Banco Central de Chile
Documentos de Trabajo

Central Bank of Chile
Working Papers

N° 643

Septiembre 2011

CONTRACTING INSTITUTIONS AND ECONOMIC GROWTH

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BANCO CENTRAL DE CHILE

CENTRAL BANK OF CHILE

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Documentos de Trabajo del Banco Central de Chile
Working Papers of the Central Bank of Chile
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Documento de Trabajo
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Abstract

This paper studies the effects of contracting institutions on economic development. A growth model is presented with endogenous incomplete markets, where financial frictions generated by the imperfect enforcement of contracts depend on the future growth of the economy, which determines the costs of being excluded from financial markets after defaulting. As the economy approaches its balanced growth path, frictions and their effect on income become more important because the net benefits of honoring contracts decrease. Therefore, as the economy approaches its steady state, the effect of contracting institutions on GDP per capita increases. This effect is due not only to a slower accumulation of capital, but also to a misallocation of resources toward labor-intensive productive sectors, where self-enforcing incentives are stronger. To validate the model empirically, the paper modifies previous specifications of cross-country regressions to estimate the effect of contracting institutions on per capita GDP. In line with the main predictions of the model, the econometric evidence shows that this effect is larger in economies that were relatively close to their steady states in 1950. Unlike contracting institutions, the evidence shows that property-rights institutions, included in an extension to the model, have an effect on income per capita throughout the development process.

Resumen

Este trabajo estudia los efectos de las instituciones que velan por el cumplimiento de los contratos entre privados sobre el desarrollo económico. Se presenta un modelo de crecimiento con mercados incompletos endógenos, donde las fricciones financieras generadas por la posibilidad de incumplir los contratos dependen del crecimiento futuro de la economía, el cual determina los costos de exclusión del mercado financiero formal. Cuando la economía se acerca a su crecimiento de largo plazo, las fricciones y sus efectos en el ingreso aumentan, porque el beneficio neto de cumplir los contratos cae. A su vez, esto implica que, cuando la economía se acerca a su estado estacionario, el efecto de las instituciones que velan por el cumplimiento de los contratos se vuelve más importante. Estos efectos no se deben sólo a una acumulación más lenta de capital, sino también a una distribución más ineficiente de los recursos productivos hacia sectores menos intensivos en capital, donde los incentivos para cumplir los contratos son más fuertes. Para validar el modelo empíricamente, este trabajo modifica especificaciones econométricas anteriores que miden el efecto de este tipo de instituciones en el ingreso per cápita utilizando una muestra amplia de países. En línea con las predicciones del modelo, la evidencia muestra que el efecto es mayor en economías que estaban relativamente cerca de sus estados estacionarios en 1950. En contraste, la evidencia muestra que las instituciones que restringen las decisiones de los gobiernos de expropiar al sector privado, las que son incluidas en una extensión del modelo teórico, tienen un efecto sobre el ingreso per cápita durante todo el proceso de desarrollo de los países.

I thank Harold L. Cole and Dirk Krueger for helpful comments, discussions and guidance. I also thank Ari Aisen, Ufuk Akcigit, Gadi Barlevy, Marco Bassetto, Je_rey Campbell, Wei Cui, Flavio Cunha, Matthias Doepke, Jesus Fernandez-Villaverde, Charles Jones, Guido Menzio, Ezra Ober_eld, Marcelo Veracierto. Finally, I am indebted to seminar participants at the Chicago FED Rookie Conference, the LACEA 2010 Annual Meeting, the Money Macro Workshop at UPenn, the Midwest Macroeconomic Meetings 2010, the 11th Meeting of LACEA's Political Economy Group, the EconCon at Princeton, the World Bank, the Inter-American Development Bank, and the Central Bank of Chile for useful comments. All errors are mine.

1 Introduction

A central question in economics is how to explain the large and persistent differences we observe in per capita income across countries. Since capital can be readily acquired and technological progress can potentially be disseminated across countries, there has been a search for some underlying feature that can account for these differences. One view relates these differences to the organization of society, or its institutions. An extensive empirical literature, described in La Porta et al. (2008), investigates the link between legal institutions and income per capita, finding a strong and significant relationship. These types of institutions are not only related to the rules governing contracting among private agents, they are also a determinant of a broader set of rules related to the protection of property rights (Levine, 2005). Acemoglu and Johnson (2005) try to unbundle the effect of different institutions. They distinguish between two different types of institutions: contracting institutions (CI) - those that enable private contracts between citizens - and property rights institutions (PRI) - those that protect citizens against expropriation by the government and powerful elites. They show that, after controlling for the effect of PRI, differences across countries in income per capita today are not related to CI quality indicators.

