793)	(0.121)				
MIN			-0.00650	0.134		
			(0.0464)	(0.112)		
MODSERV					0.0889	0.117
					(0.0708)	(0.0976)
expgdp	-0.0357	-0.0620	-0.0391	-0.0876	-0.0465*	-0.0636
	(0.0254)	(0.0571)	(0.0256)	(0.0603)	(0.0258)	(0.0576)
relus	0.0716***	0.409***	0.0599**	0.419***	0.0598**	0.395***
	(0.0259)	(0.0743)	(0.0253)	(0.0768)	(0.0252)	(0.0736)
ggfc	0.343***	0.760***	0.384***	0.821***	0.375***	0.761***
	(0.0998)	(0.141)	(0.0992)	(0.143)	(0.0988)	(0.141)
gfcf	-0.0972	-0.107	-0.110	-0.130	-0.105	-0.115
	(0.0825)	(0.103)	(0.0827)	(0.103)	(0.0827)	(0.103)
yr_sch	-0.602**	-0.290	-0.603**	-0.181	-0.707***	-0.385
	(0.246)	(0.410)	(0.246)	(0.407)	(0.260)	(0.434)
lpop	-0.00641	0.00170	-0.00839**	0.000430	-0.00862**	-0.000606
	(0.00428)	(0.00528)	(0.00419)	(0.00510)	(0.00419)	(0.00510)
elf_15	0.00269	-0.0194	0.00964	-0.0172	0.0106	-0.0129
	(0.0182)	(0.0195)	(0.0180)	(0.0192)	(0.0180)	(0.0191)
polcon	-0.0557**	-0.0752**	-0.0665**	-0.0695**	-0.0681**	-0.0781**
	(0.0272)	(0.0339)	(0.0280)	(0.0340)	(0.0271)	(0.0342)
dlcpi	0.0790***	0.0781***	0.0714***	0.0745***	0.0716***	0.0762***
	(0.0203)	(0.0214)	(0.0197)	(0.0209)	(0.0197)	(0.0212)
inttot	-9.05e-05	0.00802	0.00127	0.00849	0.000483	0.00732
	(0.00771)	(0.00851)	(0.00770)	(0.00842)	(0.00777)	(0.00856)
civtot	0.00443	0.00734*	0.00335	0.00715*	0.00349	0.00766*
	(0.00350)	(0.00434)	(0.00348)	(0.00434)	(0.00348)	(0.00439)
L.length	0.000195	0.000570	-2.53e-05	0.000514	2.67e-08	0.000599
	(0.000754)	(0.000798)	(0.000749)	(0.000798)	(0.000749)	(0.000799)
L.length_2	-1.79e-08	-2.16e-07	9.29e-08	-1.88e-07	8.03e-08	-2.30e-07
	(3.79e-07)	(4.01e-07)	(3.77e-07)	(4.01e-07)	(3.76e-07)	(4.02e-07)
Observations	3,607	3,607	3,606	3,606	3,606	3,606

Note: Standard errors in parentheses. LPM is linear probit model, PP is pooled probit, RE is random effects probit, MCM is Mundlak Chamberlain probit accounting for fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Effects of structure.

The share of manufacturing has a significant and negative effect on the chances of being in a contraction in the random effects specification (1). More industrialised economies are less vulnerable to contractions. The results in column 1 indicate that a one standard deviation increase in the manufacturing is associated with a $-(0.09 \times -0.188) \times 100 = 1.69$ percent decrease in the probability of being in a contraction. In the previous section, we showed that having a large manufacturing sector also increases the chances of being in a positive growth episode.

The coefficients for mining and modern services are not significant. In this respect, contractions differ from positive growth episodes, where the coefficient of mining is robustly negative. Mining reduces the chances of being in a positive growth episode, but does not have a consistent effect on contractions.

Effects of traditional economic variables

One of the most robust results of this study is that government consumption (as a share of national income) has a consistently positive effect on the chances of being in a contraction. (It also had a negative effect on the chances of being in a positive episode)[14]. Inflation has a significant effect on the chances of being in a contraction, as one would expect. The higher the level of investment (Gfcf), the lower the chances of being in contraction. This variable also has a significant positive effect on the chances of being in a growth episode. The sign of openness is negative, indicating that openness would reduce the chances of being in contraction, but the coefficient is only significant in the fixed effect specification in column 5.

Effects of political and institutional variables

One of the interesting results here is that two variables have very different effects on contractions than on growth episodes. Ethnic fragmentation (ELF_15) has an important and significant negative effect on the chances of being in growth. It has no significant effect whatsoever on being in contraction. On the other hand, constraints on the executive (polcon) reduce the chances of being in contraction (consistent with Bluhm *et al.,* 2014), while there was no robust positive effect on being in growth.

Interstate warfare (inttot) had a consistently negative effect in the probit regressions for growth episodes, but it is not significant in any of the specifications for contractions. This is strange. One would expect interstate wars to have a major impact on the chances of experiencing contractions. Civil conflict, on the other hand, does have a positive coefficient which is significant in the fixed effect specifications (2), (4) and (6).

Control variables.

The effects of two of the control variables are rather puzzling. Relus (the gap variable) has a significant positive coefficient in all specifications. This suggests that the smaller the gap with the US the greater the chances of being in contraction. This is counterintuitive and also not consistent with our descriptive findings in section 3.2, where we saw that poor countries have greater chances of growth interruptions. Also, in the growth episode probit regressions,

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[14] This is not tautological. There are cases where the effects of the same variable are different for contractions and growth episodes. Also, as we distinguish three kinds of episodes (growth, contraction and recovery). Contractions are not a mirror image of growth episodes.

Relus, had a positive effect, implying that higher values increase the chances of being in a growth episode. This finding requires further analysis.

The coefficient of years of schooling is negative. This suggests that more human capital reduces the chances of being in contraction. When the interaction term MANEDU is entered, schooling remains significant and the interaction term is also significant and negative. The strange thing is that in the analysis of positive growth episodes, education had a consistently negative effect. So its effects on growth and contraction are very different.

Conclusions for contractions

Summarising the findings for contractions a number of things stand out.

First, it is very interesting to note that explanations of contractions are very different from explanations of growth. This goes to the heart of this paper. It makes sense to analyse different types of growth episodes separately.

Second, industrialisation as measured by the share of manufacturing has a consistent positive effect on the chances of being in growth and a robust negative effect on the chances of being in contraction. Dependence on mining has a negative effect on growth, but no significant effect on contractions.

Third, the effects of economic variables are almost always as expected. The most marked effect is the effect of government consumption which has a negative effect on the chances of being in growth and a positive effect on the chances of being in contraction. The effects of economic openness are not clear-cut.

Fourth, the effects of political and institutional variables are often important. It is worth noting that ethnic fractionalisation has significant negative effects in the growth regressions but is insignificant in the contraction regressions. Interstate warfare had a consistently negative effect in the probit regressions for growth, but it is not significant in any of the specifications for contraction. In contrast to interstate warfare, civil conflict has a significant negative effect on being in a growth episode and a significant positive effect on the probability of being in a contraction.

The findings for constraints on the executive are somewhat ambiguous. In the regressions for positive growth episodes, its coefficient is negative and sometimes significant. On the other hand, constraints on the executive do have a significant, robust and negative effect on the chances of being in a contraction. These are more pronounced than the effects on growth. This is in line with theories that argue that countries that lack strong constraints on the executive find it hard to respond adequately to crises.

So far, our analysis does not help us in deciding which factors are more important: structure, economics, or politics and institutions. This is an important avenue for future research.

6.2 Determinants of duration

In this section we discuss the results of the duration analysis. As discussed in the methodological section, our approach is that of survival analysis. Conditional on being in an episode, what are the average chances of continuing to be in that episode? We have run two types of regression, parametric survival analysis and non-parametric analysis (Cox proportionate Hazard model). In addition we have run a normal LPM regression with the logged duration of episode as the dependent variable. By and large the results of the three approaches are consistent. Here we only present the results of the Cox proportional Hazard model, which we prefer over the parametric survival analysis because it requires fewer assumptions about the distribution of the variables.

Considering the results from the Cox proportional hazards model, it is first necessary to note that the reported results are the estimated hazard rates, $\hat{\gamma} = \exp(\hat{\beta})$. The interpretation of the coefficients is thus as follows. If the coefficient is smaller than one, one minus the coefficient represents the average reduction (in %) of the chance that the episode will come to an end. In other words, the variable is associated with a longer duration of the episode. If the coefficient is larger than one, the coefficient minus one represents the average increase in the chance that the episode comes to an end. The coefficients refer to the effects of a unit change in the explanatory variable.

