Socio-Political Instability and Growth Dynamics*

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Abstract

We develop an overlapping generations (OLG) monetary endogenous growth model characterized by socio-political instability, with the latter being specified as a fraction of output lost due to strikes, riots and protests. We show that growth dynamics arise in this model when socio-political instability is a function of inflation. In particular, two distinct growth dynamics emerge, one convergent and the other divergent contingent on the strength of the response of socio-political instability to inflation. Since our theoretical results hinge on socio-political instability being a function of inflation, we test the prediction that inflation affects socio-political instability positively by using a panel of 156 countries for the 1980-2012 period, and allowing for country and time fixed effects. The results indicate that inflation relates positively with socio-political instability. Policymakers should be cognisant that it is crucial to maintain long-run price stability, as failure to do so may result in high inflation emanating from excessive money supply growth, leading to high (er) socio-political instability, and ultimately, the economy being on a divergent balanced growth path.

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1 Introduction

"Inflation is a disease, a dangerous and sometimes fatal disease, a disease that if not checked in time can destroy a society." – Milton Friedman[1]

This paper develops an overlapping generations (OLG) monetary endogenous growth model characterized by socio-political instability (SPI) to analyse the growth dynamics in the presence of this augmentation. We endogenize growth by allowing for a Romer (1986)-type production function. In our model, money is introduced via a mandatory cash reserve requirement, set and controlled by the government and enforced on banks which operate in a perfectly competitive environment. This treatment of money is standard in literature (See Bittencourt et al. (2014) and Gupta and Stander (2018) and references cited therein).

We define SPI as the fraction of output that is lost due to crime, riots and other disruptive (labour-related) activities, with SPI being a positive function of inequality and negatively related to policing expenditures made by the government (as in Ghate et al. (2003)). In addition, unlike Ghate et al. (2003), we assume that SPI is also a positive function of inflation, as empirically suggested by Paldam (1987), Klomp and de Haan (2009), Blanco and Grier (2009), and indirectly by Aisen and Veiga (2006) and Aisen and Veiga (2008) (as they control for endogeneity when testing the impact of such instabilities on inflation). In addition, our paper relates to Ziogas and Panagiotidis (2021), who report that voters, in the Organisation for Economic Cooperation and Development (OECD) and European Union (EU) countries, punish politicians who allow inflation (and unemployment) to increase. In our case, an increase in SPI, because of inflation, might be seen as some sort of punishment as well, as this might entail an increase in expenditure on policing services at the cost of other productive government outlays. The intuition for our ad-hoc representation of SPI is very simple: inflation, emanating from growth in money supply meant to fund government expenditure, depresses the real wage and subsequently leads to strikes/riots/demonstrations. This results in output being lost, not only through the destruction of production, but also in the loss of production since time is now allocated to SPI activities instead of productive activities. Collectively, this is our definition of SPI.

With SPI being a function of inflation, we show that convergent and divergent growth dynamics arise depending on the strength of SPI's response to inflation, which is however not possible otherwise. In the process, our paper adds to the vast literature of OLG monetary endogenous growth models that analyse growth dynamics (see for example, Gupta and Vermeulen (2010), Gupta et al. (2011) and Gupta and Stander (2018) for detailed discussions in this regard), by introducing an imperfection in the form of SPI. To the best of our knowledge, this is the first theoretical model that introduces SPI to an OLG monetary endogenous growth model and analyses the growth dynamics that emerge if SPI is a function of inflation. Therefore, and for completeness and to motivate our specification of the SPI, we use a panel of 156 countries for the period 1980-2012, and test the theoretical prediction that high(er) inflation is related to high(er) SPI. This period captures enough variation in SPI - including the political-regime changes in the 1980s and 1990s in Latin America and Eastern Europe, and the Arab Spring - inflation and economic activity, which allows us to generalise the results. By allowing for country and time fixed effects, the results indicate that inflation, as predicted by the theoretical model, relates positively to SPI.

The rest of the paper is organized as follows: Section 2 defines the model's economic setting, presents our theoretical model with the optimisation solutions and details the growth dynamics. Section 3 contains the empirical evaluation of the theoretical prediction about the relation between SPI and inflation. Finally, Section 4 offers some concluding remarks and policy advice

[1] *Free to Choose: A Personal Statement* (1980).

based on the findings.

2 The Model

2.1 Economic Setting

Time is divided into discrete segments with $t = 1, 2, ...$ The principal economic activities are: (i) Two-period lived OLG consumers/labourers, who start with a positive young-age labour endowment of unit one, retire and consume only when old[2]. At time t, there exist two co-existing generations of young-age and old-age consumers, with N people born at each $t \geq 1$. At $t = 1$, there exist N people in the economy, called the initial old, who live for only one period. The young-age consumers supply their labour endowment inelastically to earn a wage income. The after-tax wage income earned in $t = 1$ is deposited into banks for future consumption. It must be realized that at each point in time (t), there are two co-existing generations of young and old, i.e., overlapping generations, and this process continues till t running to ∞ with new cohorts of young and old, and hence, our model is consistent with the other infinitely-lived agents that we describe next, even though a specific young consumer lives for only two periods; (ii) Infinitely-lived identical producers which use the same production technology to produce a single final good from the inelastically supplied labour, physical capital which is borrowed from the banks and economy-wide average capital. The representative firm maximizes its discounted streams of profit flows subject to the constraints it faces; (iii) There is a competitive banking sector that performs a simple pooling function as in Bryant and Wallace (1980) by collecting first-period deposits from the young consumers and lending it to the firms, subject to obligatory cash reserve requirements. Implicitly, we assume that capital is illiquid, in the sense that it is created in large minimum denominations (say, $\kappa > w_t$ for all t). In such a setting, it is natural to think that banks arise to provide a simple intermediation function, whereby they accumulate deposits of small savers and acquire capital on their behalf. As in Bhattacharya and Haslag (2001), we will assume that we are focusing on equilibria where κ is "large enough" to ensure that banks continue to have a purpose for existence. Furthermore, we assume that banks perform this intermediary function at zero cost[3]; and (iv) There is an infinitely-lived (consolidated) government which balances its budget on a period-by-period basis, with the Treasury-wing of the government collecting taxes from wage incomes and purchases g_t units of goods, a part of which is used as policing expenditures to reduce the loss of output due to SPI, while the remainder is used for pure consumption. The monetary authority-wing of the government also controls the setting of the reserve requirement. There is a continuum of each type of economic agent with unit mass.

