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BACHELORS THESIS

Semi-Parametric Models of the Probability of Hyperinflations

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Declaration of Authorship

I, Alessandra GUERRERO, declare that this thesis titled, "Semi-Parametric Models of the Probability of Hyperinflations" and the work presented in it are my own. I confirm that:

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- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
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Signed: Alessandra Guerrero

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Abstract

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Semi-Parametric Models of the Probability of Hyperinflations

by Alessandra GUERRERO

Hyperinflations - an economic phenomenon which describes the accelerated increase in the price level and a parallel decrease in the value of currency - are widely considered 20th century economic crises. However, within the last decade, the hyperinflations of Zimbabwe and Venezuela have brought new attention to the subject and curiosity of their possible causes. Due to their relative scarcity and typical localities, hyperinflations do not lend themselves to thorough study due to a general unavailability of data during periods of hyperinflation. Despite this, recent studies have found some similarities in the characteristics of countries experiencing hyperinflations at the time, yet no true causal link between these characteristics and the onset of a hyperinflationary period has been appropriately studied. In this paper, I study macroeconomic variables detailing the state of a country's economy and institutional variables detailing the political characteristics of the country, with focus on the effect of these factors on the probability of a hyperinflation occurring within the country experiencing accelerated inflation. I find that both macroeconomic and institutional variables significantly affect the probability of the onset of a hyperinflation, although institutional variables have a higher relative weight on the change in probability. Affirming the conclusions of previous studies, these results suggest that the incidence of a hyperinflation arise more from a failing in institutional factors, but are modulated by the effect of macroeconomic factors.

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I am indebted to my advisor, Professor Casey Mulligan, for his guidance and support throughout this process. I would additionally like to thank Professor Neele Balke for her advice and the initial inspiration of following through on the topic of macroeconomic crises. I am grateful for Victor Lima, Kotaro Yoshida, and Julie Wong for their counsel and encouragement through this thesis process, as well as my peers for their unconditional support.

Contents

1 Introduction

Dramatic and catastrophic increases in the price level, otherwise known as hyperinflation, is a relatively rare yet highly devastating economic crisis. Believed to be primarily 20th century phenomena, hyperinflations have resurfaced within the last decade: Zimbabwe first experienced hyperinflation in 2008 and has since seen a brief hyperinflationary period in 2018 (Hanke and Bushnell 2017) and, most recently, Venezuela entered a hyperinflationary period in 2017 (Hanke and Bushnell 2017).

Before continuing to study this phenomenon, we must first decide what constitutes a hyperinflation. Although economists have a variety of definitions for what is a hyperinflation, as opposed to simply high inflation or accelerated inflation, most generally agree on Phillip Cagan's definition of the phenomenon. In his seminal 1956 work, Cagan defined hyperinflations as those that exceed 50 percent monthly inflation for at least one month in the month before the month in which monthly inflation lies below 50 percent for at least a year (Cagan 1956). It is no surprise, then, that hyperinflations are so rare. If we use Cagan's criterion, the world has only seen 57 of them - the latest of which belongs to Venezuela. Hyperinflations were most common during the middle-to-late 20th century (due in no small part to the breaking-up of the Soviet Bloc countries), and only 3 hyperinflationary episodes have occurred between 1990 and 2020: Bulgaria in 1997, Zimbabwe in 2008, and Venezuela in 2017 (Hanke and Kwok 2009).

Due to this small sample of events, hyperinflations have historically received relatively little empirical attention; such infrequent events and small samples detract from the possibility to produce unbiased, practical, and robust analysis that gives us more insight into the mechanisms behind such a disastrous yet puzzling phenomenon. Instead, economists focused more on theoretical modelling of hyperinflations, most often building from Cagan's model. In recent years, likely as a result of the renewed interest in hyperinflations since Venezuela's perpetually plummeting currency, the empirical study of hyperinflations has gained more popularity.

This newfound interest necessitates a more careful and thorough look into the topic, and particularly into the macroeconomic and institutional factors that affect the incidence of hyperinflations. Of most importance is studying the likelihood of a country experiencing a hyperinflation given a change in the state of the economy or the quality of institutions within the country, which I seek to study in this paper.

As I will discuss later, previous studies have found some similarities in macroeconomic and institutional factors in countries which experience hyperinflations. Other studies have attempted to model hyperinflations based on macroeconomic or financial predictors meanwhile ignoring institutional factors that affect governmental quality in the country of interest. But how can we link changes in the economy and changes in the quality of institutions and internal pressures to the changing probability of a hyperinflation occurring? To answer this question, I examine country-level macroeconomic and institutional factors in countries that have had at least one period of accelerated inflation between 1950 and 2019. Then, I test the probability of the country with accelerated inflation shifting to a hyperinflation according to changes in the economy or in its institutions. The purpose of this paper is to find the factors that most significantly affect the probability of a hyperinflation, and in what direction those factors move to cause an increase or decrease in the probability of a hyperinflation.

Using macroeconomic and financial data from the World Bank and the IMF, and institutional and political risk data from the International Country Risk Guide (ICRG), I compare the impacts of twelve macroeconomic and twelve institutional factors on a selection of 37 countries which experienced at least one period of accelerated inflation - even if they did not experience a hyperinflation - between the years of 1960 and 2019. The macroeconomic and financial variables range from FDI inflows to external balance on goods and services, and encompass a variety of factors that are indicative of the general health of the economy; the institutional and risk variables include factors such as government stability and democratic accountability, or factors which are indicative of the relative quality of governance, levels of violence, and other risk factors. The selection of countries used are primarily classified as developing countries, which were all relatively low-income at the time of accelerated inflation and hyperinflation phenomena, and have experienced economic

and political instability before, during, at often after the incidence of hyperinflation.

The remainder of the paper outlines the study as follows: First, I will present an overview of the relevant background historical context necessary in understanding hyperinflationary phenomena, and pre-existing literature around the topic of hyperinflations, focusing on a recent study which highlights economic and institutional variables. I will follow in highlighting the ways in which my work will deviate from, and add to, this literature. Next, I introduce the data I utilize in this study, and underline my treatment of the data and the essential methodology behind my analysis. Finally, I present the results of my analysis, discuss their interpretation and meaning of the results, and conclude with final remarks and possible extensions of this work.

2 Background & Literature

As I introduced previously, a hyperinflation is very high and rapidly accelerating inflation. This increasing inflation results in a parallel erosion of the real value of the local currency as the prices of goods within the country increase. The commonly understood definition of hyperinflation is that which was defined by Phillip Cagan in The Monetary Dynamics of Hyperinflation (Cagan 1956) as an episode "starting in the month that the monthly inflation rate exceeds 50%, and ending when the monthly inflation rate drops below 50% and stays that way for at least a year." While there exist alternative definitions for hyperinflations, Cagan's criterion is the one most commonly used and acknowledged in literature.

Hyperinflations were believed to be 20th century phenomena, as most hyperinflations afflicted countries during the 1970s and 1980s, and as well believed to be phenomena arising from external pressures such as post-war fallout, international financial crises, or traumatic country-wide events. The famous example, and the one that began academic economic analysis of hyperinflations, is that of Weimar Republic Germany's 1945-1947 inflation. The rate of inflation spiked from 12% in January 1945, to 123000% in December 1947. In an attempt to pay off World War I reparations to the rest of Europe, The Weimar government printed increasing amounts of the German Frank in order to pay these debts to the rest of Europe. One of the recent entrants into the club of Hyperinflationary countries, and the most well-known in recent history, is Zimbabwe, which in 2017 saw inflation topping 18B% in 2008. Venezuela followed in 2017, entering with 1.8M% inflation in the month of August.

Recent literature in the realm of hyperinflations and their occurrences have focused more on baseline empirical similarities between the economic states of countries which experience hyperinflation. The incidence of hyperinflations by country, and the political and economic state of countries at the onset of a hyperinflation, have been subject to some research in the past years after the hyperinflations in

Zimbabwe and Venezuela. However, little work has been done in the realm of cause-effect analysis of the characteristics of macroeconomic or political variables and their effects on the likelihood of the onset of a hyperinflation.

3 Data

In this study, I use three datasets. Macroeconomic data are taken from Steve H. Hanke's and Tal Boger's *Inflation by the Decades* dataset and the World Bank Open Data database, while the institutional and political factor data are taken from the PRS Group's International Country Risk Guide (ICRG) political risk dataset and the Chinn-Ito dataset. All datasets report values on a yearly basis, with the last recorded value for each ending in 2018. The *Inflation by the Decades* data provides average annual and decadal inflation for all countries over each decade from 1950 to 2000. Using this dataset, I determined which countries over which years experienced accelerated inflation (average annual inflation between 50% and 500%) and hyperinflation (average annual inflation greater than 500%) to define the risk set of observations which would be used to analyze probabilities of hyperinflation. The data used fall into one of two categories: macroeconomic (monetary, fiscal, financial, and trade), and institutional (policy and structural). I will discuss the covariates used in the final model for each one of these categories.