We first analyse the determinants of the duration of positive growth episodes. Then we move on to the duration of contractions. The variables are the same as those in the probit analysis, though we no longer have a panel dataset.[15] For the time being most of the variables are measured at the beginning of the episode. For the structural variables such as the share of manufacturing or mining we also include the change in this share over the duration of the episode. We have decided to run these regressions for the period 1960-2015 rather than 1950-2015 because too many observations were lacking for the explanatory variables between 1950 and 1960. As in the probit analysis, we distinguish between structural variables, institutional/political variables and economic variables.

6.2.1 Duration of positive growth episodes

Table 8 presents three specifications, one with manufacturing as the structure variable, one with mining, and one with modern services (see also Annex table 7 for a broader set of specifications).

[15] It should be remembered however that countries can experience more than one growth episode or contraction.

Table 8: Duration of growth Episodes

(Preferred specifications, Cox Proportionate Hazard Model)

Variables	(1)	(2)	(3)
MAN	0.0321***		
	(0.0313)		
MIN		5.516***	
		(3.582)	
MODSERV			5.823**
			(4.871)
expgdp	1.538*	1.362	1.381
	(0.375)	(0.346)	(0.332)
relus	1.124	0.892	0.843
	(0.377)	(0.286)	(0.272)
ggfc	4.521	5.428	11.80**
	(5.083)	(6.190)	(12.97)
gfcf	1.629	0.665	0.950
	(1.699)	(0.679)	(0.991)
yr_sch	0.952*	0.950*	0.919***
	(0.0282)	(0.0279)	(0.0293)
elf_15	0.611**	0.699	0.691*
	(0.138)	(0.156)	(0.155)
polcon	0.933	0.913	0.874
	(0.312)	(0.303)	(0.290)
dlcpi	1.254	1.017	0.803
	(0.684)	(0.540)	(0.422)
inttot	0.895	0.880	0.875
	(0.0770)	(0.0764)	(0.0793)
civtot	0.992	0.968	0.986
	(0.0477)	(0.0459)	(0.0477)
Observations	310	310	310

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Effects of structure

Structural variables have a significant effect on the duration of episodes, but the effects vary. A large share of manufacturing reduces the chances that a growth episode comes to an end, while both mining and manufacturing tend to increase these chances. In particular, a one standard deviation increase in the manufacturing share (0.081, from the top panel of Table 3) is associated with a $(1 - 0.0321) \times 0.081 = 7.84$ percent decline in the hazard or risk of failure. In the case of mining we find that a one standard deviation increase in the mining share increases the risk of failure by $(5.516 - 1) \times 0.081 = 57.8\%$, with a similar change in the modern services share increasing the risk of failure by $(5.823 - 1) \times 0.081 = 42.4\%$. The positive effect of manufacturing is consistent with the engine of growth hypothesis. The negative effect of mining on duration (a consistent finding throughout our analysis) is consistent with the resource curse literature. Countries which are dependent on primary mining exports are more vulnerable to fluctuations. With regard to services, even though we focused on so-called modern market services (Lavopa and Szirmai, 2014), rather than the whole service sector, we still find rather consistent negative effects. Countries with larger services sectors tend to have shorter growth spells.

Figure 2 Kaplan Meier Survival Estimate of Growth Episodes

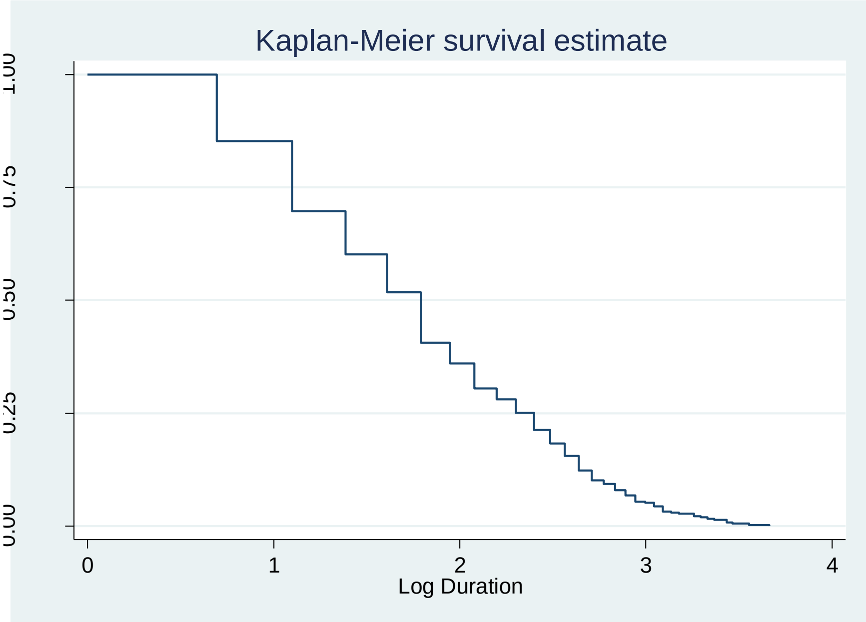
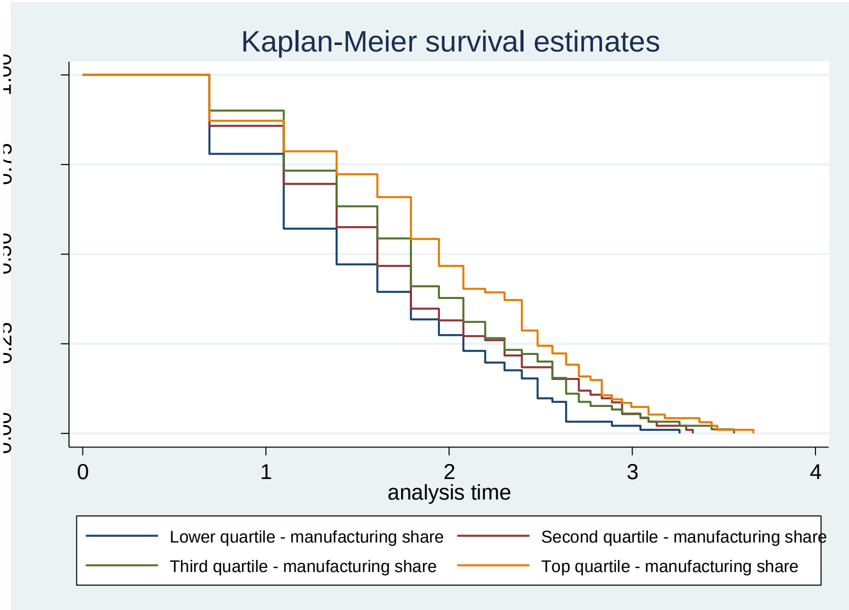


Figure 3 **Kaplan Meier estimate by manufacturing share**



The effects of manufacturing on survival of growth can be illustrated in figures 2 and 3. Figure 2 plots the overall duration of growth episodes. Figure 3 shows how the survival graph shifts to the right as we move from the lower quartile of manufacturing shares to higher quartiles. The median of log survival time is around 0.5 years higher for countries in the highest quartile of manufacturing share when compared with lowest quartile). This means that in the highest quartile growth episodes survive 1.7 years more than in the lowest quartile. [16]

Effects of traditional economic variables

Of the economic variables, openness has a significant negative effect duration in combination with the manufacturing variable (column 1). Openness tends to increase the chances of an episode coming to an end. In columns 2 and 3, the effect is also negative, but the coefficient is not significant. Government consumption (ggfc) has a significant negative effect in combination with modern services (column 3). Inflation has no significant effects.

Effects of political and institutional variables

Of the political and institutional variables only ethnic fractionalisation has a significant effect on duration. Counterintuitively, the higher ethnic fractionalisation, the smaller the chance that the episode will end (the greater the chance the episode will continue). One would have expected that ethnically highly divided societies are less able to sustain growth over longer periods.

None of the other political and institutional variables have significant effects. In particular the lack of effects of interstate and civil violence is surprising. There is a substantial literature which shows that interstate and civil warfare have negative implications for growth (e.g. Collier, 1999; Polacheck and Sevastiova, 2012). One possible reason for the lack of effects is that our variables for constraints and violence all referred to conditions at the beginning of episodes. We have also examined what happens if we replace these variables by their average values during the episode, but this did not make much difference. This issue has to be examined in further research. In particular, we need to develop more sophisticated measures of violence occurring during a growth episode.