2.2 Consumers

All consumers have the same preferences, hence in each period there is a representative agent. This representative consumer supplies its endowment of time inelastically, n_t, to earn a real wage, w_t and pay a lump-sum tax, T_t. The after-tax wage is wholly saved and deposited with the bank, d_t in period $t = 1$. When old, the consumer retires and consumes c_{t+1} from the total investment

[2]This assumption abstracts from the consumption-savings decision and ensures tractability as the analysis is now independent from the consumers utility function. Woodford (1984) offers a detailed discussion on this, even though it is by now a standard assumption in the OLG literature. Gupta and Stander (2018) use a similar formulation in their work on endogenous fluctuations and inflation targeting.

[3]This is a simplifying assumption, although Gupta and Stander (2018) show that it is straightforward to adapt the profit function of the bank to account for a fraction of the deposits spent as resource cost.

of young-age after-tax savings. Formally, the representative young-age consumer wants to [4]:

$$\max U\left(c_{t+1}\right) \tag{1}$$

subject to:

$$p_t d_t = p_t w_t - p_t T_t \tag{2}$$

$$p_{t+1} c_{t+1} = \left(1 + i_{dt+1}\right) p_t d_t \tag{3}$$

where U is a utility function of a general form but assumed to be twice-differentiable, such that $U^{'}(c) > 0$ and $U^{''}(c) < 0$. $1 + i_{dt+1}$ is the nominal interest rate received on deposits at $t+1$, p_t and p_{t+1} are the price levels in periods t and $t+1$, respectively. From the fact that $d_t = \frac{D_t}{p_t}$, it is clear that D_t is the amount of nominal deposits held by consumers. The feasibility constraint is presented by (2) (first-period budget constraint) for the young-age consumer, and (3) is the budget constraint of the old-age consumer.

2.3 Financial Intermediaries/Banks

There exist a finite number of competitive banks in this economy, subject to an obligatory cash reserve requirement, γ_t, controlled by the government. It must be realized that, introducing (non-interest bearing) money in general equilibrium models with single or multiple assets that yield non-negative nominal interest rate is not straightforward. In this regard, multiple modelling approaches exist to motivate the role of money in such models; for example, money in the production function, money in the utility function, cash-in-advance constraint, shopping-time, money-search, as well as via mandatory cash reserve requirements (see Walsh (2017) for a detailed discussion of these models).

In our case, we introduce money via the cash-reserve requirement approach instead of the role of money being incorporated via the consumers' problem, so that our analysis is independent of the specification of the utility function. To guarantee that all competitive banks levy the same cost on their loans, the nominal loan rate, i_{lt}, and guarantee the depositor the same nominal deposit rate, i_{dt}, we assume that operating the banking system comes at zero cost and that bank deposits are one period contracts. Banks maximize their profit function by pooling deposits [5], choosing the level of loans to be extended and the required cash reserves to hold and then extend loans to firms. Banks receive interest income from these loans to firms and subsequently meet their deposit rate obligations to consumers. The balance sheet is constrained by the mandatory reserve requirement, and is represented by $\left(1 - \gamma_t\right) D_t = L_t$. Hence, all banks attempt to:

$$\max \prod\nolimits_{Bt} = i_{lt} L_t - i_{dt} D_t \tag{4}$$

subject to:

$$M_t + L_t \leq D_t \tag{5}$$

$$M_t \geq \gamma_t D_t \tag{6}$$

with $\prod_{Bt}$ the bank's net profit function [6]; M_t is the cash reserves held by the banks to meet the reserve requirement and L_t are the amount of nominal loans extended to the firms. The feasibility constraint is represented by (5) resulting from optimal financing contracts and (6)

[4]Optimisation solutions for the different economic agents are fully set out in the Appendix A.

[5]See Gupta and Stander (2018) and the references cited therein for a clear description of this solitary function of the banks.

[6]The cash reserves, M_t only forms part of the bank's gross profit function as in Haslag and Young (1998) and Basu (2001), even though it is part of the bank's total portfolio.

is the reserve requirement constraint. As a competitive banking sector is characterised by free entry, new entrants will drive profits to zero. Given that (5) and (6) binds, the solution to the bank's problem reduces to:

$$i_{lt} = \frac{i_{dt}}{1-\gamma_t} \tag{7}$$

It is clear that cash reserve requirements induce a wedge between the interest rate on deposits and the lending rates [7], as evident from (7). Total cash reserves M_t is rate-of-return dominated by loans, hence (5) will be binding as banks will hold just enough real money balances to satisfy the mandatory reserve requirements.

2.4 Firms

In this economy, we consider infinitely-lived identical firms that each produce a single final good, y_t, using the same Romer (1986)-type production technology. The firms employ physical capital, k_t, labour, n_t, and economy-wide average capital, $\bar{k}_t$,[8] to produce the single good, such that:

$$y_t = Ak_t^{\alpha}\left(n_t\bar{k}_t\right)^{1-\alpha} \tag{8}$$

where $A > 0$ is a technology parameter, $0 < \alpha(1-\alpha) < 1$ represents the elasticity of output with respect to capital and labour or economy-wide average capital, respectively. At time t, the final good can either be allocated for consumption, c_t, or stored. Firms' investment in physical capital, I_{k_t}, is constrained by the availability of funding to the firms, which they can access from banks as loans. This is so since we assume that firms are able to convert borrowed funds, L_t, into fixed capital formation such that $p_tI_{k_t} = L_t$. We follow Diamond and Yellin (1990) and Chen et al. (2008), in assuming that firms are residual claimers in that they use up the unsold consumption good in a way that is consistent with lifetime value maximization of the firms. The representative firm therefore maximizes its discounted stream of net profit flows subject to the evolution of capital and the loan constraints.