This paper contributes to the debate about the comparative effects of these two types of institutions on income per capita and development. We examine a growth model with endogenous financial frictions and a distinction between CI and PRI. The main prediction of the model is that the effect of CI quality on GDP per capita depends on the distance between the current level of GDP and its steady-state level. The closer the economy is to its balanced growth path, the larger are the effects of these institutions on income per capita. Unlike CI, the effect of PRI does not depend on the stage of a country's economic development, and they affect GDP per capita throughout the development process. The paper revisits the empirical evidence on the growth-institutions nexus in light of the model to validate its main predictions.

In the model, financial frictions arise from the assumption that entrepreneurs, who borrow resources in order to invest in physical capital, cannot commit to honor their contacts. Hence, the penalties associated with default become an important component of contracting. It is assumed that one of these penalties concerns the ability of entrepreneurs who have defaulted to take full advantage of future production opportunities. Default allows appropriation of the resources borrowed from consumers, which are proportional to current output in equilibrium. Thus, the net benefit of honoring the contract is increasing in the expected future growth of the economy, as a higher growth rate makes future production opportunities more attractive relative to default. Therefore, financial frictions become less binding in quickly-growing economies and more efficient contracts are self-enforced. Further, the benefit of defaulting is decreasing in CI quality, which is assumed exogenous in the model. Thus, even if self-enforcement incentives are weak, optimal contracts can be enforced if the institutional quality is good enough. But if the efficient contract is self-enforced in the absence of these institutions, the quality of the latter does not affect production.

This paper embeds these financial frictions into the standard neoclassical growth model. Along the transition path towards a steady-state growth is declining and thus self-enforcement weakens, reaching its lowest level in the steady-state. Therefore financial frictions are more important when the economy is close to its balanced growth path. There is no default in equilibrium, but feasible contracts include debt constraints, lowering capital accumulation and output. The main prediction of the model is that the effect of the quality of CI on income per capita across countries becomes significant only after some fraction of the steady-state capital stock has been accumulated. Only after this happens debt constraints generated by financial frictions become binding.

Empirically the model predicts that, controlling for the steady-state level of output per capita, we should observe a larger effect of CI in richer economies as they are closer to their steady-states. The paper exploits this prediction to empirically validate the theoretical model by implementing known and novel IV identification strategies to estimate the effect of institutional quality on income per capita. After confirming the results of Acemoglu and Johnson (2005), the econometric specifications are modified to introduce the notion of conditional convergence (Barro, 1991; Barro and Sala-i-Martin, 1992, 2004). In this case, as we control for institutional quality, and hence for the steady state level of output per capita according to the model, the coefficient on CI should be increasing in the initial level of GDP per capita. Additionally, the baseline equations are estimated for groups of initially high and low income countries. Although the problem of different steady-states is not addressed, it is a simpler and straightforward way of testing the model implication. The main findings are (1) the effect of CI on output per capita growth in the last 60 years is significant only for countries that were relatively close to their steady-states in 1950, and for countries relatively rich in 1950, and (2) the effect of PRI on growth is always significant. These results are in line with the main predictions of the model.

The model is also extended to include PRI, although in a very stylized way. In countries with low quality PRI, the government is able to expropriate a fixed fraction of the capital stock every period. The paper reviews previous theoretical literature on expropriation to justify this assumption. Thus, poor PRI slow down the transition to the long-run equilibrium and lowers the stock of capital and income per capita in the steady-state. The lower growth rate of output per capita reduces the benefits of honoring contracts, bringing forward the threshold where CI becomes important. This illustrates the fact that the effect of CI depends on the distance to the steady-state, and not necessarily on the level of income per capita of a country.

Figure 1 illustrates the main implications of the model regarding the comparative effects of CI and PRI. The blue line shows the path for income per effective unit of labor implied by the standard neoclassical growth model. Low quality PRI affect this variable throughout the development

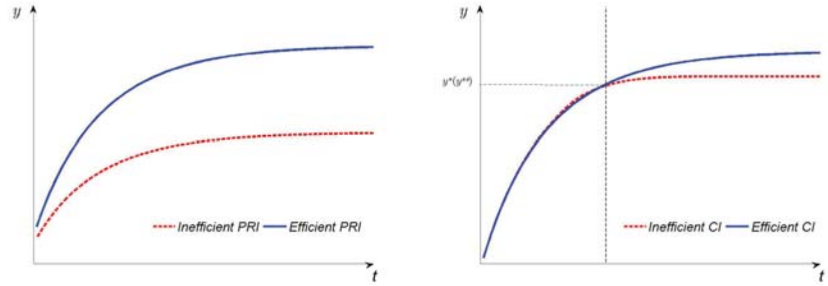

Figure 1: Model predictions on the effect of CI and PRI

process, as illustrated by the red line in the left panel of Figure 1. But in the case of CI, there exists a cut-off level of income. Below this level growth is high and the incentives to honor contracts are strong, so low quality CI do not affect output per capita. However, above that level diminishing returns reduce growth, weakening the incentives to honor contracts. In this case growth is even lower when the quality of CI is low, as shown by the red line in the right panel.