Effects of Control variables

With regard to the control variables, we note that the gap variable Relus, which is so important in growth regressions does not seem to have a significant effect on duration. This is not consistent with our descriptive analysis in section 3 where we saw that duration of episodes was longer in higher quartiles.

Schooling now has a significant effect on the chances of an episode ending: A higher stock of higher human capital will reduce the chances of a growth spell coming to an end. The effect of schooling here differs from the effects in the probit analysis[17]. The effects on duration are as one would expect.

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[16] exp(0.5) = 1.7

[17] Though the two analyses are related they are however not identical. Probit analysis examines the chances of being in growth in any year between 1960 and 2015. But a given likelihood of growth could be associated with very different duration figures. One could imagine that all growth years are part of one single long growth episode. Alternatively, the same likelihood could be associated with many short episodes.

6.2.2 Duration of contractions

Table 9 presents the preferred specifications for the duration of contractions (for more detail see Annex table 7). Each of the three columns includes a different variable for structure.

Table 9: Duration of Contractions

Preferred Specifications. Cox Proportionate Hazard Model

Variables	(1)	(2)	(3)
MAN	3.631		
	(3.784)		
MIN		0.133***	
		(0.0945)	
MODSERV			1.639
			(1.787)
expgdp	0.968	1.192	0.888
	(0.392)	(0.439)	(0.359)
relus	0.806	1.211	0.749
	(0.261)	(0.454)	(0.239)
ggfc	1.449	2.030	1.143
	(1.968)	(2.693)	(1.539)
gfcf	0.910	1.287	0.986
	(0.976)	(1.402)	(1.046)
yr_sch	1.061*	1.035	1.075**
	(0.0384)	(0.0373)	(0.0377)
elf_15	0.645	0.619*	0.610*
	(0.174)	(0.163)	(0.162)
polcon	2.707**	2.309**	2.417**
	(1.100)	(0.948)	(1.044)
dlcpi	0.792	0.883	0.852
	(0.135)	(0.138)	(0.140)
inttot	1.134	1.194**	1.110
	(0.0999)	(0.106)	(0.0944)
civtot	1.048	1.075	1.058
	(0.0527)	(0.0531)	(0.0523)
Observations	210	210	210

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Effects of structure

With regard to the structural variables, manufacturing has no significant coefficient. Though the coefficient is greater than one (greater chance of episode ending, i.e. shorter contractions) there is thus no significant relationship with the length of contractions. Mining has a negative effect. An economy that is highly dependent on mining has a significantly lower chance of a contraction ending. In other words, the contraction will tend to last longer. Modern services do not have a significant effect, though the direction of the effect on duration is the same as that of manufacturing: positive.

Effects of economic variables

None of the economic variables have any effect on the duration of contractions. This is somewhat puzzling on first sight. It may be that the variables do not capture the kind of policy responses that effect the duration of crises.

Effects of political and institutional variables.

Of the political and institutional variables ethnic fractionalisation reduces the chances of a contraction coming to an end in two of the three specifications. In other words, high ethnic fractionalisation tends to prolong economic hardship. Stronger constraints on the executive increase the chances of contractions coming to an end (in line with Bluhm et al., 2013). The effects of interstate conflict (inttot) in combination with a large share of mining (col. 2) are counterintuitive. More interstate conflict results in shorter contraction episodes.

Effects of control variables

Of the control variables years of schooling has a significant effect in specification three. It increases the chances that the contraction will end. But the coefficients was not significant in specification 2. Interestingly the gap variable Relus has no significant effects on the duration of contractions.

It is worth noting that the effects of fractionalisation and constraints are different from those found in the analysis of positive growth episodes.

In the duration analysis it would seem that structural variables perform more consistently than the other variables. In general manufacturing increases the length of positive growth episodes. Mining has the opposite effect. The effects of modern services are less pronounced, though they do tend to reduce the length of positive growth episodes. As regards the length of contractions, only mining significantly prolongs the duration of contractions.

The second important conclusion is that the same variables may have different effects when analysing the duration of growth and the duration of contractions.

7 Conclusions

In this paper we argue that breaking down long-run growth experiences into episodes can increase our understanding of the growth process. Using simple filter rules, we have created a dataset of growth episodes for 152 countries.

Descriptive analysis of these episodes shows that the duration of episodes is extremely important in differentiating between successful and less successful countries. Countries that are trapped in poverty have much shorter positive growth episodes and much longer contractions than countries that remain rich. Countries that succeed in improving their relative income positions have much longer positive episodes, sometimes even longer than the rich countries. They also have shorter contractions. The differences in rates of growth within episodes are far less pronounced. Duration matters.

The paper than goes on to analyse the determinants of duration, both of positive growth episodes and of contractions. Two econometric methods have been applied: probit analysis and survival analysis. We have compared the effects of three sets of variables: structural variables, traditional economic variables and political and institutional variables. It should be emphasised that this is still work in progress and the results are still very tentative and not always robust.

We tend to find positive effects of manufacturing on duration of positive episodes, while the effects of mining and modern services are negative. The effects on the duration of contractions are less pronounced, but dependence on mining prolongs contractions. On the whole structural variables tend to be important.

Economic variables tend to have robust and expected effects on the duration of positive growth episodes. Thus inflation and investment prolong the duration of positive growth episodes, while openness and a high share of government consumption tend to reduce the length of growth spells. Interestingly the same economic variables have no significant effects on the duration of contractions.

Political and institutional variables have mixed effects. Most of the variables do not have significant effects on the duration of positive growth episodes. This is especially strange for variables such as interstate and civil conflict, which one would expect to have strongly negative effects. Ethnic fragmentation even has a significant positive effect on sustaining growth, which is counterintuitive.

But two of the same political and institutional variables have much greater effects on the duration of contractions. While variable constraints on the executive has no significant effect on duration of growth, it does significantly shorten the duration of contractions. The same is true for ethnic fractionalisation. Highly fractionalised societies experience longer contractions.

The findings for interstate conflict are counterintuitive and require further examination. In combination with a large share of mining interstate conflict tends to shorten the duration of contractions.

One of the most interesting findings of this paper is that the same variables may have very different effects on duration of positive episodes and duration of contractions. It makes sense to analyse different kinds of episodes separately.

It should be stressed that these results are preliminary. The empirical data on structure need to be refined further, combining economic historical country studies with existing statistical datasets. Also the effects of political and institutional variables call for further and more detailed analysis.

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Annex I: The Structural Change Database, 1950-2016

This annex describes the sources and procedures used in constructing the structural change database. The database is to be found on the website of the Groningen Growth and Development Centre (GGDC): https://www.rug.nl/ggdc/overview-databases/

The structural change database presents data on sectoral shares in GDP from 1950-2016, for 156 countries, with than more than one million inhabitants. The structural change database provides sector shares as per cent of GDP in current local currency units. Sectoral data are presented for nine sectors.

There are two versions of the database:
Version A: Original data (see 'Sheet Final 9 sector'). This version presents the data as they are found in the original sources, including all gaps and holes. Gaps refer to years for which there are no data, as well as to missing sectoral information in years for which there is incomplete sectoral information. This version includes all references to sources used and detailed source notes.

Version B: Original data with extrapolations (see 'Sheet Extrapolated'. This is a version of the database in which gaps have been filled wherever possible. This table is constructed for regression analysis, with the aim of reducing the number of missing data.

The database distinguishes nine sectors[18]:

1 Agriculture (Agriculture, Hunting, Forestry and Fishing (A+B)
2 Mining (Mining and Quarrying) (C)
3 Manufacturing (D)
4 Utilities (Electricity, Gas and Water Supply) (E)
5 Construction (F)
6 Trade, restaurants and hotels (Wholesale, retail trade, repair of motor vehicles, motorcycles and personal and households goods; hotels and restaurants) (G+H)
7 Transport, storage and communication (I)
8 Finance, insurance, real estate and business services (Financial intermediation; real estate, renting and business activities (J+K)
9 Government services, Community, social and personal services (Public administration and defence; compulsory social security; Education; health and social work; other community, social and personal services, Private households with employed persons (L+M+N+O+P)[19]

[18] Using SNA93 item codes. The first sector name is the name used in the structural change database. Between brackets is the official description of the sector).

[19] In many countries and years sector P (private households with employed persons) is not distinguished in the raw data. It is included in Other community, social and personal services. In the database we refer to sector 9 as L+M+N+O.

Sector 9 merges two sectors:
Public administration and defence; compulsory social security (L)
Education, health and social work, other community, social and personal services M+N+O+P
For many years and many countries these two sectors are combined, so it did not make sense to distinguish them in the database.