3.1 Macroeconomic Variables

3.1.1 Inflation Data

The choice of which data to use to measure inflation was one of utmost importance. As previously mentioned, inflation data can be unreliable or completely missing for several groups of observations: mid-20th century data for most countries (even developed or industrialized European countries; mid- to late-20th century data for developing countries or those which were initially poor at the beginning of the 20th century; and data for this group of developing countries in the year leading up to a hyperinflation, and the years in which the country experienced a hyperinflation. Publicly available data sources - such the World Bank, the IMF, or any other inflation data aggregator - does not have robust or complete enough data throughout the 20th

to support an analysis based on the event study of hyperinflations. Thus, it was important to find a source which was reliable in the values extracted, as well as the completeness of the database during the years in which hyperinflations occurred.

The inflation database which contains the most complete consecutive observations and which is most reliable is that compiled by Professors Steve H. Hanke and Tal Boger. This dataset compiles and analyzes data from the World Bank, the IMF's IFS, and private and closed-access inflation databases. This database is complete until the year 2013, after which data on inflation rates has not been published and is thus unavailable. After 2013, I substitute the inflation data available from the IMF's IFS database to complete later years of inflation data. Although any inflation data is generally less robust and reliable than data on other macroeconomic variables (particularly during the year of inflationary troubles or macroeconomic crises), the accuracy of the values is not as important in the scope of this study as the years in which a country enters a high-inflation or hyperinflationary state. I am thus still able to find the years in which these changes and states occur, and conduct my analysis with the data available without loss of model or analytical significance due to the data. The exceptions to this assessment are those countries and years in which no inflation data exists for more than a single year period. However, these observations were removed, as will be further detailed in Section 3.3.

Using this completed dataset for our countries and years of interest, I created re-coded indicator variables for observations which occurred in a year for a country experiencing accelerated inflation - that is, average annual inflation rate between 50% and 500% - and experiencing hyperinflation - average annual inflation exceeding 500%. The analysis lies on the incidence of these indicator variables, and the changes in the macroeconomic factors and institutional factors. These are further discussed in Sections 3.1.2 and 3.2, respectively.

3.1.2 Macroeconomic Country Covariates

Data for all macroeconomic covariates - including those which describe monetary, fiscal, financial, and trade factors in the economy - are collected annually from the World Bank's publicly available World Development Indicators database. Since my study lies in the analysis of hazard rates and odds ratios (see Section 4, there was

no need to log-linearize them or transform them using logarithmic transformation. Hence, I used the data as it is presented by the World Bank. I combine this dataset of macroeconomic covariates with the inflation data by country and year, of course keeping only countries which have most of the observations intact and its missing values do not impact the analysis of accelerated inflation states.

The macroeconomic covariates are described, by the World Bank's World Development Indicators, as follows:

- Bank Credit to the Private Sector (% of GDP) (World Bank): Domestic credit to the private sector refers to financial resources provided to the private sector by financial corporations, such as loans, purchases of securities other than investment and commercial loans and other accounts receivable, which establish a claim for refund. For some countries these claims include credit to public companies. Financial corporations include monetary authorities and money deposit banks, as well as other financial corporations where data is available (including companies that do not accept transferable deposits but incur liabilities such as savings and time deposits). Examples of other financial corporations are financial and leasing companies, money lenders, insurance companies, pension funds and currency companies. Sourced from the International Monetary Fund's (IMF) International Financial Statistics (IFS) and OECD World Bank GDP estimates. From the World Bank: *Private sector development and investment - tapping private sector initiative and investment for socially useful purposes - are critical for poverty reduction. In parallel with public sector efforts, private investment, especially in competitive markets, has tremendous potential to contribute to growth. Private markets are the engine of productivity growth, creating productive jobs and higher incomes. And with government playing a complementary role of regulation, funding, and service provision, private initiative and investment can help provide the basic services and conditions that empower poor people - by improving health, education, and infrastructure.*

- Exports of Goods and Services (% Growth) (World Bank): Annual growth rate of exports of goods and services based on constant local currency. Aggregates

are based on constant 2010 U.S. dollars. Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments. Sourced from the World Bank's national accounts data.

- Gross Fixed Capital Formation (% of GDP) (World Bank): Gross fixed capital formation (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. Sourced from the World Bank's national accounts data.

- Gross Savings (% of GDP) (World Bank): Gross savings are calculated as gross national income less total consumption, plus net transfers. Gross savings represent the difference between disposable income and consumption and replace gross domestic savings, a concept used by the World Bank and included in World Development Indicators editions before 2006. The change was made to conform to SNA concepts and definitions. Sourced from the World Bank's national accounts data.

- GDP Growth (% Change from Previous Year) (IFS): Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant U.S. dollars of 2010. GDP is the sum of the gross added value of all producers' resident in the economy plus any tax on the product and less any subsidy not included in the value of the products. It is calculated without making deductions for the depreciation of manufactured assets or for the depletion and degradation of natural resources.

- Net Lending and Borrowing (% of GDP) (World Bank): Net lending (+) / net borrowing (–) equals government revenue minus expense, minus net investment in non-financial assets. It is also equal to the net result of transactions in financial assets and liabilities. Net lending/net borrowing is a summary measure indicating the extent to which government is either putting financial resources at the disposal of other sectors in the economy or abroad, or utilizing the financial resources generated by other sectors in the economy or from abroad. Sourced from the IMF's Government Finance Statistics. Limitations of this data include the following: *For most countries central government finance data have been consolidated into one account, but for others only budgetary central government accounts are available. Countries reporting budgetary data are noted in the country metadata. Because budgetary accounts may not include all central government units (such as social security funds), they usually provide an incomplete picture. In federal states the central government accounts provide an incomplete view of total public finance. Data on government revenue and expense are collected by the IMF through questionnaires to member countries and by the Organisation for Economic Co-operation and Development (OECD). Despite IMF efforts to standardize data collection, statistics are often incomplete, untimely, and not comparable across countries*.

- Current Account Balance (% of GDP) (World Bank): The balance of the current account is the sum of net exports of goods and services, net primary income and net secondary income. Sourced from the IMF's Balance of Payments Statistics.

- Foreign Direct Investment, Net Inflows (% of GDP) (World Bank): Direct foreign investment is the net investment flows to acquire a long-term management interest (10% or more of the shares with voting rights) in a company that operates in an economy different from that of the investor. It is the sum of social capital, the reinvestment of profits, other long-term capital and short-term capital, as shown in the balance of payments. This series shows net inflows (new investment flows minus divestment) in the reporting economy of foreign investors and is divided by GDP.

- Foreign Direct Investment, Net Outflows (% of GDP) (World Bank): Foreign direct investment refers to direct investment capital flows in an economy. It is the sum of social capital, reinvestment of profits and other capital. Direct investment is a category of cross-border investment associated with a resident in an economy that has control or a significant degree of influence in the management of a company that resides in another economy. The ownership of 10 percent or more of the common shares of voting shares is the criterion to determine the existence of a direct investment relationship. This series shows the net outflows of investment from the reporting economy to the rest of the world and is divided by GDP. Sourced from the IMF's IFS and Balance of Payments Database, the World Bank, and International Debt Statistics. From the World Bank: *Private financial flows - equity and debt - account for the bulk of development finance. Equity flows comprise foreign direct investment (FDI) and portfolio equity. Debt flows are financing raised through bond issuance, bank lending, and supplier credits*. Limitations of this data include the following: *FDI data do not give a complete picture of international investment in an economy. Balance of payments data on FDI do not include capital raised locally, an important source of investment financing in some developing countries. In addition, FDI data omit non-equity cross-border transactions such as intra-unit flows of goods and services. The volume of global private financial flows reported by the World Bank generally differs from that reported by other sources because of differences in sources, classification of economies, and method used to adjust and disaggregate reported information. In addition, particularly for debt financing, differences may also reflect how some installments of the transactions and certain offshore issuances are treated. Data on equity flows are shown for all countries for which data are available*.

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- Imports of Goods and Services (% of GDP) (World Bank): Imports of goods and services represent the value of all goods and other market services received from the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude compensation of employees and investment income (formerly called factor services) and transfer payments. Sourced from the World Bank's national accounts data. Limitations of this data include the following: *Because policymakers have tended to focus on fostering the growth of output, and because data on production are easier to collect than data on spending, many countries generate their primary estimate of GDP using the production approach. Moreover, many countries do not estimate all the components of national*

expenditures but instead derive some of the main aggregates indirectly using GDP (based on the production approach) as the control total. Data on exports and imports are compiled from customs reports and balance of payments data. Although the data from the payments side provide reasonably reliable records of cross-border transactions, they may not adhere strictly to the appropriate definitions of valuation and timing used in the balance of payments or corresponds to the change-of ownership criterion. This issue has assumed greater significance with the increasing globalization of international business. Neither customs nor balance of payments data usually capture the illegal transactions that occur in many countries. Goods carried by travelers across borders in legal but unreported shuttle trade may further distort trade statistics.