Formally, the firm's problem is outlined as follows:

$$\max_{k_{t+1},n_t}\sum_{i=0}^{\infty}\rho^i\left[p_t(1-\lambda_t)y_t - p_tw_tn_t - (1+i_{lt})L_t\right] \tag{9}$$

subject to:

$$k_{t+1} \leq (1-\delta_k)k_t + I_{k_t} \tag{10}$$

$$p_tI_{k_t} \leq L_t \tag{11}$$

$$L_t \leq (1-\gamma_t)D_t \tag{12}$$

where ρ is the firm owners' (constant) discount rate and δ_k is the (constant) rate of capital depreciation. λ_t is the socio-political instability (SPI) factor, defined as the fraction of output lost due to crime, riots and other disruptive (labour-related) activities (Ghate et al., 2003). The

[7] The simplifying assumption that banks operate at zero cost, could also be replaced with an assumption that banks spend a portion of the deposits as resource cost in operating the bank system. This would imply that the bank's net profit function would be max $\prod_{Bt} = i_{lt}L_t - i_{dt}D_t - cD_t$, with c being the fraction of deposits banks spend on its operations. The optimisation solution (with the same constraints) would become $i_{lt} = \frac{i_{dt}}{1-\gamma_t-c}$. It is evident that our results would not be affected if we redefined $\gamma_t^c = (\gamma_t + c)$.

[8] Note that, $\bar{k} = \frac{1}{N}\sum_{i=1}^{N}k_i$, where N is the number of firms, which is equal to the number of consumers as in Romer (1986), and k_i is the per capita capital stock of each firm i. Since all firms are identical, i.e., $k_i = k$, in equilibrium, we will have $\bar{k} = k$.

SPI is explicitly expressed as follows, keeping in mind that in the balanced growth path, all real variables need to grow at the same rate, i.e., ratios of real variables must be constant:

$$\lambda_t = 1 - B\frac{\frac{g_{1t}}{w_t}}{\frac{T_t}{w_t}(\Pi_t)^{\phi}} \tag{13}$$

where $\frac{g_{1t}}{w_t}$ is policing expenditure as percentage of wages directed at restoring or maintaining law and order, hence making it more difficult for rioters to destroy output during demonstrations, and in the process implying a negative relationship with λ. $\frac{T_t}{w_t}$ is the ratio of the lump-sum tax to wages, and is assumed to increase SPI, since taxes are regressive and it raises inequality (assuming an underlying linear regression for simplicity), resulting in higher SPI (Ghate et al., 2003). Π_t is the gross inflation rate, expressed as the growth in annual consumer price index (CPI) plus one. As indicated in the introduction, based on available empirical evidence, we formulate the functional form of the SPI such that, higher inflation increases social and political unrest, with ϕ defining the response of SPI to movements in the gross inflation rate. B is a constant that is restricted and meant to keep (13) well-defined, hence $B \in \left(0, \frac{\frac{T_t}{w_t}(\Pi_t)^{\phi}}{\frac{g_{1t}}{w_t}}\right)$. Note that $\Omega_t\Pi_t = \mu_t$, with Ω_t defined as the gross growth rate of the economy at time t and μ_t is the money growth rate. The infinitely-lived government purchases $g_t = g_{1t} + g_{2t}$ units of the consumption good, with $g_{1t} = \theta_1 g_t$, $g_{2t} = (1-\theta_1)g_t$ and $\frac{g_t}{w_t} = \theta_t$. g_{2t} is an input into the firms' production function. These relationships entail that $\frac{g_{1t}}{w_t} = \theta_1\theta_t$ and that $\frac{T_t}{w_t} = \tau_t$ such that we can then express (13) as:[9]

$$\lambda_t = 1 - B\frac{\theta_1\theta_t\Omega_t^{\phi}}{\mu_t^{\phi}\tau_t} \tag{14}$$

The firm solves the following recursive problem in order to determine the demand for labour and investment:

$$V(k_t) = \max\left[p_t(1-\lambda_t)Ak_t^{\alpha}\left(n_t\bar{k}_t\right)^{1-\alpha} - p_t w_t n_t - p_t(1+i_{lt})(k_{t+1} - (1-\delta_k)k_t) + \rho V(k_{t+1})\right] \tag{15}$$

yielding the following first order conditions:

$$n_t : w_t = (1-\lambda_t)(1-\alpha)A(\frac{k_t}{n_t})^{\alpha}\bar{k}_t^{1-\alpha} \tag{16}$$

This represents the optimal hiring decision for a firm, in that the firm will hire labour up to a point whereby the marginal product of labour is equal to the real wage.

$$k_{t+1} : (1+i_{lt}) = \rho\left(\frac{p_{t+1}}{p_t}\right)\left[(1-\lambda_{t+1})\alpha A\left(\frac{n_{t+1}\bar{k}_{t+1}}{k_{t+1}}\right)^{1-\alpha} + (1+i_{lt+1})(1-\delta_k)\right] \tag{17}$$

The above expression is an efficiency condition that provides for the optimal investment decisions of the firm. The firm compares the cost of increasing investment in the current period with the future stream of benefits generated from the additional capital invested in the current period. If we go by the assumption that there is full depreciation of capital between periods such that $\delta_k = 1$, then, without any loss of generality, (17) simplifies to

[9] As pointed out by an anonymous referee, SPI can also be affected by the unemployment rate (see for example, Panagiotidis and Roumanias (2021)), but since this is an equilibrium model of endogenous growth in the long-run, it is not possible for us to explicitly incorporate unemployment, i.e., a situation of disequilibrium, into the framework.

$$(1+i_{lt}) = \rho\left(\frac{p_{t+1}}{p_t}\right)\left[(1-\lambda_{t+1})\alpha A\left(\frac{n_{t+1}\bar{k}_{t+1}}{k_{t+1}}\right)^{1-\alpha}\right] \tag{18}$$