Sources:

Data sources include the following:

1950-73:	United Nations, *Yearbook of National Accounts*, 1957, 1962, 1967, 1975 (
1950-2013	GGDC 10 sector database.
1950-2015	UN National Accounts National Accounts database
1995-2008	Groningen Growth and Development Centre, World Input-Output Database (WIOD)
1950-2016	Data derived from country sources

1950-73 United Nations National Accounts

UN, *Yearbook of National Accounts*, 1957 has data for 1950-56
UN, *Yearbook National Accounts*, 1962, has data for 1955-1961
UN *Yearbook of National Accounts, 1967* has data for 1953, 1955, 1957-66
UN, *Yearbook National Accounts*, 1975 has data 1967-74

Later editions are preferred over earlier ones. We start with the latest source and then fill gaps with earlier editions of the Yearbook. Usually, the data refer to million LCUs at current prices.

The UN yearbooks provide data for at most 11 sectors which are collapsed into the standard nine sectors. UN Sector 9 (Ownership of dwellings) is incorporated in our sector 8: Finance, insurance, real estate and business services. Sectors 10 (Public administration and defence) and 10 (services) are combined into our sector 9: Government services, community, social and personal services

GGDC Ten-Sector database

The GGDC Ten-Sector database presents data for 10 sectors, as defined in the International Standard Industrial Classification, Rev. 3.1. Data are available for 31 developing economies and 9 advanced economies from 1950 till 2013. The dataset includes GDP at current local prices, GDP at constant prices, GDP at 1995 PPP dollars and employment data. We have used the data at current prices to calculate sector shares. Sectors 9 and 10 of the GDDC database have been merged into our sector 9 (see above).

This Ten-Sector database is available at: http://www.rug.nl/ggdc/productivity/10-sector/
For a detailed description see: Timmer, M. P., de Vries, G. J., & de Vries, K. (2015). "Patterns of Structural Change in Developing Countries." . In J. Weiss, & M. Tribe (Eds.), *Routledge Handbook of Industry and Development*. (pp. 65-83). Routledge.

We used a version of the database downloaded in April 2015

United Nations National Accounts website

Original current price data (LCU) were downloaded from UN national accounts website United Nations Statistics Division, National Accounts Database Official Country data Table 2.1 Value added by industries at current prices (ISIC Rev. 3):
http://data.un.org/Data.aspx?d=SNA&f=group_code%3a201

This database includes non-standardised country data on national accounts, including a sectoral breakdown of GDP (table 2.1). Table 2.1 provides far more sectoral detail than standardised datasets found elsewhere on the UN, National Accounts Website such as the National Accounts Main Aggregates database, which only distinguish seven main sectors, see: https://unstats.un.org/unsd/snaama/selbasicFast.asp.

Depending on the country and the period, table 2.1 provides breakdown for up to 20 sectors. We would like to include as much detail as possible, but there is a trade-off between detail and missing data. The number of sectors varies substantially from country to country and from year to year. For earlier years much less detail is available than for later years and there are far more missing values. By aggregating all sectors into our standard nine-sector classification, we were able to create long-run series with consistent sectoral classifications.

For each country there are multiple series, according to successive versions of the UN System of National Accounts. When we had to choose between alternative SNA series, we always preferred the latest version, incorporating the latest national accounts concepts. We traced the data of the most recent series back as far as possible and then switched to the latest of the previous versions. This procedure was repeated till we arrived at the first year for which data were available.

All series are in local currency units, which change over time. As we are only interested in shares, changes in currency units do not pose a problem.

Data on total GDP are available at both basic prices and at producer prices (SNA 1993). In most cases, the sum of sectoral value added equals the printed total of GDP at basic prices. But sometimes there were discrepancies. We calculated sectoral shares as percentage of summed sectors rather than printed totals.

Groningen Growth and Development Centre, World Input-Output Database

This database can be accessed at: http://www.wiod.org/home.
Our data were downloaded in February 2015.
The WIOD database contains a series of world input-output data for over forty countries covering around 85% of global GDP. Release 2013 provides information for no less than 35 sectors. We collapsed these sectors into our standard nine sector classification.

Country sources

The data sources above were supplemented by data from country statistical sources and publications referring to specific countries. This was especially useful for the early years where the gaps in the standardised databases are numerous. The country sources are documented in the footnotes of the database.

Methods for interpolation, retropolation and extrapolation

Version B of the database is a version in which gaps have been filled wherever possible. This table is constructed for purposes of regression analysis, with the aim of reducing the number of missing data.

In the case of countries with missing data for some sectors in given years the procedure was as follows. Usually, the value added of the missing sectors was included in the total value added of another sector. For instance, in early years value added in mining often included value added of manufacturing and utilities. The shares of the missing sectors were estimated using sectoral proportions of later or earlier years, for which more sectoral detail was available. Thus in the example of mining, we used proportions of mining, manufacturing and utilities to distribute the value added of mining over these three sectors.

For the years in which all sectoral data are missing, we filled gaps by interpolation, retropolation or extrapolation. When there are data before and after the years with missing data, the gaps were interpolated using linear interpolation of the sector shares. This implies that the interpolated shares may not always add up to hundred percent, but the discrepancies were small.

Where possible data have been retropolated at the beginning of the series or extrapolated forwards at the end of the series. Retropolations were particularly important because data for the 1950s and 1960s are more scarce.

For retropolation two methods were used:

a. applying growth trends for the first five years for which data are available;
b. retropolation using shares of first year for which data are available. The choice between the two methods was based on the plausibility of the retropolated figures.

The same procedure was followed for extrapolation.

Interpolation, retropolation and extrapolation have been subjected to plausibility tests. Where inter- , retro-, and extrapolation provided results that were implausible or inconsistent with the secondary literature, they have not been included in the table. Detailed notes for the procedures of individual country are found in column BY of the sheet 'extrapolated' of the database.

Annex II Tables with alternative specifications

This annex contains 7 tables with alternative specifications for the probit and duration analysis. These tables form the basis for the preferred specifications discussed in the main text. Annex Tables 1-3 present a set of specifications for the probit analysis of positive growth episodes.

Probit analysis of growth episodes

Annex table 1 has twelve specifications The table has two functions. First it compares the LPM, Pooled Probit, Random effects and Fixed Effects specifications. This helps us assess the robustness of the coefficients to alternative methods. The preferred specifications are the random and fixed effects specifications. The second function of the table is to examine the significance of control variables schooling (yr_sch) and population (lpop). Schooling turns out to be significant across all specifications and will be retained. Population is almost never significant and will be dropped in the preferred specifications in the main text.

Annex table 2 examines different ways of accounting for time dependence. To what extent is the chance of being in a growth episode affected by whether or not previous years were years of growth? In this table population has been dropped and only RE and MCM specifications are reported. In specifications 3 and 4, the time from the beginning of the episode to the previous year is entered (L.length), as well as time squared (L.length-2) to account for non-linearities. These terms are highly significant. This implies that the longer a country is experiencing positive growth, the greater the chances of being in a growth episode in the current year. But the negative coefficient on the squared term indicates that beyond some optimum the chances of remaining in growth start declining. Growth is not self-perpetuating. In specifications 5 and 6, we include the lag of the dependent dummy variable (episode_dummy_lag) to examine the importance of persistence in being in a growth episode. The coefficient of this dummy is also positive and significant at the 1 per cent level. The chances of being in a growth episode are larger if the previous year was also part of a positive growth episode.

Our preferred specifications will be those including time and time squared. First, these specifications are theoretically more plausible than those with only the lag. Second, the lagged dummy captures a lot of the effects of the explanatory variables, which tend to lose significance when this variable is entered. In the tables of the main text, all specifications will include L.length and L.length_2.

In Annex table 3, we examine the effects of including two interaction terms: MANEDU and MANREL. In a previous paper focusing on the impact of economic structure on Growth (Szirmai and Verspagen, 2015), we found that these interaction terms significantly influenced GDP per capita growth rates. The rationale for these terms is as follows. MANREL is the interaction term between the share of manufacturing (MAN) and the gap with the USA (RELUS, $GDP/C_i/GDP/C_{US}$). We found that the sign of the interaction term was negative, indicating that manufacturing had positive effects on growth at lower levels of relative income. Here, we examine what effect it has in the probit analysis. MANEDU is the interaction term between the share of manufacturing and years of schooling. We found that the influence of education was not neutral, but depended on the structure of the economy. Education had positive effects on growth in economies with larger manufacturing sectors.

The coefficient of the interaction term MANEDU is not significant and when this term is entered the coefficient of manufacturing (MAN) also becomes non-significant.