- External Balance on Goods and Services (% of GDP) (World Bank): External balance on goods and services (formerly resource balance) equals exports of goods and services minus imports of goods and services (previously non-factor services).

- Natural Resource Rents (% of GDP) (World Bank): Total rents of natural resources are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents and forest rents, divided by GDP. From the World Bank: *Accounting for the contribution of natural resources to economic output is important in building an analytical framework for sustainable development. In some countries earnings from natural resources, especially from fossil fuels and minerals, account for a sizable share of GDP, and much of these earnings come in the form of economic rents - revenues above the cost of extracting the resources. Natural resources give rise to economic rents because they are not produced. For produced goods and services competitive forces expand supply until economic profits are driven to zero, but natural resources in fixed supply often command returns well in excess of their cost of production. Rents from nonrenewable resources - fossil fuels and minerals - as well as rents from over-harvesting of forests indicate the liquidation of a country's capital stock. When countries use such rents to support current consumption rather than to invest in new capital to replace what is being used up, they are, in effect, borrowing against their future.* Limitations of this data include the following: *This definition of economic rent differs from that used in the System of National Accounts, where rents*

are a form of property income, consisting of payments to landowners by a tenant for the use of the land or payments to the owners of subsoil assets by institutional units permitting them to extract subsoil deposits.

3.2 Institutional Variables

Next, I combine my dataset of macroeconomic variables (including the indicators and covariates) with institutional or political covariates by country and year. All institutional variable data - including policy, political risk, and structural factors - is collected annually from the PRS Group's ICRG database, and the Chinn-Ito Financial Openness Index. These variables are indices, and thus I use them as they are by their respective authors and publishers. The PRS's ICRG database has three components: Political Risk Components, Economic Risk Components, and Financial Risk Components. We were primarily interested in the Political Risk Components, which are the only components of the three which are readily available for researchers. For my analysis, I only kept the factors within the Political Risk component which had a significant statistical effect on the likelihood of the onset of a hyperinflation, and thus chose to ignore variables such as general corruption (which is present in other forms as factors which remained within the analysis), and religious tensions. Foreign debt as a percent of GDP traditionally belongs to Economic Risk Components dataset, but I found it important to include in the analysis due to previous studies which highlighted the relationship between central government debt and inflation (see Chapter 2).

The institutional and political factors belonging to this component are described as follows:

- Government Stability (Index, 0 to 12) (International Risk Country Guide): This is an assessment of both the ability of the government to carry out its declared program(s) and its ability to remain in office. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. The assigned risk rating is the sum of three sub-components: unity in the government, legislative force and popular support.

- Socioeconomic Conditions (Index, 0 to 12) (International Risk Country Guide): This is an assessment of socioeconomic pressures in society that could restrict government action or fuel social dissatisfaction. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. The assigned risk rating is the sum of three sub-components: unemployment, consumer confidence and poverty.

- Investment Profile (Index, 0 to 4) (International Risk Country Guide): This is an assessment of factors affecting the risk to investment that are not covered by other political, economic and financial risk components. The risk rating assigned is the sum of three sub-components, each with a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. The sub-components are: contract viability/expropriation, profits repatriation, payment delays.

- Internal Conflict (Index, 0 to 12) (International Risk Country Guide): This is an assessment of political violence in the country and its actual or potential impact on governance. The highest rating is given to those countries where there is no armed or civil opposition to the government and the government does not allow arbitrary violence, direct or indirect, against its own people. The lowest rating is awarded to a country involved in an ongoing civil war. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk. The sub-components are: civil war/coup threat, terrorism/political violence, civil disorder.

- External Conflict (Index, 0 to 12) (International Risk Country Guide): The measure of external conflict is an assessment of the risk to the exercise of foreign action, from non-violent external pressure (diplomatic pressure, withholding of aid, trade restrictions, territorial disputes, sanctions, etc.) to violent external pressure (from border conflicts to total war). External conflicts can adversely affect foreign business in many ways, ranging from restrictions on operations to trade and investment sanctions, to distortions in the allocation of economic resources, to violent change in the structure of society. The sub-components

are: war, cross-border conflict. A score of 4 points equates to Very Low Risk and a score of 0 points to Very High Risk.

- Military in Politics (Index, 0 to 6) (International Risk Country Guide): The military is not democratically elected. Therefore, their participation in politics, even at a peripheral level, is a diminution of democratic responsibility. However, it also has other significant implications. The military could, for example, become involved in government due to an actual or created internal or external threat. Such a situation would imply the distortion of government policy to deal with this threat, for example, by increasing the defense budget at the expense of other budgetary allocations. In some countries, the threat of military take-over can force an elected government to change policy or cause its replacement by another government more amenable to the military's wishes. A military takeover or threat of a takeover may also represent a high risk if it is an indication that the government is unable to function effectively and that the country therefore has an uneasy environment for foreign businesses. A full-scale military regime poses the greatest risk. In the short term a military regime may provide a new stability and thus reduce business risks. However, in the longer term the risk will almost certainly rise, partly because the system of governance will be become corrupt and partly because the continuation of such a government is likely to create an armed opposition. In some cases, military participation in government may be a symptom rather than a cause of underlying difficulties. Overall, lower risk ratings indicate a greater degree of military participation in politics and a higher level of political risk.

- Law and Order (Index, 0 to 4) (International Risk Country Guide): "Law and Order" form a single component, but its two elements are assessed separately, with each element being scored from zero to three points. To assess the "Law" element, the strength and impartiality of the legal system are considered, while the "Order" element is an assessment of popular observance of the law. Thus, a country can enjoy a high rating – 3 – in terms of its judicial system, but a low rating – 1 – if it suffers from a very high crime rate if the law is routinely ignored without effective sanction (for example, widespread illegal strikes).

- Democratic Accountability (Index, 0 to 6) (International Risk Country Guide): This is a measure of how responsive the government is to its people, on the basis that the less receptive it is, the more likely it is that the government will fall peacefully (in a democratic society), but possibly violently (in an undemocratic one). The points in this component are awarded on the basis of the type of governance enjoyed by the country in question. For this purpose, we have defined the following types of governance:

  1. Alternating Democracy:
     - A government/executive that has not served more than two successive terms,
     - Free and fair elections for the legislature and executive as determined by constitution or statute,
     - The active presence of more than one political party and a viable opposition,
     - Evidence of checks and balances among the three elements of government: executive, legislative and judicial,
     - Evidence of an independent judiciary,
     - Evidence of the protection of personal liberties through constitutional or other legal guarantees.
  2. Alternating Democracy:
     - A government/executive that has served more than two successive terms,
     - Free and fair elections for the legislature and executive as determined by constitution or statute,
     - The active presence of more than one political party,
     - Evidence of checks and balances between the executive, legislature, and judiciary, legislative and judicial,
     - Evidence of an independent judiciary,
     - Evidence of the protection of personal liberties.
  3. De Facto One-Party State:

- A government/executive that has served more than two successive terms, or where the political/electoral system is designed or distorted to ensure the domination of governance by a particular government/executive,
- Holding of regular elections as determined by constitution or statute,
- Evidence of restrictions on the activity of non-government political parties (disproportionate media access between the governing and non-governing parties, harassment of the leaders and/or supporters of non-government political parties, the creation of impediments and obstacles affecting only the non-government political parties, electoral fraud, etc).

4. De Jure One-Party State:
   - A constitutional requirement that there be only one governing party,
   - Lack of any legally recognized political opposition.
5. Autarky:
   - Leadership of the state by a group or single person, without being subject to any franchise, either through military might or inherited right;
   - In an autarky, the leadership might indulge in some quasi-democratic processes. In its most developed form this allows competing political parties and regular elections, through popular franchise, to an assembly with restricted legislative powers (approaching the category of a de jure or de facto one-party state). However, the defining feature is whether the leadership, i.e. the head of government, is subject to election in which political opponents are allowed to stand.

In general, the highest number of risk points (lowest risk) is assigned to Alternating Democracies, while the lowest number of risk points (highest risk) is assigned to Autarkies.

- Bureaucratic Quality (Index, 0 to 4) (International Risk Country Guide): The institutional strength and quality of the bureaucracy is a buffer that tends to minimize policy revisions when governments change. Therefore, outstanding

points are awarded to countries where the bureaucracy has the strength and experience to govern without drastic changes in policy or interruptions in government services. In a low-risk country, the bureaucracy tends to be somewhat autonomous in the face of political pressure and have an established mechanism of recruitment and training. Countries that lack the cushioning effect of a strong bureaucracy receive low points because a change in government tends to be traumatic in terms of policy formulation and day-to-day administrative functions.