2.5 Government

As pointed above, we assume an infinitely-lived government that purchases g_t units of the consumption good such that $g_t = g_{1t} + g_{2t}$ where g_{1t} and g_{2t} are policing and unproductive expenditures respectively. These expenditures are financed through taxes on income and seigniorage (inflation tax). The government's budget constraint at time t can be written in real per-capita terms as follows:

$$g_t = T_t + \frac{M_t - M_{t-1}}{p_t} \tag{19}$$

with $M_t = \mu_t M_{t-1}$, where μ_t is the money growth rate. $T_t = w_t\tau_t$ is the tax revenue, with τ_t being the tax rate. It is the consolidated government that coordinates operations of treasury and the central bank, both of which serve the government's interests. The government implements fiscal policy: raising revenue through income taxes and managing government expenditures. Given that $T_t = w_t\tau_t$, $M_t = \mu_t M_{t-1}$, $m_t = \gamma_t d_t$ from (6), $d_t = w_t - T_t$ from (2) and that $\Omega_t\Pi_t = \mu_t$, the government's budget constraint, in real terms, can be expressed as

$$g_t = T_t + \gamma_t d_t\left(1 - \frac{1}{\Omega_t\Pi_t}\right) \tag{20}$$

where Ω_t is the gross growth rate of the economy at time t and Π_t is the gross inflation rate at time t.

Note that, the role of the government here is primarily to raise revenue via taxation and seigniorage to meet its consumption and the policing expenditures to reduce the loss of output due to the impact of SPI. Indeed, the role of the government here is quite passive, with it not having a specific objective function per se, besides balancing its budget at each point in time. But with our focus being growth dynamics in the presence of SPI, the structure of the government has been kept to bare minimum in line with the endogenous growth theory literature. Of course, interesting future analysis could involve the optimal choices of policy decisions by the government in the context of welfare-maximization, given the existence of SPI, along the lines of Ghate et al. (2003).

2.6 Equilibrium

A competitive equilibrium for this economy is characterised as a sequence of prices $\{p_t, i_{lt}, i_{dt}\}_{t=0}^{\infty}$, allocations $\{c_{t+1}, n_t, I_{kt}\}_{t=0}^{\infty}$, stocks of financial assets $\{m_t, d_t\}_{t=0}^{\infty}$, and policy variables $\{\gamma_t, \tau_t, \mu_t, g_t\}_{t=0}^{\infty}$ such that:

- The consumer maximizes utility given by (1) subject to (2) and (3);
- Banks maximize profits, taking i_{lt}, i_{dt} and γ_t as given and such that (7) holds;
- The real allocations solve the firm's date t profit maximization problem, given prices and policy variables, such that (16) and (17) hold;
- The money market equilibrium conditions: $m_t = \gamma_t d_t$ is satisfied for all $t \geqslant 0$;
- The loanable funds market equilibrium condition: $p_t I_{kt} = L_t$ where the total supply of loans $L_t = (1-\gamma_t)D_t$ is satisfied for all $t \geqslant 0$;

- The goods market equilibrium condition require: $c_t + I_{kt} + g_t = (1-\lambda_t)Ak_t^{\alpha}\left(n_t\bar{k}_t\right)^{1-\alpha}$ is satisfied for all $t > 0$;
- The labour market equilibrium condition: $(n_t)^d = 1$ for all $t > 0$;
- The government budget constraint in (20) is balanced on a period-by-period basis;
- d_t, p_t, i_{lt}, i_{dt} and A are positive for all $t > 0$.

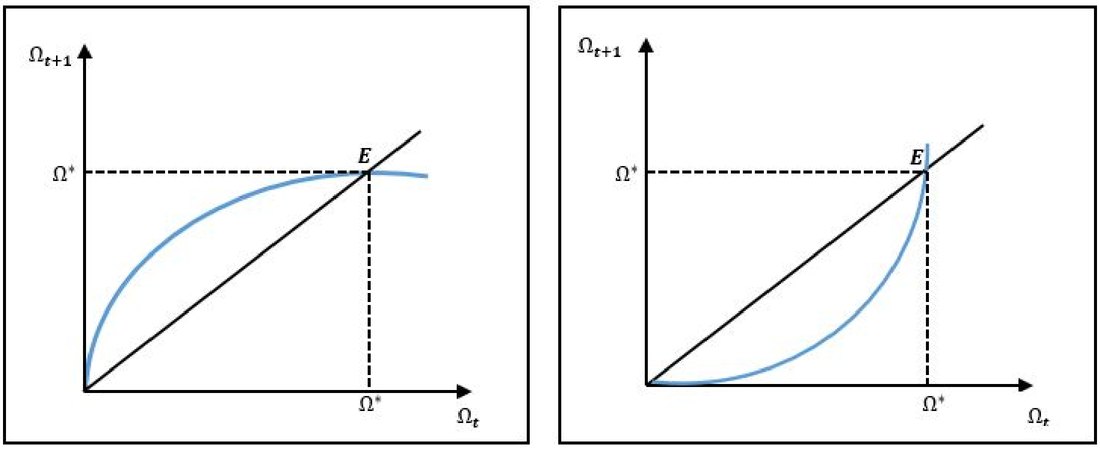
2.7 Growth Dynamics

We analyse the possible growth dynamics for our model using (2), (10), (11), (12) and (20) and the fact that in equilibrium, $n_t = 1$ and $k_t = \bar{k}_t$. We obtain an expression for the relationship between the gross growth rate in time $t+1$, Ω_{t+1} and the gross growth rate in time t, Ω_t. In other words, we obtain $\Omega_{t+1} = f(\Omega_t)$, which is expressed as:

$$\Omega_{t+1} = A(1-\gamma_t)(1-\alpha)B\frac{\theta_1\theta_t\Omega_t^{\phi}}{\mu_t^{\phi}\tau_t}\left[1-\tau_t\right] \tag{21}$$

where $\theta_t = \tau_t + \gamma_t(1-\tau_t)\left(1-\frac{1}{\mu_t}\right)$. Given A, α, γ, θ_1, θ τ, μ, we can have two different types of balanced growth paths depending on ϕ. In particular, ϕ, the responsiveness of the SPI, λ_t, to inflation, Π_t, is the one that determines the two different growth paths. On one hand, the economy's growth path is concave, and hence convergent to the steady-state gross growth rate, Ω^* $\left(=\left(\frac{A(1-\gamma)(1-\alpha)B\theta_1\theta(1-\tau)}{\mu^{\phi}\tau}\right)^{\frac{1}{1-\phi}}\right)$, if $\phi < 1$, as shown in Figure 1. On the other hand, the growth path is convex, and hence divergent from the steady-state gross growth rate, Ω^*, if $\phi > 1$ (See Figure 1). In other words, stronger the influence of inflation on SPI, the more likely the economy can end up on a divergent growth path. Recall that, all the real variables in the economy grow at the same rate along the balanced growth path, and hence would depict the same dynamics. Further, given that $\Omega_t\Pi_t = \mu_t$, it must be realized that there is also a corresponding (inverse to growth) dynamics of inflation.