The coefficient of the interaction term MANREL is significant, but when this term is entered the coefficient for MAN becomes non-significant and the sign flips. The sign of relus also becomes non-significant. Thus MANREL captures the positive effects of MAN and relus – at higher levels of relative income, a larger share of manufacturing increases the probability of being in growth - , but both MAN and relus themselves become non-significant. Thus, we find that the interaction terms do not add much in the way of new insights. We therefore focus on specifications that exclude these interaction terms, such as those in columns (1) and (2) of the table. In annex table 3, we discuss the interaction terms combined with the structure variable MAN. Similar tables have been constructed using the other structural variables MIN and MODSERV. These tables are available on request. In all cases, we conclude that adding interaction terms does not provide any additional insights. In the main text tables, no interaction terms will be included.

Annex Table 1: Probability of being in a positive growth episode: base runs without interaction terms and time dependence variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	LPM	PP	RE	MCM	LPM	PP	RE	MCM	LPM	PP	RE	MCM
MAN	0.739**	0.994***	0.354*	0.0981	0.848***	1.096***	0.335*	0.0674	0.744**	0.932***	0.176	0.0390
	(0.310)	(0.299)	(0.192)	(0.195)	(0.311)	(0.298)	(0.192)	(0.193)	(0.295)	(0.286)	(0.177)	(0.184)
expgdp	-0.0368	-0.101	-0.0444	0.0320	-0.135**	-0.184***	-0.0637	0.0280	-0.166***	-0.217***	-0.193***	-0.175**
	(0.0684)	(0.0695)	(0.0760)	(0.0870)	(0.0623)	(0.0622)	(0.0751)	(0.0863)	(0.0633)	(0.0630)	(0.0678)	(0.0790)
relus	0.549***	0.502***	0.733***	0.732***	0.556***	0.514***	0.728***	0.733***	0.504***	0.461***	0.681***	0.856***
	(0.100)	(0.0902)	(0.0773)	(0.141)	(0.0978)	(0.0900)	(0.0783)	(0.140)	(0.0891)	(0.0830)	(0.0754)	(0.141)
ggfc	-1.382***	-1.425***	-2.321***	-2.292***	-1.526***	-1.549***	-2.352***	-2.278***	-1.564***	-1.652***	-2.361***	-2.312***
	(0.414)	(0.416)	(0.262)	(0.276)	(0.381)	(0.392)	(0.260)	(0.274)	(0.385)	(0.393)	(0.246)	(0.266)
gfcf	1.788***	1.803***	2.256***	2.190***	1.901***	1.890***	2.275***	2.185***	1.815***	1.780***	2.153***	2.120***
	(0.302)	(0.283)	(0.169)	(0.183)	(0.302)	(0.279)	(0.169)	(0.181)	(0.280)	(0.263)	(0.159)	(0.175)
yr_sch	-2.049**	-2.122***	-3.326***	-3.318***	-0.0173**	-0.0194**	-.0304***	-.0329***				
	(0.848)	(0.807)	(0.610)	(0.664)	(0.00822)	(0.00803)	(0.00569)	(0.00592)				
lpop	0.0326*	0.0263	0.0225	-3.59e-05								
	(0.0168)	(0.0160)	(0.0195)	(0.0241)								
elf_15	-0.0954	-0.111*	-0.274***	-0.129	-0.0611	-0.0815	-0.259**	-0.131	-0.0431	-0.0596	-0.165*	-0.144
	(0.0717)	(0.0670)	(0.101)	(0.0996)	(0.0735)	(0.0673)	(0.100)	(0.0957)	(0.0721)	(0.0655)	(0.0970)	(0.0991)
polcon	0.152	0.109	-0.105*	-0.133**	0.148	0.109	-0.104*	-0.139***	0.0702	0.0292	-0.136***	-0.154***
	(0.0982)	(0.0914)	(0.0546)	(0.0542)	(0.0974)	(0.0899)	(0.0537)	(0.0530)	(0.0913)	(0.0837)	(0.0492)	(0.0511)
dlcpi	-0.328***	-0.883***	-1.138***	-1.077***	-0.325***	-0.896***	-1.125***	-1.059***	-0.327***	-0.867***	-1.026***	-1.005***
	(0.0520)	(0.138)	(0.0940)	(0.100)	(0.0504)	(0.139)	(0.0946)	(0.0989)	(0.0504)	(0.139)	(0.0910)	(0.0977)
inttot	-0.0478**	-0.0678***	-0.0538***	-0.0523***	-0.0423*	-0.0657***	-0.0538***	-0.0519***	-0.0434*	-0.0638**	-0.0437**	-0.0430**
	(0.0226)	(0.0254)	(0.0183)	(0.0178)	(0.0242)	(0.0250)	(0.0183)	(0.0177)	(0.0228)	(0.0251)	(0.0177)	(0.0175)
civtot	-0.000709	0.000391	-0.0162**	-0.0184***	0.00427	0.00425	-0.0170**	-0.0200***	0.00546	0.00564	-0.0186***	-0.0224***
	(0.0142)	(0.0125)	(0.00688)	(0.00679)	(0.0146)	(0.0124)	(0.00673)	(0.00666)	(0.0143)	(0.0125)	(0.00644)	(0.00661)
Observations	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607

Note: Standard errors in parentheses. LPM is linear probit model, PP is pooled probit, RE is random effects probit, MCM is Mundlak Chamberlain probit accounting for fixed effects. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Annex Table 2:

Probability of being in a positive growth episode: effects of time dependence

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	RE	MCM	RE	MCM	RE	MCM
MAN	0.335*	0.0674	0.442**	0.187	0.447***	0.262*
	(0.192)	(0.193)	(0.188)	(0.175)	(0.103)	(0.136)
expgdp	-0.0637	0.0280	0.0317	0.118	-0.0446	0.0644
	(0.0751)	(0.0863)	(0.0752)	(0.0757)	(0.0303)	(0.0614)
relus	0.728***	0.733***	0.402***	0.291**	0.1000***	0.0423
	(0.0783)	(0.140)	(0.0854)	(0.122)	(0.0358)	(0.0898)
ggfc	-2.352***	-2.278***	-1.558***	-1.291***	-0.659***	-0.762***
	(0.260)	(0.274)	(0.250)	(0.230)	(0.146)	(0.186)
gfcf	2.275***	2.185***	1.513***	1.338***	0.487***	0.499***
	(0.169)	(0.181)	(0.161)	(0.144)	(0.107)	(0.118)
yr_sch	-.0304***	-.0329***	-0.0206***	-0.0227***	-0.00553*	-.0116***
	(0.00569)	(0.00592)	(0.00558)	(0.00514)	(0.00309)	(0.00414)
elf_15	-0.259**	-0.131	-0.185*	-0.0912	-0.0408	-0.0330
	(0.100)	(0.0957)	(0.101)	(0.0659)	(0.0273)	(0.0264)
polcon	-0.104*	-0.139***	-0.0736	-0.0830*	0.0329	-0.0223
	(0.0537)	(0.0530)	(0.0518)	(0.0462)	(0.0332)	(0.0381)
dlcpi	-1.125***	-1.059***	-0.969***	-0.780***	-0.449***	-0.455***
	(0.0946)	(0.0989)	(0.0895)	(0.0802)	(0.0653)	(0.0662)
inttot	-.0538***	-.0519***	-0.0544***	-0.0483***	-0.0286**	-0.0325**
	(0.0183)	(0.0177)	(0.0183)	(0.0160)	(0.0129)	(0.0132)
civtot	-0.0170**	-.0200***	-0.0210***	-0.0204***	-0.00607	-0.0110**
	(0.00673)	(0.00666)	(0.00673)	(0.00600)	(0.00429)	(0.00490)
L.length			0.0400***	0.0448***		
			(0.00268)	(0.00282)		
L.length_2			-.00107***	-.00143***		
			(0.000102)	(0.000105)		
Episode_dummy_lag					0.371***	0.361***
					(0.00795)	(0.00836)
Observations	3,630	3,630	3,630	3,630	3,630	3,630

Standard errors in parentheses. RE is random effects probit, MCM is Mundlak Chamberlain Model probit accounting for fixed effects