- Foreign Debt (% of GDP) (International Risk Country Guide): The estimated gross foreign debt in a given year, converted into US dollars at the average exchange rate for that year, is expressed as a percentage of the gross domestic product converted into US dollars at the average exchange rate for that year. The risk points are assigned according to the following scale:
  - Foreign Debt to GDP Ratio: 0.0 to 4.9 - Risk Points: 10.0
  - Foreign Debt to GDP Ratio: 5.0 to 9.9 - Risk Points: 9.5
  - Foreign Debt to GDP Ratio: 10.0 to 14.9 - Risk Points: 9.0
  - Foreign Debt to GDP Ratio: 15.0 to 19.9 - Risk Points: 8.5
  - Foreign Debt to GDP Ratio: 20 to 24.9 - Risk Points: 8.0
  - Foreign Debt to GDP Ratio: 25.0 to 29.9 - Risk Points: 7.5
  - Foreign Debt to GDP Ratio: 30.0 to 34.9 - Risk Points: 7.0
  - Foreign Debt to GDP Ratio: 35.0 to 39.9 - Risk Points: 6.5
  - Foreign Debt to GDP Ratio: 40.0 to 44.9 - Risk Points: 6.0
  - Foreign Debt to GDP Ratio: 45.0 to 49.9 - Risk Points: 5.5
  - Foreign Debt to GDP Ratio: 50.0 – 59.9 - Risk Points: 5.0
  - Foreign Debt to GDP Ratio: 60.0 to 69.9 - Risk Points: 4.5
  - Foreign Debt to GDP Ratio: 70.0 to 79.9 - Risk Points: 4.0
  - Foreign Debt to GDP Ratio: 80.0 to 89.9 - Risk Points: 3.5
  - Foreign Debt to GDP Ratio: 90.0 to 99.9 - Risk Points: 3.0
  - Foreign Debt to GDP Ratio: 100.0 to 109.9 - Risk Points: 2.5

  - Foreign Debt to GDP Ratio: 110.0 to 119.9 - Risk Points: 2.0
  - Foreign Debt to GDP Ratio: 120.0 to 129.9 - Risk Points: 1.5
  - Foreign Debt to GDP Ratio: 130.0 to 149.9 - Risk Points: 1.0
  - Foreign Debt to GDP Ratio: 150.0 to 199.9 - Risk Points: 0.5
  - Foreign Debt to GDP Ratio: 200.0 plus - Risk Points: 0.0

- Financial Account Openness (Index, -2 to 2) (Chinn and Ito): Range that goes from -2 to 2, where a negative value reflects greater restrictions to the transactions of the financial account.

3.3 Choice of Country Subjects

Using Hanke's and Boger's inflation data, detailed in Section 3.1.1, I defined 64 countries between 1950 and 2019 which experienced either an accelerated inflation, hyperinflation, or both. Due to the nature of mid-to-late 20th century data availability, as well as the economic and developmental status of a 64 countries, there were large gaps of unavailable or missing data that prevented further analysis of hyperinflation probabilities. Thus, from these 64 countries, I chose to keep within my analysis dataset those with the most complete data, and restrict my observations to the years in which the data for these countries was most complete. This method does not adversely affect the robustness of the analysis, as completing survival analysis on this type of discrete dataset does not rely on consistent study time intervals for each subject in the study. Thus, the removal of years with large portions of missing variable values does not affect the data pertaining to the spells of accelerated inflation and hyperinflation. As such, the countries chosen as subjects - and the years for each country subject to study - are given as follows:

1. Angola: 1990 to 2017
2. Argentina: 1960 to 2018
3. Armenia: 1994 to 2016
4. Azerbaijan: 1991 to 2018

5. Belarus: 1993 to 2018
6. Bolivia: 1964 to 2018
7. Brazil: 1965 to 2018
8. Bulgaria: 1986 to 2018
9. Chile: 1965 to 2018
10. Democratic Republic of Congo: 1990 to 2014
11. Costa Rica: 1970 to 2018
12. Dominican Republic: 1970 to 2018
13. Ecuador: 1976 to 2018
14. Georgia: 1995 to 2018
15. Iceland: 1970 to 2018
16. Indonesia: 1968 to 2018
17. Israel: 1960 to 2018
18. Latvia: 1991 to 2017
19. Mexico: 1958 to 2018
20. Moldova: 1994 to 2017
21. Nigeria: 1960 to 2017
22. Paraguay: 1965 to 2017
23. Peru: 1960 to 2018
24. Philippines: 1960 to 2017
25. Romania: 1985 to 2014
26. Russian Federation: 1992 to 2017
27. Turkey: 1970 to 2018

28. Ukraine: 1993 to 2017

29. Uruguay: 1965 to 2018

30. Venezuela: 1980 to 2018

31. Zimbabwe: 1971 to 2018

4 Methodology

This study comprises two consecutive analyses with which to study the relationship between institutional and macroeconomic variables and the incidence of hyperinflations. The first examines whether we can establish a link between the our chosen set of covariates and any incidence of hyperinflation, through a series of preliminary regressions. Our response variable is a binary outcome of the hyperinflation, and it is dependent on: 1) nineteen country-level institutional and macroeconomic variables; and 2) five country- and region-specific variables as described in the previous section, such as regional instability and general regional poverty. Given the outcome of whether a country experiences a hyperinflation at any given year Y, I control for the country- and region-specific variables D_1 through D_5 and country-specific institutional and macroeconomic covariates X_1 through X_19. Since we have a binary dependent variable with survival analysis data in discrete time intervals, I will be running the following logistic regression:

$$\Pr(Yi = 1|D_i, X_i) = \frac{1}{1 + \mathrm{e}^{-(\beta_0 + X_i\beta_i + u_i)}}, \quad \forall 1 \leq i \leq 24 \tag{4.1}$$

Each variable D_i and X_i are dependent on the country, while Y_i identified whether a country went into a hyperinflation within a during a given year. In this model, $\Pr(Y_i = 1|D_i, X_i)$ is interpreted as the probability of a our dependent variable being a "success" given the set of covariates. This equates to interpreting $\Pr(Y_i = 1|D_i, X_i)$ as the probability that a country i experiences a hyperinflation on any given year rather than not experiencing one, conditional on changes in institutional and macroeconomic variables. This logistic regression serves as a preliminary study on the effects of our covariates on the incidence of hyperinflation, as it is both standard in the study of macroeconomic effects on the probability of economic events, and are widely statistically accepted for this use. However, when considering the small number of hyperinflationary events and the time at risk of a hyperinflationary event - defined as the accelerated inflation - we must step out of the static framework to

control for the time that a country is in accelerated inflation before a hyperinflation. Otherwise, this study can result in significant selection bias due to the logistic regression's inability to account for time-varying covariates.

Thus, in the second analysis, I will focus on the time-varying nature of the probability of hyperinflationary episodes. To this goal I turn to survival analysis to model the risk of a hyperinflation. Survival analysis is a branch of risk modeling which analyzes the period of time until a "failure event" occurs. The general aim of survival analysis, and thus our aim, is to both estimate the length of time to failure (read: hyperinflation) and the relationship between the causes of a hyperinflation (our covariates) and the hyperinflation. Hazard models, a form of models in survival analysis, are dynamic, and thus are able to incorporate time-varying covariates. This characteristics are key in this study, as it gives us an opportunity to study the probability of a hyperinflation occurring, not only at a given point in time, but most importantly as an event at the end of a period of inflation risk and accelerated inflation.

As hazard model implementation relies on the interval length to a "failure", the type of data this time is measure in is crucial for proper study. I will therefore conduct two further hazard model analyses, one in which I will treat my time interval data as purely discrete, and one in which I treat my time interval data as continuous. First, I treat the time data as discrete, as we only observe data on a year-by-year basis. The approach to discrete data lies in the estimation of the discrete hazard function and the distribution function. In a discrete setting, we let T be a discrete random variable that takes the values $t_1 < t_2 < \ldots < t_n$ with the probabilities

$$f(t_j) = f_j = \Pr(T = t_j) \tag{4.2}$$

We define the survival function at a time t_j as the probability that the survival time T is at least t_j, such that

$$S_{t_j} = S_j = \Pr(T \geq t_j) = \Pr(T \geq t_j - 1) \tag{4.3}$$

which describes the chance that a country will avoid the hyperinflation beyond the current period. We can estimate this by using a cumulative hazard estimate,

$$\hat{S}(t) = \hat{S}(t)\left[1 - \hat{h}(t)\right] \tag{4.4}$$

In other words, for any t, $\hat{S}$ gives us the probability of any at-risk country experiencing a hyperinflation. The hazard function is denoted by

$$h_t = h(t) = \Pr(T = t | T \geq t) = \Pr(T = t | t > t - 1) \tag{4.5}$$

and describes the conditional probability that a country will experience a hyperinflation in the current period. We can estimate this by the corresponding sample probability,

$$\hat{h}(t) = \frac{n \text{ of events total}}{n \text{ of events at risk}} \tag{4.6}$$