An additional implication of the model is that the incentives to default, and therefore the consequences of financial frictions, depend positively on the intensity with which capital is used in production. To explore this feature the model is extended to include two sectors, a capital intensive sector and a labor intensive sector. In this context financial constraints are more binding in the capital intensive sector, generating not only a fall in total savings but also an inefficient allocation of capital (and thus labor) towards the labor intensive sector. Therefore, CI affect income per capita not only because capital accumulation slows, but also because of a misallocation of resources that affects the economy-wide total factor productivity (TFP) negatively. This in line with the evidence identifying TFP as the main channel through which legal institutions affect GDP per capita (Beck et al., 2000), and as the main source of output per worker differences across countries (Hall and Jones, 1999).

After a brief review of the related literature, the next section of the paper presents the model. It first characterizes the competitive equilibrium under perfect enforcement of contracts. Then it describes the imperfect enforcement equilibrium and extends the model to the inclusion of two sectors and PRI. Section 3 presents the econometric evidence, and the last section concludes.

Literature Review

This paper is closely related to the theoretical literature on financial frictions and growth. Most of this literature focuses on informational imperfections as the main source of financial frictions, following Townsend (1979)[1]. Since exclusion from future production opportunities as a punishment has not been introduced in these papers, the main implication of the model presented is a new contribution. Among the papers focusing on pure enforcement problems as the source of financial frictions, the most closely related to this paper is Marcet and Marimon (1992). Their results are different from the ones presented here because they analyze the central planner problem, allowing transfers between lenders and borrowers contingent on default decisions. Then, the fact that growth is decreasing over time implies a path for borrowers' consumption that is increasing over time. Moreover the optimal level of investment is feasible in steady-state as contingent transfers to borrowers are positive. Another paper focusing on imperfect enforcement is the quantitative study by Buera et al. (2011). There, exclusion from future production opportunities after defaulting is not included, but the ability to overcome financial constraints with internal funds is. The authors show quantitatively that even with self-financing the efficient level of investment can not be achieved in sectors with larger financial needs.

Theoretically this paper is also related to the literature on limited enforceability of contracts and imperfect insurance (Kehoe and Levine (1993), Kocherlakota (1996), and Alvarez and Jermann (2000) among others), and on sovereign borrowing (Eaton and Gersovitz (1981), Cole and Kehoe (1995), Kletzer and Wright (2000), and Kehoe and Perri (2002) among others), where enforcement by a third party is totally absent. These papers study theoretically the implications of exclusion from financial markets after defaulting, although not in a growth context. Among the papers on imperfect insurance and incomplete markets, the closest to this paper is Krueger and Perri (2006), who also study the effect of changes in the environment, the volatility of idiosyncratic income shocks, on self-enforcement incentives, although in a different context.

Empirically this paper is related to the extensive literature exploring the link between institutions and income per capita. Papers focusing on the role of legal institutions have found a close link between their quality and the origin of legal systems. Some of the outcomes influenced by the latter are investor protection (La Porta et al., 1997, 1998), the formalism of judicial procedures (Djankov et al., 2003), judicial independence (La Porta et al., 2004), and the quality of contract enforcement (Djankov et al., 2008). Using these findings some papers have identified a strong and significant relationship between these institutions and income per capita (Beck et al., 2000; Levine, 1998, 1999; Levine et al., 2000). As noted above, Acemoglu and Johnson (2005) explore the comparative effects of CI and PRI on income per capita. They document a strong link between CI and legal origin on the one hand, and PRI and initial endowments on the other, which would have influenced the type of institutions established by Europeans in former colonies. The latter relationship has been studied by Engerman and Sokoloff (1997), Engerman and Sokoloff (2002), Acemoglu et al. (2001),

[1]See for instance Greenwood and Jovanovic (1990), Castro et al. (2004, 2009) Townsend and Ueda (2006), and Greenwood et al. (2010)

and Acemoglu et al. (2002).

There is a related empirical literature showing that legal institutions have affected economic outcomes in industrialized countries only in the last century (Rajan and Zingales, 2003; La Porta et al., 2008; Musacchio, 2010). The explanation for these findings is that the quality of legal institutions is not an issue for growth as long as prevalent political interests support them. The model in this paper is able to generate the observed divergence in outcomes without relying on political drivers. An empirical implication of the model is that, assuming constant steady-states, a larger effect of CI should be observed in recent periods, as most of the transitional dynamics have taken place. Direct evidence on this issue is also presented in the empirical part of the paper. In particular, controlling for PRI, it is shown that the effect of CI in rich European countries arose before it did in (poorer) former colonies.