*** p<0.01, ** p<0.05, * p<0.1

Annex Table 3: Probability of being in a growth episode: interaction terms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	RE	MCM	RE	MCM	RE	MCM	RE	MCM
	No Interaction terms		Incl. MANEDU		Incl. MANREL		Incl. both	
MAN	0.442**	0.187	0.167	-0.0938	-0.0805	-0.274	0.0412	-0.209
	(0.188)	(0.175)	(0.411)	(0.356)	(0.298)	(0.263)	(0.418)	(0.362)
Expgdp	0.0317	0.118	0.0260	0.112	0.0496	0.135*	0.0550	0.137*
	(0.0752)	(0.0757)	(0.0755)	(0.0759)	(0.0761)	(0.0762)	(0.0774)	(0.0770)
Relus	0.402***	0.291**	0.396***	0.282**	0.165	0.0919	0.145	0.0825
	(0.0854)	(0.122)	(0.0860)	(0.123)	(0.139)	(0.151)	(0.147)	(0.155)
Ggfc	-1.558***	-1.291***	-1.559***	-1.287***	-1.539***	-1.262***	-1.537***	-1.262***
	(0.250)	(0.230)	(0.250)	(0.230)	(0.250)	(0.230)	(0.250)	(0.230)
Gfcf	1.513***	1.338***	1.510***	1.332***	1.467***	1.296***	1.464***	1.296***
	(0.161)	(0.144)	(0.162)	(0.144)	(0.162)	(0.144)	(0.162)	(0.144)
yr_sch	-0.0206***	-0.0227***	-0.0272***	-0.0293***	-0.0189***	-0.0211***	-0.0146	-0.0188*
	(0.00558)	(0.00514)	(0.0104)	(0.00893)	(0.00561)	(0.00516)	(0.0118)	(0.0101)
elf_15	-0.185*	-0.0912	-0.185*	-0.0920	-0.193*	-0.0953	-0.194*	-0.0953
	(0.101)	(0.0659)	(0.101)	(0.0657)	(0.102)	(0.0659)	(0.102)	(0.0660)
polcon	-0.0736	-0.0830*	-0.0736	-0.0834*	-0.0801	-0.0887*	-0.0807	-0.0889*
	(0.0518)	(0.0462)	(0.0519)	(0.0462)	(0.0519)	(0.0463)	(0.0519)	(0.0463)
dlcpi	-0.969***	-0.780***	-0.967***	-0.775***	-0.954***	-0.766***	-0.954***	-0.767***
	(0.0895)	(0.0802)	(0.0896)	(0.0802)	(0.0899)	(0.0803)	(0.0900)	(0.0804)
inttot	-0.0544***	-0.0483***	-0.0537***	-0.0475***	-0.0548***	-0.0487***	-0.0552***	-0.0489***
	(0.0183)	(0.0160)	(0.0183)	(0.0161)	(0.0183)	(0.0161)	(0.0184)	(0.0161)
civtot	-0.0210***	-0.0204***	-0.0212***	-0.0206***	-0.0208***	-0.0204***	-0.0207***	-0.0204***
	(0.00673)	(0.00600)	(0.00673)	(0.00600)	(0.00669)	(0.00597)	(0.00669)	(0.00597)

L.length	0.0400***	0.0448***	0.0402***	0.0450***	0.0404***	0.0450***	0.0403***	0.0449***
	(0.00268)	(0.00282)	(0.00270)	(0.00283)	(0.00270)	(0.00282)	(0.00271)	(0.00283)
L.length_2	-.00107***	-.00143***	-0.00107***	-0.00144***	-0.00108***	-0.00144***	-0.00108***	-0.00144***
	(0.000102)	(0.000105)	(0.000103)	(0.000105)	(0.000102)	(0.000105)	(0.000102)	(0.000105)
MANEDU			0.0436	0.0440			-0.0277	-0.0147
			(0.0579)	(0.0487)			(0.0667)	(0.0561)
MANREL					1.421**	1.246**	1.566**	1.324**
					(0.625)	(0.535)	(0.717)	(0.612)
Observations	3,630	3,630	3,630	3,630	3,630	3,630	3,630	3,630

Note: Standard errors in parentheses. RE is random effects probit, MCM is Mundlak Chamberlain probit accounting for fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Probit analysis of contractions

Annex tables 4 and 5 provide a broad range of specifications for the probit analysis of contractions.

As in annex table 2, annex table 4 compares the two different ways of accounting for time dependence. In columns 5-8, we add L.length and L.length_2, in columns (9) to (12) we add a dummy for being in a contraction in the previous year. The results are not the same as those for positive growth episodes. In the case of contractions, length and length squared are always non-significant. In other words, there is no built in tendency for contractions to come to an end. However, the lagged dummy is highly significant. Being in a contraction in the previous year, increases the chances of being in contraction in the current year. Rather than including the lagged dummy in the preferred specifications in the main text, we nevertheless chose for specifications (7) and (8) with length and length squared. The mean reason was to achieve consistency with the growth probit regressions. As it is clear in Annex table 4, the way time dependence is dealt with has hardly any influence on the coefficients of the other variables.

In annex table 5, we explore the effect of adding the two interaction terms discussed above: MANEDU and MANREL. We find that the interaction terms are both significant when entered separately, but MANREL becomes non-significant when they are entered jointly (columns 11 and 12).. The coefficient of interaction term MANEDU is significant and negative, which suggests that a larger manufacturing share in combination with higher education reduces the chances of being in contraction. But the coefficient of education loses its significance, so the interaction term mainly captures the negative effects of education on chances of being in contraction. Something similar obtains when we enter interaction term MANREL in specifications (9) and (10). The interaction term has a significant negative effect on the chances of being in contraction, but the direct effect of manufacturing (MAN) becomes non-significant and the sign flips, becoming positive. Thus, the interaction term does not add much to our understanding of contractions. In the analysis in the main text of the paper, we will not include any of the interaction terms.

Annex Table 4: Probability of being in contraction: time dependence

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	LPM	PP	RE	MCM	LPM	PP	RE	MCM	LPM	PP	RE	MCM
MAN	-0.253	-0.341*	-0.319**	-0.0995	-0.192**	-0.188**	-0.188**	-0.150	-0.190**	-0.194**	-0.194**	-0.162
	(0.199)	(0.195)	(0.144)	(0.163)	(0.0788)	(0.0757)	(0.0793)	(0.121)	(0.0803)	(0.0770)	(0.0786)	(0.123)
expgdp	-0.0622	-0.0819	-0.0838	-0.220***	-0.0391*	-0.0357	-0.0357	-0.0620	-0.0416**	-0.0357	-0.0357	-0.0566
	(0.0598)	(0.0710)	(0.0585)	(0.0772)	(0.0216)	(0.0232)	(0.0254)	(0.0571)	(0.0209)	(0.0223)	(0.0252)	(0.0574)
relus	0.0436	0.0546	0.270***	0.774***	0.0568**	0.0716***	0.0716***	0.409***	0.0620**	0.0730***	0.0730***	0.381***
	(0.0739)	(0.0701)	(0.0692)	(0.120)	(0.0262)	(0.0255)	(0.0259)	(0.0743)	(0.0275)	(0.0254)	(0.0254)	(0.0746)
ggfc	1.237***	1.126***	1.709***	1.972***	0.385***	0.343***	0.343***	0.760***	0.385***	0.343***	0.343***	0.679***
	(0.322)	(0.275)	(0.196)	(0.209)	(0.148)	(0.130)	(0.0998)	(0.141)	(0.147)	(0.130)	(0.0997)	(0.141)
gfcf	-0.809***	-0.833***	-0.831***	-0.928***	-0.0666	-0.0972	-0.0972	-0.107	-0.0666	-0.0948	-0.0948	-0.0414
	(0.240)	(0.221)	(0.138)	(0.142)	(0.0864)	(0.0778)	(0.0825)	(0.103)	(0.0863)	(0.0777)	(0.0824)	(0.103)
yr_sch	-1.023*	-0.795	-0.889*	0.0871	-0.584***	-0.602***	-0.602**	-0.290	-0.623***	-0.601***	-0.601**	-0.222
	(0.529)	(0.522)	(0.461)	(0.540)	(0.197)	(0.205)	(0.246)	(0.410)	(0.200)	(0.204)	(0.240)	(0.394)
lpop	-0.0170	-0.0190*	-0.0134	-0.0120	-0.00767*	-0.00641	-0.00641	0.00170	-0.00794*	-0.00614	-0.00614	-0.00604
	(0.0110)	(0.0111)	(0.0122)	(0.0147)	(0.00437)	(0.00424)	(0.00428)	(0.00528)	(0.00417)	(0.00403)	(0.00422)	(0.00531)
elf_15	0.0341	0.0342	0.0544	0.00544	0.00860	0.00269	0.00269	-0.0194	0.0104	0.00404	0.00404	0.0107
	(0.0542)	(0.0486)	(0.0626)	(0.0593)	(0.0219)	(0.0199)	(0.0182)	(0.0195)	(0.0217)	(0.0197)	(0.0182)	(0.0191)
polcon	-0.181**	-0.156**	-0.166***	-0.130***	-0.0661**	-0.0557*	-0.0557**	-0.0752**	-0.0692**	-0.0563*	-0.0563**	-0.0587*
	(0.0758)	(0.0708)	(0.0424)	(0.0438)	(0.0304)	(0.0286)	(0.0272)	(0.0339)	(0.0306)	(0.0288)	(0.0271)	(0.0338)
dlcpi	0.306***	0.277***	0.295***	0.284***	0.0985***	0.0790***	0.0790***	0.0781***	0.0999***	0.0793***	0.0793***	0.0708***
	(0.0409)	(0.0693)	(0.0364)	(0.0353)	(0.0263)	(0.0285)	(0.0203)	(0.0214)	(0.0263)	(0.0284)	(0.0202)	(0.0219)
inttot	0.00993	0.00341	0.00812	0.0145	0.00281	-9.05e-05	-9.05e-05	0.00802	0.00313	-0.000286	-0.000286	0.00813
	(0.0386)	(0.0260)	(0.0102)	(0.0107)	(0.0148)	(0.0111)	(0.00771)	(0.00851)	(0.0148)	(0.0111)	(0.00770)	(0.00887)
civtot	0.00528	0.00772	0.0137**	0.0137**	0.00401	0.00443*	0.00443	0.00734*	0.00410	0.00448*	0.00448	0.00670
	(0.00754)	(0.00692)	(0.00546)	(0.00560)	(0.00278)	(0.00265)	(0.00350)	(0.00434)	(0.00282)	(0.00264)	(0.00349)	(0.00436)
L.length					0.00154	0.000195	0.000195	0.000570				
					(0.00209)	(0.000973)	(0.000754)	(0.000798)				
L.length_2					-6.15e-07	-1.79e-08	-1.79e-08	-2.16e-07				
					(1.05e-06)	(4.89e-07)	(3.79e-07)	(4.01e-07)				
contract_lag									0.636***	0.316***	0.316***	0.309***
									(0.0273)	(0.00721)	(0.00788)	(0.00803)
Observations	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607