Figure 1: Model Growth Dynamics



(a) Convergent Growth Path ($\phi < 1$) (b) Divergent Growth Path ($\phi > 1$).

To gain some intuition of the result, using equation (13) under constant policy rules, it is easy to show that the time path of $(1-\lambda)$, i.e., the socio-political stability (SPS) is given by $\lambda_{t+1} = \left(\frac{\Omega_{t+1}}{\Omega_t}\right)^{\phi} \lambda_t$. Given this, when ϕ <1, and we have the convergent growth path, starting from a point below the steady-state, the increase in growth would be lower in the next period than in the current period, and so would be the SPS, causing the economy to converge to the steady-state over time, with the opposite holding when we are above the steady-state. Under the divergent growth path, i.e., when ϕ >1, and we are above the steady-state, the growth rate in next period will be higher than the current period, as would be the SPS, which will feedback into the growth process and cause the growth to be explosive. But, if we are below the steady-state in this case, then the growth starts to fall, as does the SPS, leading the economy to the origin, where the gross growth rate is unity, and the growth rate is zero. Note that, we are considering an economy with positive money growth rate and hence inflation, i.e., both their gross growth rates are greater than one, and given the money-market equilibrium, it should imply that the lowest value of the gross economic growth rate (i.e., the origin in the figures) would be unity, in others words, a net growth rate of zero.

3 Data and Results

3.1 Data

To test the theoretical prediction that inflation correlates positively to social-political instability, upon which our results of growth dynamics depend on completely, we use annual data from 156 countries, a list of which has now been included in the Appendix B, over the 1980 - 2012 period. Although some countries have data available for longer periods, 1980 is the year when most countries in the world actually start having data available.

Social-political instability (SPI) is an index that consists of six political variables collected from the Cross–National Time–Series (CNTS) database published by Databanks International (DI). DI compiles a comprehensive database containing different political, conflict, legislative and economic variables. The DI database defines SPI differently to the index we use here: whereas DI provides a broad SPI index comprising eight social–political variables, our SPI index excludes the two most–heavily weighted variables, 'Guerrilla Warfare' and 'Revolutions'. The DI assigned weighting to each of these excluded variables is 100 and 150. This implies that within the DI SPI index, these two 'radical' variables account for almost 68 percent of the total SPI index.

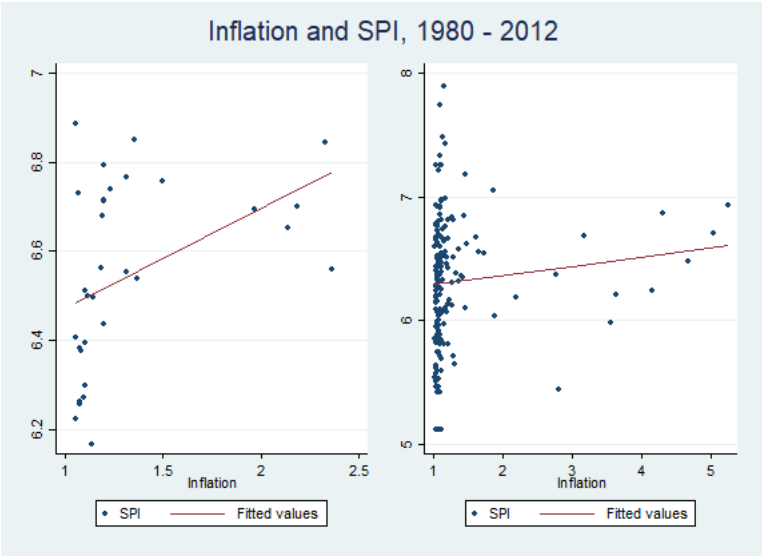
Given that our theoretical interest is on labour decisions such as 'riots', 'strikes' and 'anti-government demonstrations' that might lead to reductions in output, we use a re–weighted index that is more consistent with our theoretical prediction. Specifically, our index includes 'anti-government demonstrations' (any public gathering of at least 100 people), 'assassinations' (any politically motivated assassination of a government official or politician), 'general strikes' (any strike of at least 1,000 people involving more than one employer), 'major government crises' (any threat to bring the current regime down), 'purges' (any removal of political opposition) and 'riots' (any violent demonstration with more than 100 people taking part).

To capture the gross inflation rate, the variable inflation is the growth in the annual consumer price index plus one, which is consistent with the SPI function of the theoretical model. The data on inflation rates are provided by the World Bank.

3.2 Results

To illustrate how both variables relate to each other, Figure 2 depicts the OLS regression lines between inflation and SPI. The correlations between inflation and SPI are, as predicted, positive, over time and across countries, respectively.

Figure 2: Inflation and SPI over time and across countries



Sources: Databanks International and World Bank

About the method: given the dimension of the data set, $N = 156$ countries and $T = 33$ years, we use the one- and two-way Fixed–Effects (FE) estimator that allows for unobserved heterogeneity and unexpected events affecting SPI, with and without instrumental variables, to further test our theoretical prediction. In such a panel, idiosyncratic characteristics and shocks that can drive some of the differences in SPI across countries and over time include institutional quality, legal frameworks, central bank independence, fiscal regimes, end of the cold war, *etc.*

For robustness, we include in the FE regressions some controls. First, 'Cabinet Changes' counts the number of times in a year in which a new premier or president is named and/or 50 percent of the cabinet posts are occupied by new ministers, and the data are from the CNTS database. This variable captures internal political turnover and is usually used to control for the effect that political turnover may have on the economy. We expect a positive correlation between cabinet changes and SPI. Second, real income *per capita* (GDP_PC) controls for the effect of development on SPI, and the data are from the World Bank. It is expected that richer countries have lower SPI. And the Gini coefficient of income inequality are obtained from the World Bank as well. In this case it is expected that higher inequality is correlated to higher SPI. The estimated equation is as follows:

$$SPI_{it} = \alpha_i + \eta_t + \beta Inflation_{it} + \gamma CabChanges_{it} + \delta GDP\_PC_{it} + \epsilon Gini_{it} + u_{it} \qquad (22)$$

where α_i and η_t are country and time fixed effects. We report the summary statistics in Table 1.