Using the Cox (1972) extension of his proportional hazards model, we can work with the proportional hazard assumption in discrete time by using the conditional odds of failure at each time t_j given the survival up to that point in time. The model is as follows

$$\frac{h\left(t_j | X_i\right)}{1 - h\left(t_j | X_i\right)} = \frac{h_0\left(t_j\right)}{1 - h_0\left(t_j\right)} \exp(X_i \beta_i) \tag{4.7}$$

where $h(t_j|X_i)$ is the hazard at time t_j for a country with covariates X_i, $h_0(t_j)$ is the baseline hazard at time t_j, and $\exp(X_i\beta_i)$ is the relative risk associated with covariate values X_i. Using this model, we arrive at a dynamic logistic model on the logit of the hazard, or conditional probability of dying at t_j, given survival at that time

$$\text{logit}\left(h\left(t_j | X_i\right)\right) = \text{logit}\left(h_0\left(t_j\right)\right) + X_i \beta_i \tag{4.8}$$

We can extend the proportional hazard model to begin from the survival function,

$$S\left(t_j | X_i\right) = S_0\left(t_j\right)^{\exp(X_i \beta_i)}, \tag{4.9}$$

where $S\left(t_j|X_i\right)$ is the probability that an individual with covariates X_i will survive until t_j, and $S_0(t_j)$ is the baseline survival function. Then solving for the hazard function for a country i at time t_j, we obtain the hazard function

$$h\left(t_j|X_i\right) = 1 - \left[1 - h_0\left(t_j\right)\right]^{\exp(X_i\beta_i)} \tag{4.10}$$

And we further apply a logarithmic transformation to obtain a function linear in parameters through a complementary log-log transformation. Applying it gives us the model

$$\log\left(-\log\left(1 - h\left(t_j|X_i\right)\right)\right) = \log\left(-\log\left(1 - h_0\left(t_j\right)\right)\right) + X_i\beta_i \tag{4.11}$$

Interestingly, this c-log-log link is uniquely appropriate for grouped data from the continuous proportional hazards model. In fact, this model can be obtained by grouping time in intervals in a continuous time proportional hazards model. This brings me to the second portion of analysis, in which I treat my data as continuous and split as interval-censored data.

Although the data for this study is recorded yearly, and thus is considered discrete, it cannot be considered "purely" discrete. The data is recorded on a yearly basis, but it is clear that hyperinflations do not occur at the same point in time in the year it occurs - that is, discrete yearly records are as such for simplicity. Thus, we can treat the data as interval-censored continuous time and estimate the underlying continuous survival function. This is simpler than discrete-time analysis, and does not require us to complete additional steps in the data-preparation process to apply. We again fit a proportional hazards model of the form

$$h_i(t|X_i) = h_0(t)\exp(X_i\beta_i) \tag{4.12}$$

Where we partition the duration into J intervals with cut-off opints $0 = \tau_0 < \tau_1 < \ldots < \tau_J = \infty$. We assume the baseline hazard is constant within each interval, such that

$$h_0(t) = h_j \text{ for } t \text{ in } [\tau_{j-1}, \tau_j) \tag{4.13}$$

Since the risk is piece-wise constant, the corresponding survival function is called piece-wise exponential. Introducing time-varying covariates, we write the model as

$$h_{i,j} = h_j \exp(X_i' \beta_i), \tag{4.14}$$

where $h_{i,j}$ is the hazard corresponding to country i at interval j, h_i is the baseline hazard for interval j, and $\exp(X_i' \beta_i)$ is the relative risk for a country with covariates X_i', compared to the baseline, at any time. We arrive at a log-linear model,

$$\log h_{i,j} = \log h_i + X_{i,j}' \beta_i \tag{4.15}$$

Where the covariates change values only at time interval boundaries, as we have in our data.

5 Results

First, I adapted my dataset to the requirements of event time analysis in order to properly analyze the results as survival analyses. Allison (2014) presents the episode splitting method as an appropriate way to set up data with time-varying covariates (Allison 2014). This has become the go-to method for adequately handling time-varying covariates within a survival analysis set-up. Splitting data into episodes sorts data observations according to spells and record an observation per subject per moment in time during the spell. In each observation, the explanatory variables (time-varying covariates in non-expanded form) stay the same. The starting and ending times of the observations are measured from the beginning of the spell, and they are considered censored if the event did not occur and uncensored if the interval ended with a hyperinflation. The advantage of the episode splitting method is that is allows equal treatment for time-constant and time-varying covariates, since during an interval the covariates are constant.

In order to specify the model, I used backward selection in order to identify the most explanatory covariates for a hyperinflation. The covariates producing the least significant F statistic is dropped and the process continues until all covariates remaining in the regression have F statistics that are significant at the 0.05 level (which I will use as the specified significance level for the rest of my analysis).

First, I ran initial regressions using discrete-time and continuous-time analysis in both static and dynamic settings. This was used as the first starting point to explain the explanatory power of macroeconomic and institutional variables on the probability and incidence of a hyperinflation in a static setting using a logit model. The hazards ratios presented in Table A.2 - in Models (2), (3), and (5)- can be interpreted as the chance of the hyperinflation occurring for a country with the covariate divided by the chance of the hyperinflation occurring without the covariate. Thus, a hazard ratio describes how many times more likely a hyperinflation is to occur at each time-point given a one unit increase in the covariate. If we consider the output

of the logistic regression in Model (1) (as well as a GLM regression in Model (4)), then the odds ratios can be interpreted as how many times more likely a hyperinflation is probable to occur given a one-unit increase in the covariate. The hazard ratio and odds ratio interpretation can be considered essentially equivalent given that the ratios themselves are almost the same.

Looking at Table A.2, we first consider a static logistic regression model. Although on its own the logistic regression cannot be enough to give us accurate results (due to the discrepancy between our time-varying covariates and the static nature of the model), it can provide a first-step in the effects of our variables of interest on the probabilities of hyperinflation. According to the Model (1) output, a one-unit increase in the export of goods and services results in a 1.6% increase in the odds of a country experiencing a hyperinflation. Similarly, a one-unit increase in the FDI outflows results in a 16.7% increase in the odds of a country experiencing a hyperinflation. On the other hand, a one-unit decrease in the government stability variable results in a 23.8% increase in the odds of a country experiencing hyperinflation (that is, the less stable the government, the more likely the odds of a hyperinflation). As expected, both according to established patterns of hyperinflationary countries as well as the outcomes found in median-median analysis of country characteristics (Saboin 2018), the factors that most dramatically affect the increased odds of a country experiencing hyperinflation are institutional factors.

Interestingly, the regression results for all five of the different models on Table A.2 give similar results (for both odds ratios and hazard ratios). As such, we can interpret these in the same manner. With the hazard ratios, we instead interpret each hazard ratio as a percentage increase or decrease in the hazard rate per one-unit increase in the covariate of interest. In addition, each model presents its Bayesian Information Criterion (BIC), which is an estimate of a function's posterior probability of a model being true; it therefore penalizes the use of additional parameters which do not add to the explanatory power of the functional model. Thus, a lower BIC represents the best model amongst the choice of models. As we can see, the model with the lowest BIC is the static logistic model - this is partially due to the episode expansion done in the data preparation, which then allows for an episode-by-episode analysis of the covariates.

Although the Cox PH Model gave the highest BIC value, it is useful in the analysis of time-varying covariates and their absolute importance on the probability of a hyperinflation. Before running a Cox regression, we must first verify the Proportional Hazards assumption for each of our covariates, as well as the finalized model. Table A.1 lists each covariate to test the Proportional Hazards assumption. Although some variables - namely, *Exports of Goods and Services (% of GDP)* and *Natural Resource Rents (% of GDP)* - have relatively low P-values, both the majority of the covariates and the final model choice itself have a large enough P-value such that we fail to reject the Proportional Hazards assumption. Thus, we can use the COX PH Model to analyze our various covariates, and test the absolute importance of the macroeconomic variables or institutional variables. The results for the covariates signal that the direction of the economy is significant, and on all the models the majority of the covariates reach significance.

The results show that the model utilizing all model covariates demonstrates the highest $Chi - Sq.$ and the lowest BIC values, as well as recovering statistical significance on all the covariates of interest.

6 Conclusion

In this paper I sought to understand and recover the causal links between the changes in economic and institutional factors on the probability of the onset of a hyperinflationary episode. That is, could we see a change in the probability that a country, already seeing some accelerated inflation, goes into a hyperinflationary state due to changes in certain economic and institutional factors? And in what ways do these factors affect the probability of a hyperinflation? Are macroeconomic and financial factors more significant to the changes in probability than institutional factors?

The results indicate that certain economic factors have a noticeable effect on the probability of the onset of a hyperinflation, and institutional factors even more so. Our results verify the hypothesis and conclusion of previous studies which have attempted to link certain macroeconomic factors and institutional factors to the incidence of hyperinflationary episodes. That is to say, that factors regarding the quality of institutions and the legal and political characteristics of a given country contribute to the increased or decreased probability of a hyperinflation when a country is already experiencing an episode of accelerated inflation. Although the significance of covariate effects vary depending on the regression model used, the results are uniform across the board, both in odds ratio and hazard ratio values. The results are also indicative of the importance in the inclusion of macroeconomic and financial covariates as well as institutional and political covariates, not simply one of these two groups of variables.