Note: Standard errors in parentheses. LPM is linear probit model, PP is pooled probit, RE is random effects probit, MCM is Mundlak Chamberlain probit accounting for fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Annex Table 5: Probability of being in contraction: effect of interaction terms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	RE	MCM	RE	MCM	RE	MCM	RE	MCM	RE	MCM	RE	MCM
	No interaction terms		Incl. MANEDU				Incl. MANREL				Incl. both	
MAN	-0.188**	-0.150	0.317	0.876**	0.146	0.355*	0.480**	0.722***	0.0107	0.168	0.154	0.392*
	(0.0793)	(0.121)	(0.320)	(0.345)	(0.161)	(0.207)	(0.230)	(0.253)	(0.112)	(0.162)	(0.161)	(0.209)
expgdp	-0.0357	-0.0620	-0.0766	-0.202***	-0.0359	-0.0550	-0.115*	-0.259***	-0.0418	-0.0779	-0.0398	-0.0680
	(0.0254)	(0.0571)	(0.0585)	(0.0778)	(0.0255)	(0.0573)	(0.0600)	(0.0781)	(0.0258)	(0.0576)	(0.0258)	(0.0579)
relus	0.0716***	0.409***	0.281***	0.816***	0.0761***	0.419***	0.623***	1.115***	0.187***	0.548***	0.153**	0.504***
	(0.0259)	(0.0743)	(0.0696)	(0.121)	(0.0260)	(0.0747)	(0.114)	(0.154)	(0.0540)	(0.0889)	(0.0600)	(0.0920)
ggfc	0.343***	0.760***	1.727***	2.018***	0.346***	0.768***	1.706***	1.934***	0.335***	0.727***	0.340***	0.745***
	(0.0998)	(0.141)	(0.195)	(0.207)	(0.0995)	(0.140)	(0.197)	(0.208)	(0.0996)	(0.141)	(0.0996)	(0.141)
gfcf	-0.0972	-0.107	-0.833***	-0.936***	-0.0911	-0.0957	-0.750***	-0.865***	-0.0674	-0.0890	-0.0729	-0.0874
	(0.0825)	(0.103)	(0.138)	(0.142)	(0.0826)	(0.103)	(0.136)	(0.141)	(0.0831)	(0.103)	(0.0833)	(0.103)
yr_sch	-0.602**	-0.290	0.680	2.387***	0.320	0.909	-0.992**	-0.158	-0.669***	-0.330	-0.0770	0.485
	(0.246)	(0.410)	(0.841)	(0.904)	(0.460)	(0.573)	(0.466)	(0.544)	(0.248)	(0.411)	(0.539)	(0.631)
lpop	-0.00641	0.00170	-0.0147	-0.00967	-0.00620	0.00453	-0.0184	-0.00766	-0.00736*	0.00322	-0.00693	0.00459
	(0.00428)	(0.00528)	(0.0122)	(0.0146)	(0.00427)	(0.00536)	(0.0125)	(0.0151)	(0.00430)	(0.00529)	(0.00431)	(0.00535)
elf_15	0.00269	-0.0194	0.0572	0.00887	0.00422	-0.0209	0.0717	0.00455	0.00511	-0.0207	0.00531	-0.0212
	(0.0182)	(0.0195)	(0.0624)	(0.0583)	(0.0182)	(0.0195)	(0.0640)	(0.0606)	(0.0182)	(0.0195)	(0.0182)	(0.0195)
polcon	-0.0557**	-0.0752**	-0.164***	-0.128***	-0.0511*	-0.0703**	-0.148***	-0.116***	-0.0490*	-0.0694**	-0.0482*	-0.0681**
	(0.0272)	(0.0339)	(0.0424)	(0.0440)	(0.0272)	(0.0338)	(0.0421)	(0.0436)	(0.0273)	(0.0338)	(0.0273)	(0.0338)
dlcpi	0.0790***	0.0781***	0.299***	0.290***	0.0797***	0.0800***	0.278***	0.271***	0.0739***	0.0730***	0.0759***	0.0760***
	(0.0203)	(0.0214)	(0.0364)	(0.0352)	(0.0202)	(0.0213)	(0.0358)	(0.0349)	(0.0201)	(0.0212)	(0.0202)	(0.0213)
inttot	-9.05e-05	0.00802	0.00729	0.0136	-0.000953	0.00749	0.0102	0.0158	0.000706	0.00886	-5.86e-05	0.00817
	(0.00771)	(0.00851)	(0.0102)	(0.0107)	(0.00765)	(0.00843)	(0.0102)	(0.0107)	(0.00781)	(0.00860)	(0.00776)	(0.00852)
civtot	0.00443	0.00734*	0.0140**	0.0150***	0.00346	0.00786*	0.0127**	0.0138**	0.00305	0.00720*	0.00288	0.00759*
	(0.00350)	(0.00434)	(0.00547)	(0.00565)	(0.00351)	(0.00434)	(0.00539)	(0.00555)	(0.00353)	(0.00435)	(0.00354)	(0.00435)
L length	0.000195	0.000570			0.000261	0.000644			0.000109	0.000562	0.000178	0.000614
	(0.000754)	(0.000798)			(0.000754)	(0.000798)			(0.000753)	(0.000797)	(0.000756)	(0.000798)

L length_2	-1.79e-08	-2.16e-07			-5.10e-08	-2.53e-07			2.51e-08	-2.12e-07	-9.52e-09	-2.39e-07
	(3.79e-07)	(4.01e-07)			(3.79e-07)	(4.01e-07)			(3.79e-07)	(4.01e-07)	(3.80e-07)	(4.01e-07)
MANEDU			-10.21**	-15.07***	-5.942**	-7.687***					-3.671	-5.135*
			(4.620)	(4.714)	(2.519)	(2.586)					(2.976)	(3.031)
MANREL							-2.205***	-2.189***	-0.663**	-0.835***	-0.450	-0.534
							(0.509)	(0.526)	(0.271)	(0.287)	(0.317)	(0.334)
Observations	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607	3,607

Note: Standard errors in parentheses. LPM is linear probit model, PP is pooled probit, RE is random effects probit, MCM is Mundlak Chamberlain probit accounting for fixed effects. *** p<0.01, ** p<0.05, * p<0.1

Duration of positive growth episodes

Annex Table 6 provides a set of specifications for the duration of positive growth episodes. This table compares the effects of the three structural variables: Man (columns 1-3), MIN (columns 4-6) and MODSERV (columns 7-9). In columns (2), (5) and (8) we add a term which captures the change in the structural variable during the episode. For instance, in the case of manufacturing, is there industrialisation or deindustrialisation during the episode. In our previous research, this variable turned out to be of importance. In columns ((3), (6) and (9), we add the interaction term RELUS to see whether the effect of manufacturing changes at different levels of economic development.