Table 1: Summary Statistics

	SPI	Inflation	CabChanges	GDP_PC	Gini
Mean	6.5593	1.3011	0.0667	7.9095	3.6506
Median	6.5023	1.0633	0.0000	7.8586	3.6467
SD	0.9549	2.7027	0.2222	1.5591	0.2520
Min	5.1160	1.0002	0.0000	4.6228	2.7869
Max	9.9322	118.4964	1.6094	11.3138	4.3085

We report the statistical correlations in Table 2. Consistent with the OLS regression lines depicted in Figure 2, inflation and SPI are positively correlated to each other at the five percent level. The correlations between the controls and SPI are also consistent with *a priori* predictions.

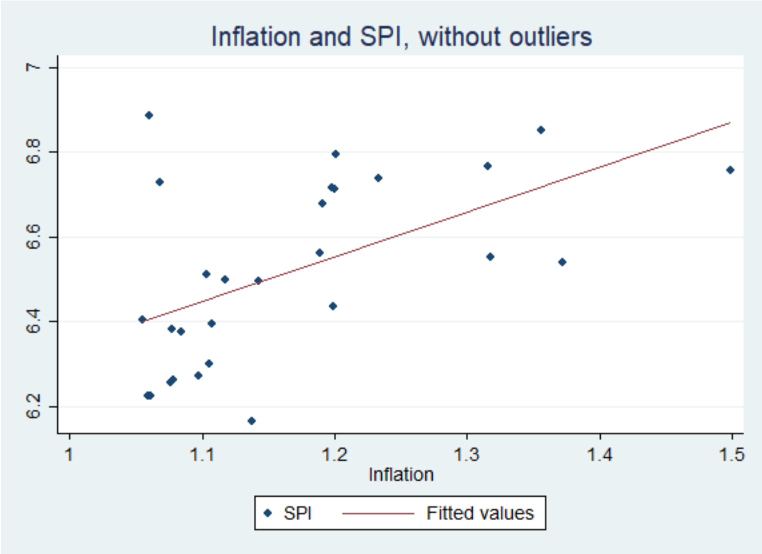
Table 2: Correlation Matrix

	SPI	Inflation	CabChanges	GDP_PC	Gini
SPI	1.0000				
Inflation	0.0715**	1.0000			
CabChanges	0.1120**	0.0018	1.0000		
GDP_PC	-0.1010***	-0.0384*	-0.0513*	1.0000	
Gini	0.0263	0.0181	-0.0323	-0.2830***	1.0000

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

The FE estimates are reported in Table 3. Yet again, for our main variable of interest, inflation, the effects are consistently positive and statistically significant on SPI. Moreover, given that the plots in figure 2 might give the impression that non-linearities are present, in columns 5 and 6 we run regressions with inflation and its squared term, and then only with those countries with above-the-mean inflation, $N = 68$, respectively. Interestingly enough, in these cases inflation is not significant, suggesting that non-linearities, although plausible, are not likely, and also that the results are not being driven by high-inflation episodes/countries. To further illustrate that periods with above-mean inflation do not distort the results, in Figure 3 we remove from the sample the years 1985, 1989, 1990, 1993 and 1994, the years that some South American and former USSR countries experienced high rates of inflation, and the correlation between inflation and SPI is still positive.

Figure 3: Inflation and SPI without 1985, 1989, 1990, 1993 and 1994



Sources: Databanks International and World Bank

Although the FE estimator deals with statistical endogeneity, by demeaning the data, and the Davidson and Mackinnon (D-M) test for exogeneity suggests that endogeneity is not a problem here, for completeness in column six we instrument inflation with the lags of all right-hand side variables. Reassuringly, the estimates in column six are consistent with all other estimates and also slightly larger in size, which illustrates the external power of the instruments. Also, the Sargan test does not indicate that the instruments are not valid.

Perhaps also worth mentioning, given the differences in scale and units of measurement between the variables, the size of the estimates is not necessarily important. The direction, however, is consistent with our theoretical prediction. About the controls: Cabinet Changes is, as expected, positively related to SPI; income, or development, is mostly negatively related to SPI and inequality is essentially zero.

Table 3: Fixed Effects Regressions

VARIABLES	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE	(6) FE	(7) FE-IV
Inflation	0.0141***	0.0137**	0.0122**	0.0190***	0.0121	0.0136	0.0358**
	(0.0049)	(0.0056)	(0.0056)	(0.0059)	(0.0231)	(0.0152)	(0.0174)
Inflation2					0.0001		
					(0.0003)		
CabChanges		0.5060***	0.4830***	0.6690***	0.6700***	1.2840**	0.3980
		(0.1400)	(0.1530)	(0.2240)	(0.2240)	(0.5350)	(0.3500)
GDP_PC			-0.8370**	-0.2160	-0.2160	2.0830	-1.1760*
			(0.3610)	(0.4960)	(0.4960)	(1.4730)	(0.6150)
Gini				-0.3330	-0.320	0.0559	-1.2160
				(0.7010)	(0.6980)	(1.9470)	(1.1480)
Constant	6.5390***	6.5690***	13.1200***	9.9050**	9.8610**	-11.0400	
	(0.0078)	(0.0168)	(2.8320)	(4.3230)	(4.3510)	(10.9300)	
Observations	1,516	595	570	373	373	68	121
R-squared	0.0050	0.0340	0.0680	0.1710	0.1710	0.5730	0.1470
Number of i	156	131	127	94	94	28	30
Country FE	YES	YES	YES	YES	YES	YES	YES
Rob SE	YES	YES	YES	YES	YES	YES	YES
Instruments							YES
Time FE				YES	YES	YES	
Above mean						YES	
Squared					YES		
D-M p-value							0.6538
Sargan p-value							0.5163

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

All in all, the upward-sloping OLS regression lines, the positive and significant correlations between inflation and SPI, and the positive and significant FE estimates of inflation on SPI are consistent across the board and therefore reassuring for the specification of the SPI function of the theoretical model, and the growth dynamics that emerge thereafter.