When we look at the results together, we can see the significance of movements in _ on the probability of inducing a hyperinflation. It is important, however, that we consider the sample used; the countries used were those which had at some point in the last half-century experienced at least one episode of accelerated inflation. Thus, we focus on primarily low-income, developing countries with storied political mismanagement and economic troubles. Thus, we can only assert the validity of our results within the group of troubled countries. We cannot affirm, within the scope of

this paper, that the significance of the effects hold with countries that are primarily high-income or whose economic outlook has remained relatively stable within the last half-century. It is important to note, however, that these results do match up with previous academic conceptions on the probable causes of hyperinflations.

Further studies using the method of survival analysis on a wider sample, including both high-income and low-income countries, may provide alternative results on the relative importance of macroeconomic and institutional factors. As a possible extension of this paper, we could study the conditional probability of entering a hyperinflationary period given a country entering a state of accelerated inflation. Would we find the same magnitude of effects and the same significance of each covariate when considering the conditional probability of entering a state of accelerated inflation? I used publicly available data in this study, but would the results be different if the analysis was done using more granular, restricted-access data? These considerations may help us identify more precisely the effects of certain country-level factors on the probability of the occurrence of a hyperinflation.

Appendices

A Tables

TABLE A.1: Cox Proportional-Hazard Test

	Rho	Chi-Squ.	DF	P-Value
Domestic Credit by Private Banks (% of GDP)	-.0148466	.088775	1	.7657404
Exports of Goods and Services (% Growth)	.1032273	3.583414	1	.0583591
Gross Fixed Capital Formation (% of GDP)	-.0379815	.5046769	1	.4774523
Gross Savings (% of GDP)	.0155771	.0754047	1	.7836242
GDP Growth (% Growth)	-.0518032	.6431968	1	.4225556
Net Lending and Borrowing (% of GDP)	-.059333	1.501276	1	.2204751
Current Account (% of GDP)	-.0344861	.4279572	1	.512993
FDI Inflows (% of GDP)	.0152494	.0628692	1	.8020173
FDI Outflows (% of GDP)	.0238366	.1507996	1	.6977724
Imports of Goods and Services (% of GDP)	.0453666	.7220419	1	.3954749
External Balance on Goods and Services (% of GDP)	.0300131	.4731557	1	.491539
Natural Research Rents (% of GDP)	-.1280909	5.003686	1	.0252934
Government Stability	.085594	2.309929	1	.12855
Socioeconomic Conditions	.0095574	.0283709	1	.8662397
Investment Profile	-.0004063	.0000552	1	.9940717
Internal Conflict	.0019497	.0011388	1	.9730792
External Conflict	.0030462	.0046575	1	.94559
Military in Politics	-.0245085	.2039683	1	.6515367
Law and Order	.0045034	.0077277	1	.9299502
Democratic Accountability	.0096685	.0597557	1	.8068826
Bureaucratic Quality	-.0045926	.0044355	1	.9469003
Foreign Debt (% of GDP)	.0292619	.2195933	1	.6393499
Exchange Rate Stability	.0312922	.2290288	1	.6322449
Chinn-Ito Index	-.07759	1.777336	1	.1824768
Global Test		25.84807	24	.3609186

TABLE A.2: Hazard Ratios for All Discrete and Continuous Time Models

	(1)	(2)	(3)	(4)	(5)
Domestic Credit by Private Banks (% of GDP)	1.016**	1.027***	1.025***	1.014**	1.014**
	(0.00592)	(0.00527)	(0.00503)	(0.00530)	(0.00530)
Exports of Goods and Services (% Growth)	0.930***	0.943***	0.953***	0.939***	0.939***
	(0.0158)	(0.00990)	(0.00961)	(0.0134)	(0.0134)
Gross Fixed Capital Formation (% of GDP)	1.295***	1.271***	1.239***	1.190***	1.190***
	(0.0508)	(0.0410)	(0.0429)	(0.0362)	(0.0362)
Gross Savings (% of GDP)	0.945*	0.943**	0.955*	0.953*	0.953*
	(0.0239)	(0.0209)	(0.0218)	(0.0222)	(0.0222)
GDP Growth (% Growth)	0.825***	0.846***	0.866***	0.842***	0.842***
	(0.0249)	(0.0216)	(0.0215)	(0.0227)	(0.0227)
Net Lending and Borrowing (% of GDP)	0.838***	0.832***	0.839***	0.859***	0.859***
	(0.0334)	(0.0264)	(0.0267)	(0.0306)	(0.0306)
Current Account (% of GDP)	1.139**	1.230***	1.213***	1.083*	1.083*
	(0.0452)	(0.0421)	(0.0426)	(0.0368)	(0.0368)
FDI Inflows (% of GDP)	0.778***	0.809***	0.860***	0.796***	0.796***
	(0.0326)	(0.0246)	(0.0259)	(0.0290)	(0.0290)
FDI Outflows (% of GDP)	1.167***	1.078**	1.059*	1.151***	1.151***
	(0.0409)	(0.0287)	(0.0276)	(0.0349)	(0.0349)
Imports of Goods and Services (% of GDP)	0.941***	0.923***	0.932***	0.961***	0.961***
	(0.0112)	(0.0104)	(0.0106)	(0.00969)	(0.00969)

External Balance on Goods and Services (% of GDP)	1.001	0.924***	0.930***	1.001	1.001
	(0.0221)	(0.0179)	(0.0179)	(0.0195)	(0.0195)
Natural Resources Rents (% of GDP)	0.862***	0.930***	0.917***	0.897***	0.897***
	(0.0218)	(0.0176)	(0.0177)	(0.0188)	(0.0188)
Government Stability	0.267***	0.330***	0.370***	0.308***	0.308***
	(0.0318)	(0.0303)	(0.0335)	(0.0321)	(0.0321)
Socioeconomic Conditions	1.895***	2.009***	1.956***	1.821***	1.821***
	(0.291)	(0.257)	(0.246)	(0.252)	(0.252)
Investment Profile	3.025***	3.013***	2.490***	2.847***	2.847***
	(0.456)	(0.399)	(0.314)	(0.394)	(0.394)
Internal Conflict	3.157***	3.038***	2.376***	2.671***	2.671***
	(0.421)	(0.336)	(0.255)	(0.301)	(0.301)
External Conflict	0.426***	0.498***	0.543***	0.486***	0.486***
	(0.0388)	(0.0343)	(0.0383)	(0.0376)	(0.0376)
Military in Politics	0.405***	0.374***	0.470***	0.473***	0.473***
	(0.0642)	(0.0509)	(0.0632)	(0.0651)	(0.0651)
Law and Order	0.227***	0.203***	0.264***	0.281***	0.281***
	(0.0421)	(0.0319)	(0.0414)	(0.0472)	(0.0472)
Democratic Accountability	0.333***	0.399***	0.425***	0.349***	0.349***
	(0.0434)	(0.0456)	(0.0477)	(0.0426)	(0.0426)
Bureaucratic Quality	0.366***	0.360***	0.424***	0.424***	0.424***
	(0.0686)	(0.0636)	(0.0738)	(0.0720)	(0.0720)
Foreign Debt (% of GDP)	0.604***	0.595***	0.667***	0.683***	0.683***

	(0.0541)	(0.0489)	(0.0532)	(0.0547)	(0.0547)
Exchange Rate Stability	2.183***	1.898***	1.741***	1.844***	1.844***
	(0.165)	(0.103)	(0.0979)	(0.110)	(0.110)
Chinn-Ito Index	0.160***	0.190***	0.231***	0.201***	0.201***
	(0.0241)	(0.0222)	(0.0266)	(0.0258)	(0.0258)
Observations	10497	10494	10494	10497	10497
BIC	1083.1	1514.2	2452.8	1089.4	1089.4
Chi-Squ.	854.5	1027.8	818.0	503.5	848.2

Exponentiated coefficients; Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

All results presented as odd-ratios and exponentiated coefficients. Model (1) describes the static logistic regression using all of our covariates; Model (2) describes utilizing the **streg** command for the regression; Model (3) describes the Cox PH model command for the regression; Model (4) describes the Generalized Linear Model (**glm**) for the regression; and Model (5) describes the C-Log-Log model for the regression. All models utilize all of our model's time-varying covariates, with expanded time intervals as described in Results.