In the case of the manufacturing and mining specifications, both the structural change variables and the interactions are non-significant.

In the case of modern services, the structural change variable is significant and much smaller than one. This means that it reduces the changes that the episode ends, in other words prolonging the duration of the episode. This is hard to interpret, as the direct effect of a large modern services share is to increase the chances of the growth episode ending. When the structural change variable is entered, the coefficient of the direct variable (MODSERV) becomes non-significant. Something similar happens when the interaction term MODREL is entered. The interaction term is significant and smaller than one, but the main variable MODSERV becomes non-significant. For the time being, our preferred specification is the simplest version in column 7 of Annex table 6.

Duration of contraction episodes

In Annex table 7, a similar procedure is followed for the duration of contractions. It has the same nine columns as annex table 6. For manufacturing and services, the structural variables and the structural change variables are non-significant. This is different for mining. Here both the share of mining and the increase of the mining share reduce the chances of a contraction episode coming to an end. In other words, while manufacturing and services have no significant effects on the length contractions, dependence on mining tends to prolong them..

The interaction term between the structure variable and RELUS is non-significant in the case of mining (specification 6) and services (specification 9). In the case of manufacturing it is significant and far larger than one, suggesting an increase in the chances of a contraction ending. The smaller the gap with the US and the larger the manufacturing sector, the greater the chances of contractions ending. But the effects are so large (a one standard deviation increase in MANREL is associated with an increase in the risk of failure of 187%) that this finding should be treated with caution. In sum our preferred specifications are those without the interaction term and the structural change variables. Our preferred specifications are therefore those in columns (1), (4) and (7). These specifications will be further discussed in the main text.

Annex Table 6: Duration of Growth: Alternative specifications

(Cox Proportional Hazard Model)

	Manufacturing			Mining			Modern Services		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MAN	0.0321***	0.0376***	0.0575**						
	(0.0313)	(0.0378)	(0.0781)						
ΔMAN		2.314							
		(3.231)							
MANREL			0.0984						
			(0.373)						
MIN				5.516***	4.917**	2.562			
				(3.582)	(3.176)	(2.397)			
ΔMIN					0.127				
					(0.176)				
MINREL						33.08			
						(92.89)			
MODSERV							5.823**	1.011	1.178
							(4.871)	(0.924)	(1.447)
ΔMODSERV								0.00792***	
								(0.00883)	
MODSERVREL									96.32*
									(243.9)
expgdp	1.538*	1.533*	1.563*	1.362	1.357	1.404	1.381	1.802**	1.384
	(0.375)	(0.373)	(0.384)	(0.346)	(0.344)	(0.361)	(0.332)	(0.449)	(0.325)
relus	1.124	1.174	1.822	0.892	0.910	0.761	0.843	1.080	0.316*
	(0.377)	(0.403)	(1.557)	(0.286)	(0.292)	(0.266)	(0.272)	(0.349)	(0.204)
ggfc	4.521	5.012	4.474	5.428	6.845*	6.666	11.80**	16.82***	14.90**
	(5.083)	(5.697)	(5.043)	(6.190)	(7.818)	(7.701)	(12.97)	(17.97)	(16.32)
gfcf	1.629	1.717	1.754	0.665	0.595	0.774	0.950	0.613	1.054
	(1.699)	(1.801)	(1.842)	(0.679)	(0.619)	(0.802)	(0.991)	(0.638)	(1.100)
yr_sch	0.952*	0.951*	0.946*	0.950*	0.947*	0.948*	0.919***	0.933**	0.917***
	(0.0282)	(0.0283)	(0.0297)	(0.0279)	(0.0280)	(0.0279)	(0.0293)	(0.0296)	(0.0295)
elf_15	0.611**	0.616**	0.611**	0.699	0.708	0.688*	0.691*	0.631**	0.649*
	(0.138)	(0.139)	(0.138)	(0.156)	(0.158)	(0.154)	(0.155)	(0.143)	(0.146)
polcon	0.933	0.948	0.946	0.913	0.860	0.933	0.874	0.990	0.935
	(0.312)	(0.317)	(0.317)	(0.303)	(0.286)	(0.311)	(0.290)	(0.330)	(0.314)

dlcpi	1.254	1.222	1.217	1.017	1.010	1.032	0.803	0.940	0.832
	(0.684)	(0.666)	(0.665)	(0.540)	(0.533)	(0.547)	(0.422)	(0.494)	(0.435)
inttot	0.895	0.897	0.896	0.880	0.896	0.881	0.875	0.838*	0.867
	(0.0770)	(0.0772)	(0.0772)	(0.0764)	(0.0791)	(0.0766)	(0.0793)	(0.0792)	(0.0775)
civtot	0.992	0.991	0.992	0.968	0.969	0.970	0.986	0.997	0.984
	(0.0477)	(0.0474)	(0.0476)	(0.0459)	(0.0454)	(0.0463)	(0.0477)	(0.0480)	(0.0475)
Observations	310	310	310	310	310	310	310	310	310

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex Table 7: Duration of Contractions, Alternative Specifications

(Cox Proportionate Hazard Model)

	Manufacturing			Mining			Modern Services		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
MAN	3.631	4.850	0.305						
	(3.784)	(5.395)	(0.457)						
ΔMAN		2.218							
		(2.278)							
MANRELUS			3,217**						
			(11,000)						
MIN				0.133***	0.151***	0.289			
				(0.0945)	(0.110)	(0.260)			
ΔMIN					1.819				
					(1.403)				
MINRELUS						0.134			
						(0.212)			
MODSERV							1.639	1.651	0.454
							(1.787)	(1.792)	(0.677)
ΔMODSERV								1.750	
								(1.711)	
MODSRELUS									21.00
									(48.38)
expgdp	0.968	0.983	0.987	1.192	1.208	1.113	0.888	0.872	0.804
	(0.392)	(0.395)	(0.391)	(0.439)	(0.444)	(0.401)	(0.359)	(0.351)	(0.315)
relus	0.806	0.810	0.306*	1.211	1.201	1.991	0.749	0.762	0.434
	(0.261)	(0.263)	(0.186)	(0.454)	(0.457)	(1.045)	(0.239)	(0.241)	(0.238)
ggfc	1.449	1.745	1.291	2.030	1.761	1.919	1.143	1.085	1.392
	(1.968)	(2.391)	(1.728)	(2.693)	(2.366)	(2.534)	(1.539)	(1.460)	(1.877)
gfcf	0.910	0.807	0.859	1.287	1.104	1.149	0.986	1.092	0.945
	(0.976)	(0.875)	(0.913)	(1.402)	(1.221)	(1.243)	(1.046)	(1.174)	(0.997)

yr_sch	1.061*	1.069*	1.053	1.035	1.036	1.017	1.075**	1.070*	1.068*
	(0.0384)	(0.0401)	(0.0394)	(0.0373)	(0.0374)	(0.0393)	(0.0377)	(0.0382)	(0.0377)
elf_15	0.645	0.628*	0.629*	0.619*	0.622*	0.611*	0.610*	0.620*	0.588**
	(0.174)	(0.170)	(0.171)	(0.163)	(0.164)	(0.161)	(0.162)	(0.166)	(0.156)
polcon	2.707**	2.757**	2.296**	2.309**	2.418**	2.028*	2.417**	2.391**	2.519**
	(1.100)	(1.122)	(0.967)	(0.948)	(1.010)	(0.865)	(1.044)	(1.034)	(1.111)
dlcpi	0.792	0.798	0.826	0.883	0.876	0.907	0.852	0.848	0.868
	(0.135)	(0.136)	(0.141)	(0.138)	(0.138)	(0.143)	(0.140)	(0.140)	(0.142)
inttot	1.134	1.137	1.107	1.194**	1.206**	1.172*	1.110	1.108	1.096
	(0.0999)	(0.0996)	(0.0973)	(0.106)	(0.111)	(0.105)	(0.0944)	(0.0939)	(0.0936)
civtot	1.048	1.051	1.066	1.075	1.061	1.076	1.058	1.060	1.063
	(0.0527)	(0.0527)	(0.0541)	(0.0531)	(0.0563)	(0.0532)	(0.0523)	(0.0527)	(0.0526)
Observations	210	210	210	210	210	210	210	210	210

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1