At this stage, it is probably important to highlight that the way SPI is measured in the empirical part, does not necessarily has one-to-one correspondence with the SPI function specified in the theoretical part. Hence, while we are able to provide evidence that SPI relates positively with inflation, as suggested in the theoretical model, it is not possible for us to say with certainty, that the coefficient of less than one on the gross inflation rate obtained from the empirical exercise corresponds to ϕ being less than one as well. In other words, this result does not necessarily translate into convergent growth dynamics.

4 Conclusion

We develop an overlapping generations (OLG) monetary endogenous growth model characterized by socio-political instability (SPI), and analyse the resulting growth dynamics when SPI is a positive function of inflation. We define SPI as the fraction of output that is lost due to disruptive activities which include crime, riots and other labour-related activities. The model produces two distinct growth dynamics, one convergent and the other divergent, informed by the responsiveness of SPI to inflation. And by using a data set covering 156 countries during the $1980 - 2012$ period, and allowing for country and time fixed effects, we show that higher inflation relates positively with socio-political instability, and hence, corroborates the theoretical prediction of the SPI function in our theoretical set-up. Having said this, we must formally acknowledge that our specification the SPI function is ad-hoc, as rightly pointed out by an anonymous referee, and hence, as part of future analysis, it would be interesting to develop a more nuanced model that provide micro-foundations to the SPI function based on optimal decisions of the agents populating the economy in our theoretical set-up. In addition, the same anonymous referee highlights that as an extension of our work, we should consider bringing in heterogeneity into the banking structure, rather than assuming perfect competition, given that banks in developed countries perform in an oligopolistic environment, while those in developing economies belong mainly to the state and are associated with monopolistic practices. Naturally, it would make sense to incorporate a parameter in the model that governs the degree of competition in the banking sector (Gupta, 2011), while obtaining our growth dynamics.

Despite the limitations, our theoretical results have important policy implications. Notably, policy makers in economies where government consumption expenditures are financed by income taxes and seigniorage and in which the government coordinates operations of the central bank through setting the level of reserve requirements, should be cognisant that it is crucial to maintain long-run price stability. Failure to do so may results in episodes of high inflation emanating from excessive money supply growth, and high (er) socio-political instability, which in turn, would put the economies in a divergent balanced growth path, under the situation when the socio-political instability is highly sensitive to the inflation rate.

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A Appendix A

A.1 Optimisation solutions for economic agents

Note that from the solution to the consumer's problem, we have:

$$d_t = w_t - T_t \tag{A.1}$$

$$c_{t+1} = (1 + i_{dt+1})d_t \tag{A.2}$$

from (2) and (3). The bank's solution follows directly from its net profit function, and the fact that (5) and (6) holds. We also obtain, from putting (6) into (5) that:

$$l_t = (1 - \gamma_t)d_t \tag{A.3}$$

Recall the firm's optimisation problem, in recursive form:

$$V(k_t) = \max \left[p_t(1-\lambda_t)Ak_t^{\alpha}\left(n_t\bar{k}_t\right)^{1-\alpha} - p_t w_t n_t - p_t(1+i_{lt})(k_{t+1} - (1-\delta_k)k_t) + \rho V(k_{t+1})\right] \tag{A.4}$$

which yields the following first order conditions (FOC):

$$n_t : w_t = (1-\lambda_t)(1-\alpha)A(\frac{k_t}{n_t})\bar{k}_t^{1-\alpha} \tag{A.5}$$

$$k_t : p_t(1 + i_{it}) = \rho V^{'}(k_{t+1}) \tag{A.6}$$

with the solution to the FOC for k_{t+1} found in the derivative of the value function with respect to k_t, updated for one period. Formally:

$$V^{'}(k_{t+1}) = p_{t+1}(1-\lambda_{t+1})\alpha A\left(\frac{n_{t+1}\bar{k}_{t+1}}{k_{t+1}}\right)^{1-\alpha} + (1 + i_{lt+1})(1-\delta_k) \tag{A.7}$$

which results in (17). Simply substituting $\delta_k = 1$ and n_{t+1} into (17), yields

$$(1 + i_{lt}) = \rho\left(\frac{p_{t+1}}{p_t}\right)\left[(1-\lambda_{t+1})\alpha A\left(\frac{n_{t+1}\bar{k}_{t+1}}{k_{t+1}}\right)^{1-\alpha}\right] \tag{A.8}$$

A.2 Derivation of the balanced growth path (BGP) of gross growth rate

Note that from the solution to the consumer's problem, we have, in real terms:

$$d_t = w_t - T_t \tag{A.9}$$

and from the solution of the banks' problem, we have

$$l_t = (1 - \gamma_t)d_t \tag{A.10}$$

From (11), we have

$$l_t = I_{k_t} \tag{A.11}$$

Given the assumption that capital fully depreciates between periods such that $\delta = 1$, then (10) reduces to

$$k_{t+1} = I_{k_t} \tag{A.12}$$

such that (A.11) can then be expressed as

$$l_t = k_{t+1} \tag{A.13}$$

We can also express (A.13) as

$$k_{t+1} = (1-\gamma_t)d_t \tag{A.14}$$

Given that $d_t = w_t - T_t$, we have

$$k_{t+1} = (1-\gamma_t)(w_t - T_t) \tag{A.15}$$

From (16), we have $w_t = (1-\lambda_t)(1-\alpha)A(\frac{k_t}{n_t})^{\alpha}\bar{k}_t^{1-\alpha}$. In equilibrium, $n_t = 1$ and $k_t = \bar{k}_t$ such that

$$w_t = (1-\lambda_t)(1-\alpha)Ak_t \tag{A.16}$$

Thus, (A.15) can then be expressed as:

$$k_{t+1} = (1-\gamma_t)\left[(1-\lambda_t)(1-\alpha)Ak_t - T_t\right] \tag{A.17}$$