TABLE A.3: Cox Proportional Model Hazards Ratios

	(1)	(2)	(3)	(4)
Domestic Credit by Private Banks (% of GDP)	0.991*	1.019***	0.998	1.025***
	(0.00374)	(0.00487)	(0.00364)	(0.00503)
Exports of Goods and Services (% Growth)	0.960***	0.941***	0.967**	0.953***
	(0.0105)	(0.0105)	(0.0104)	(0.00961)
Gross Fixed Capital Formation (% of GDP)	1.146***	1.216***	1.177***	1.239***
	(0.0273)	(0.0368)	(0.0278)	(0.0429)
Gross Savings (% of GDP)	0.998	0.981	1.000	0.955*
	(0.0201)	(0.0237)	(0.0197)	(0.0218)
GDP Growth (% Growth)	0.878***	0.873***	0.866***	0.866***
	(0.0167)	(0.0181)	(0.0166)	(0.0215)
Net Lending and Borrowing (% of GDP)	0.991	0.879***	1.006	0.839***
	(0.0239)	(0.0250)	(0.0236)	(0.0267)
Current Account (% of GDP)	0.939	1.098**	0.977	1.213***
	(0.0306)	(0.0393)	(0.0301)	(0.0426)
FDI Inflows (% of GDP)	0.815***	0.809***	0.855***	0.860***
	(0.0271)	(0.0266)	(0.0282)	(0.0259)
FDI Outflows (% of GDP)	1.092**	1.103***	1.056	1.059*
	(0.0343)	(0.0320)	(0.0298)	(0.0276)
Imports of Goods and Services (% of GDP)	0.990	0.969***	0.976**	0.932***
	(0.00789)	(0.00898)	(0.00798)	(0.0106)

External Balance on Goods and Services (% of GDP)	1.044	1.010	1.014	0.930***
	(0.0242)	(0.0215)	(0.0213)	(0.0179)
Natural Research Rents (% of GDP)	0.994	0.978	0.983	0.917***
	(0.0148)	(0.0176)	(0.0142)	(0.0177)
Government Stability		0.523***		0.370***
		(0.0435)		(0.0335)
Socioeconomic Conditions		1.483***		1.956***
		(0.157)		(0.246)
Investment Profile		0.864		2.490***
		(0.0859)		(0.314)
Internal Conflict		2.094***		2.376***
		(0.202)		(0.255)
External Conflict		0.687***		0.543***
		(0.0464)		(0.0383)
Military in Politics		0.609***		0.470***
		(0.0694)		(0.0632)
Law and Order		0.315***		0.264***
		(0.0443)		(0.0414)
Democratic Accountability		0.525***		0.425***
		(0.0553)		(0.0477)
Bureaucratic Quality		0.771		0.424***
		(0.118)		(0.0738)
Foreign Debt (% of GDP)		0.734***		0.667***

		(0.0513)		(0.0532)
Exchange Rate Stability		1.693***		1.741***
		(0.108)		(0.0979)
Chinn-Ito Index			0.660***	0.231***
			(0.0447)	(0.0266)
Observations	10494	10494	10494	10494
BIC	2920.3	2637.7	2888.9	2452.8
Chi-Squ.	239.4	623.8	280.0	818.0

Exponentiated coefficients; Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

All results presented as hazard ratios in exponentiated coefficients. Model (1) describes the Cox PH model using only macroeconomic variables as covariates; Model (2) describes the Cox PH model using macroeconomic variables and institutional variables as covariates, excluding the **kaopen** "exchange rate regime" variable; Model (3) describes the Cox PH model using only institutional variables and exchange rate stability as covariates; and Model (4) describes the Cox PH model using all model variables as covariates.

B Figures

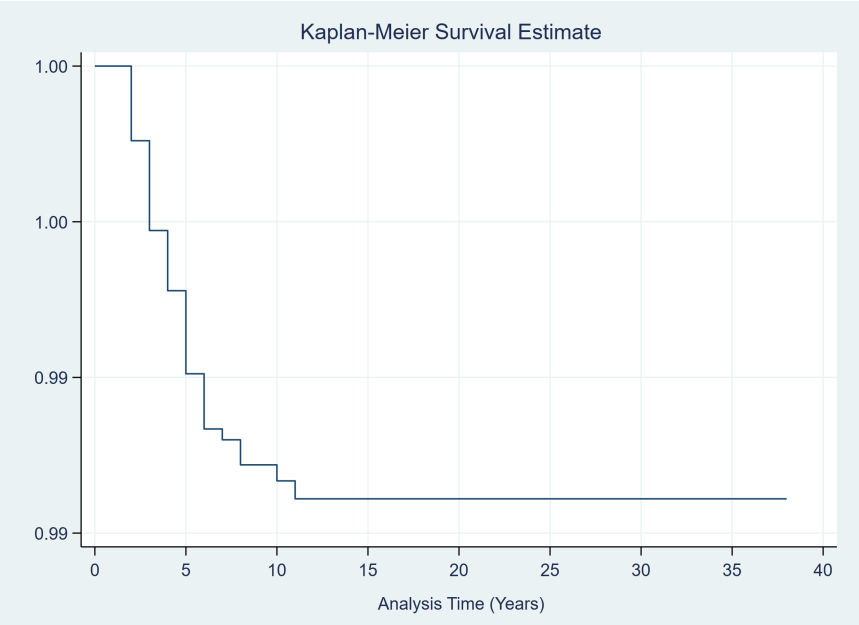

FIGURE B.1: Kaplan-Meier Survival Estimate

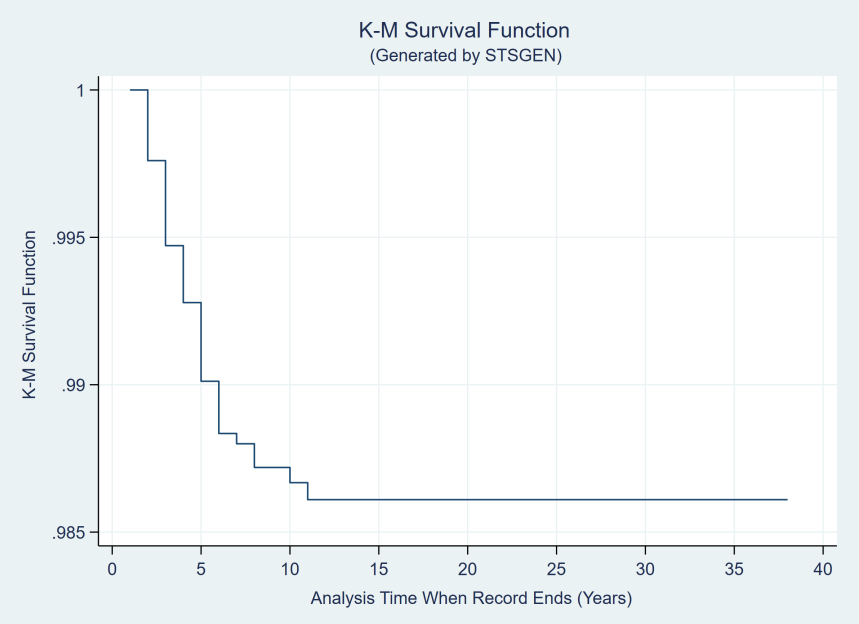

FIGURE B.2: Kaplan-Meier Survival Estimate Generated by **stsgen**

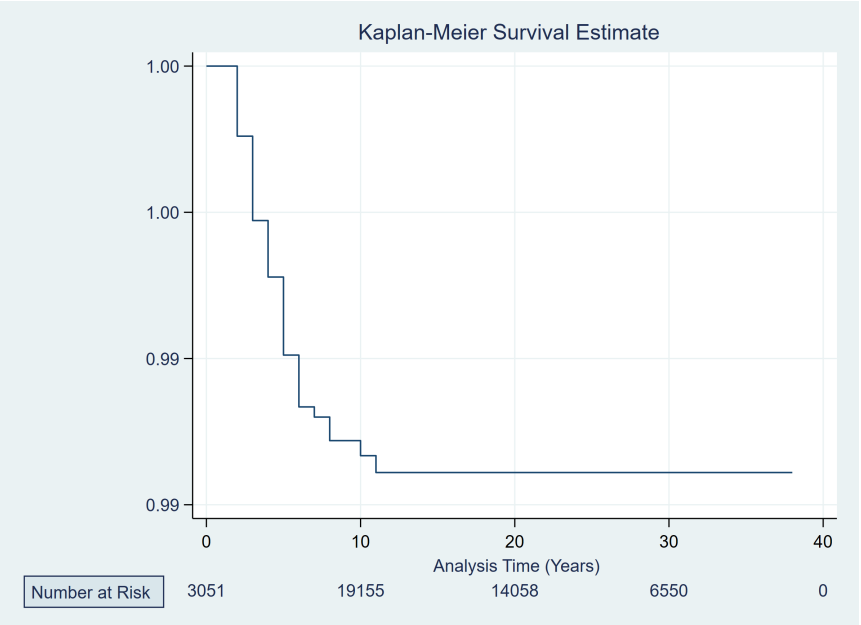

FIGURE B.3: Kaplan-Meier Survival Estimate and Number at Risk

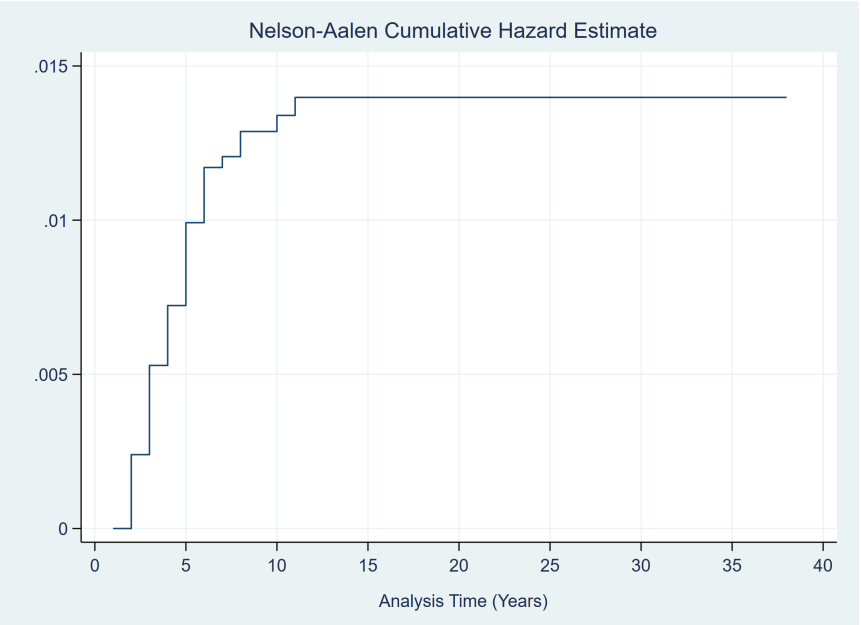

FIGURE B.4: Nelson-Aalen Cumulative Hazard Estimate

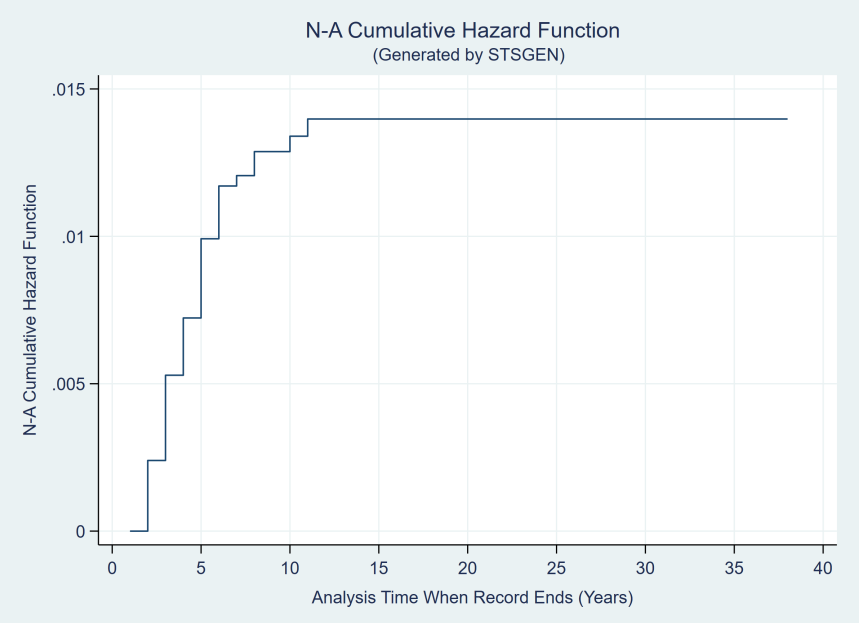

FIGURE B.5: Nelson-Aalen Cumulative Hazard Estimate Generated by **stsgen**

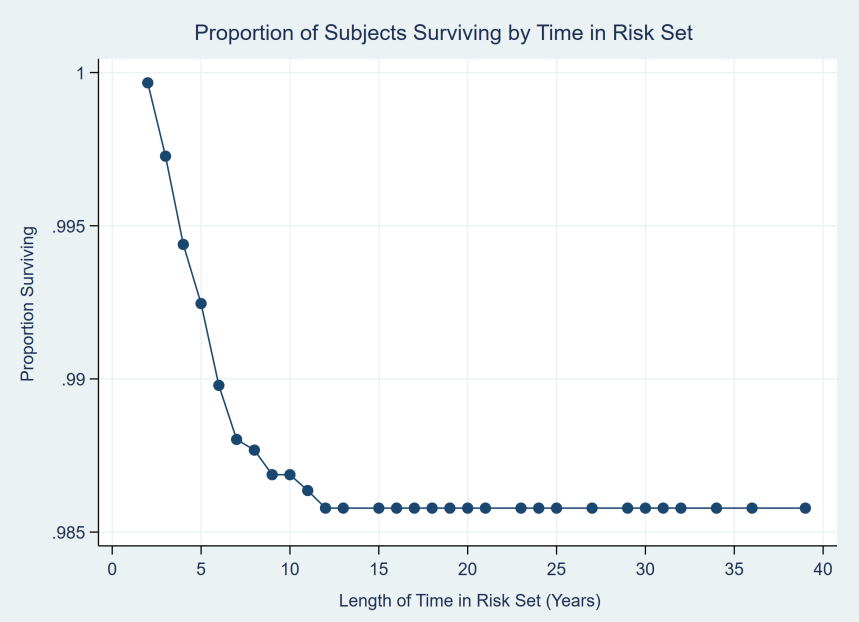

FIGURE B.6: Proportion of Subjects Surviving

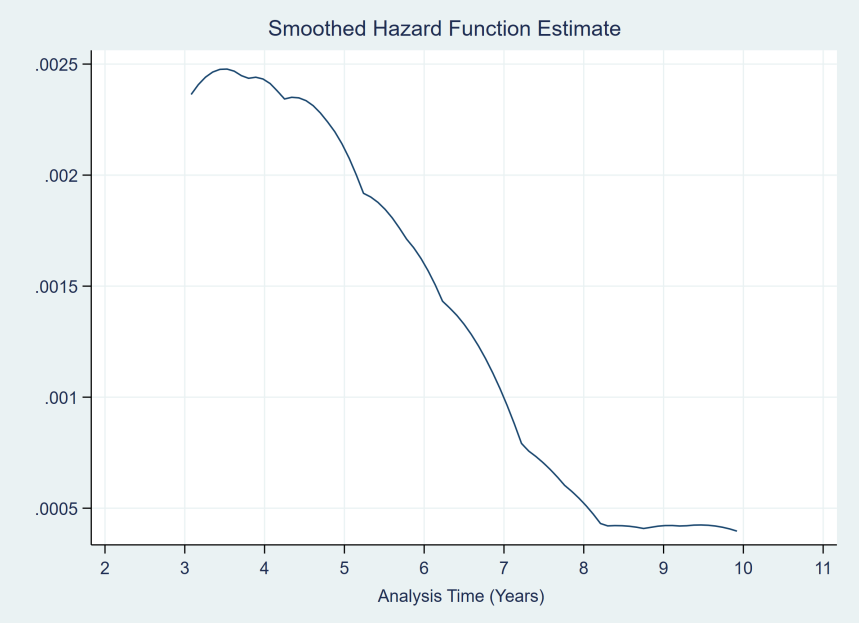

FIGURE B.7: Smoothed Cumulative Hazard Function with Bins of 1

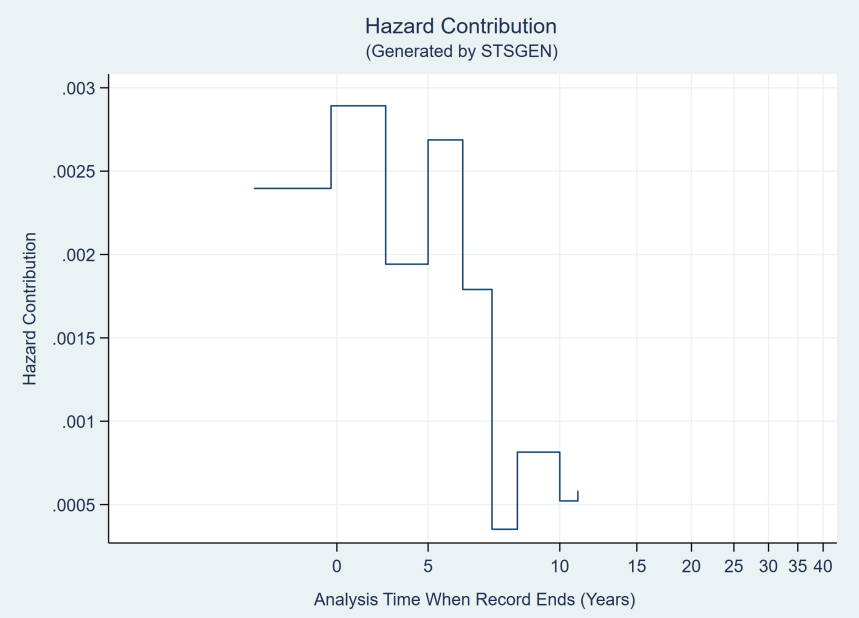

FIGURE B.8: Hazard Contribution

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