Since $T_t = w_t\tau_t$ and $w_t = (1-\lambda_t)(1-\alpha)Ak_t$, we can proceed as follows:

$$k_{t+1} = (1-\gamma_t)\left[(1-\lambda_t)(1-\alpha)Ak_t - ((1-\lambda_t)(1-\alpha)Ak_t)\tau_t\right]$$

and dividing the above expression both sides by k_t, we have

$$\frac{k_{t+1}}{k_t} = \frac{(1-\gamma_t)(1-\alpha)A(1-\lambda_t)k_t}{k_t}\left[1-\tau_t\right]$$

$$\Omega_{t+1} = (1-\gamma_t)(1-\alpha)A(1-\lambda_t)\left[1-\tau_t\right]$$

The SPI, denoted by λ_t, is explicitly expressed as $\lambda_t = 1 - B\frac{\frac{g_{1t}}{w_t}}{\frac{T_t}{w_t}(\Pi_t)^{\phi}}$ where $B \in \left(0, \frac{\frac{T_t}{w_t}(\Pi_t)^{\phi}}{\frac{g_{1t}}{w_t}}\right)$. Note that $\Omega_t\Pi_t = \mu_t$, with Ω_t defined as the gross growth rate in time t, Π_t is time t gross inflation and μ_t is the money growth rate. ϕ is the responsiveness of SPI to inflation. We have that the infinitely-lived government purchases $g_t = g_{1t} + g_{2t}$ units of the consumption good, with $g_{1t} = \theta_1 g_t$, $g_{2t} = (1-\theta_1)g_t$ and $\frac{g_t}{w_t} = \theta_t$. These relationships entail that $\frac{g_{1t}}{w_t} = \theta_1\theta_t$ and that $\frac{T_t}{w_t} = \tau_t$ such that we can then express 1-λ_t as

$$1-\lambda_t = B\frac{\theta_1\theta_t\Omega_t^{\phi}}{\mu_t^{\phi}\tau_t} \tag{A.18}$$

Given (A.18), we have

$$\Omega_{t+1} = A(1-\gamma_t)(1-\alpha)B\frac{\theta_1\theta\Omega_t^{\phi}}{\mu_t^{\phi}\tau_t}\left[1-\tau_t\right] \tag{A.19}$$

From the government's budget constrain in (19), and that in equilibrium, $\delta_k = 1$ and $n_t = 1$ we have:

$$g_t = T_t + \frac{M_t - M_{t-1}}{p_t} \tag{A.20}$$

We have that $T_t = w_t \tau_t$ and $M_t = \mu_t M_{t-1}$ such that (A.20) can be expressed as

$$= \tau_t w_t + m_t - \frac{M_{t-1}}{M_t} \frac{M_t}{p_t}$$

$$= \tau_t w_t + m_t - \frac{1}{\mu_t} m_t$$

$$= \tau_t w_t + m_t \left(1 - \frac{1}{\mu_t}\right)$$

From (6), we have $m_t = \gamma_t d_t$, $d_t = w_t - T_t$ and $\frac{T_t}{w_t} = \tau_t$, such that

$$g_t = \tau_t w_t + \gamma_t (w_t - T_t) \left(1 - \frac{1}{\mu_t}\right)$$

and dividing the above expression both sides by w_t, we have

$$\theta_t = \tau_t + \gamma_t (1 - \tau_t) \left(1 - \frac{1}{\mu_t}\right) \tag{A.21}$$

B Appendix B

B.1 List of Countries

Angola	Denmark	Kyrgyzstan	Poland	Samoa
Albania	Dominican Republic	Cambodia	Portugal	Yemen
United Arab Emirates	Algeria	St. Kitts & Nevis	Paraguay	South Africa
Argentina	Ecuador	Korea, Republic of	Qatar	Congo, Dem.
Armenia	Egypt	Kuwait	Romania	Zambia
Antigua and Barbuda	Eritrea	Laos	Russia	Zimbabwe
Australia	Spain	Lebanon	Rwanda	
Austria	Estonia	Liberia	Saudi Arabia	
Azerbaijan	Ethiopia	Libya	Sudan	
Burundi	Finland	St. Lucia	Senegal	
Belgium	Fiji	Sri Lanka	Singapore	
Benin	France	Lesotho	Solomon Islands	
Burkina Faso	Gabon	Lithuania	Sierra Leone	
Bangladesh	United Kingdom	Latvia	El Salvador	
Bulgaria	Georgia	Moldova	Sao Tome and Principe	
Bahrain	Germany	Madagascar	Suriname	
Bahamas	Ghana	Maldives	Slovak Republic	
Bosnia and Herzegovina	Guinea	Mexico	Slovenia	
Belarus	Gambia, The	Macedonia	Sweden	
Belize	Guinea-Bissau	Mali	Swaziland	
Bolivia	Equatorial Guinea	Malta	Seychelles	
Brazil	Greece	Mongolia	Syria	
Barbados	Grenada	Mozambique	Chad	
Bhutan	Guatemala	Mauritania	Togo	
Botswana	Guyana	Mauritius	Thailand	
Central African Republic	Honduras	Malawi	Tajikistan	
Canada	Croatia	Malaysia	Turkmenistan	
Switzerland	Haiti	Namibia	Tonga	
Chile	Hungary	Niger	Trinidad &Tobago	
China	Indonesia	Nigeria	Tunisia	
Cote d'Ivoire	India	Nicaragua	Turkey	
Cameroon	Ireland	Netherlands	Tanzania	
Congo, Republic of	Iran	Norway	Uganda	
Colombia	Iceland	Nepal	Ukraine	
Comoros	Israel	New Zealand	Uruguay	
Cape Verde	Italy	Oman	United States	
Costa Rica	Jamaica	Pakistan	Uzbekistan	
Cyprus	Jordan	Panama	St.Vincent & Grenadines	
Czech Republic	Japan	Peru	Venezuela	
Djibouti	Kazakhstan	Philippines	Vietnam	
Dominica	Kenya	Papua New Guinea	Vanuatu	