2 The Model

The Economic Environment

The economy is populated by consumers ($i = c$) and entrepreneurs ($i = e$), each with measure 1. There is no entry to, or exit from, entrepreneurship[2]. Entrepreneurs have access to the following technology to produce output,

$$y_t = z_t k_t^{\alpha} n_t^{\upsilon} \tag{1}$$

where z captures the level of technology, k and n are capital and labor used in production, respectively, and α and υ are positive constants. There are decreasing returns to scale, so $\omega = 1 - \alpha - \upsilon > 0$. Finally z grows at constant (gross) rate $\mu > 1$, so this is a deterministic growth model. The representative type i agent maximizes the expected value of his lifetime utility as given by

$$\sum_{t=0}^{\infty} \beta^t u(c_t^i) = \sum_{t=0}^{\infty} \beta^t \frac{(c_t^i)^{1-\sigma^i} - 1}{1 - \sigma^i}$$

where σ^i is the risk aversion coefficient or the inverse of the elasticity of substitution. It is assumed for simplicity that entrepreneurs are risk neutral, so $\sigma^i = 0$ for $i = e$. Consumers are risk averse so $\sigma^c = \sigma > 0$. Capital depreciates at rate δ each period, implying the following market clearing condition,

$$C_t = \sum_i c_t^i = Y_t + (1 - \delta) K_t - K_{t+1} \tag{2}$$

[2]This simplifying assumption together with decreasing returns to scale implies the existence of positive profits in the long run. But since lending is constrained at an individual level due to the possibility of default, entry could overcome the effects of financial frictions. However, if entrepreneurs differ in their productivity, new entrants will be less productive and therefore a misallocation of entrepreneurial ability will reduce output as well.

where c^i is total consumption by agents $i = c, e$, and capital letters denote aggregate variables.

Consumers save an amount b out of their income and lend it to entrepreneurs, who do not save. Entrepreneurs finance capital with these resources and, if they find it optimal to do so, they repay consumers the amount lent plus the market interest rate after production takes place. If they find it optimal not to repay consumers and if they are not caught doing so, which happens with probability ρ, they appropriate the stock of capital and its return. Thus the parameter ρ captures the quality of institutions related to the enforcement of contracts. In case of default, entrepreneurs cannot further borrow, but they can use the amount of capital stolen to produce in the future with the same technology described above. If the entrepreneur is caught, which happens with probability $(1 - \rho)$, he is forced to give back the capital stolen and the return, and he is also excluded from financial markets, leaving him without any income source for the future.

Discussion

In order to introduce a need for external borrowing in the model in a simplified way it is assumed entrepreneurs cannot save. However, in the presence of financial frictions affecting external financing, agents may be able to invest in their own projects, at the cost of forgoing current consumption, to achieve higher levels of investment. The importance of self-investment in attenuating frictions is a quantitative issue not addressed by this paper. However, the results of Buera et al. (2011) give some insights on this issue. The authors allow entrepreneurs to save in a similar model of imperfect enforcement and show that external financing is increasing in entrepreneurs' wealth. One of the main quantitative findings of the paper is that, while self-financing can alleviate the inefficiencies generated by financial frictions, the efficient level of investment cannot be achieved in sectors with larger financial needs[3].

The assumption behind the main result of the paper, that after defaulting entrepreneurs cannot take full advantage of future production opportunities, can be implemented in different ways. Albuquerque and Hopenhayn (2004) specifies an outside value function for defaulters that depends positively on the amount borrowed and the technology shock. This function can also be interpreted in different ways: the entrepreneur may not be able to re-establish itself as a new firm but can save the amount stolen, or may be excluded from borrowing, saving, and insurance, or only from borrowing, but still may be able to produce. All of these punishments may be temporary or permanent. As will become clear later, this general approach is valid for this paper as well, as in all cases the net benefit of defaulting is decreasing in future growth. However, in order to

[3] Additionally, the effect of collateral on external financing depends positively on the credible commitment of the government to reallocate collateral across agents (Kletzer and Wright, 2000), i.e. on the quality of CI. Therefore, as the quality of CI falls, and so the importance of borrowing restrictions rises, the lower is the efficiency of collateral in alleviating financial frictions.

clearly illuminate the proposed mechanism it is assumed that defaulting entrepreneurs, although able to produce, are excluded from financial markets permanently. As noted in the introduction this is the most common assumption adopted in the theoretical literature on limited enforceability of contracts and imperfect insurance, and on sovereign borrowing, where enforcement by a third party is totally absent. Moreover it is simple enough to analyze commitment problems only from the side of borrowers[4].

The monitoring technology becomes a critical issue when introducing exclusion as punishment in low income countries, as lenders generally lack the ability to monitor borrowers. It could be argued that under these conditions a borrower can easily renege on their debt with a lender and form a relationship with another one that has no information about his past behaviour. However, there is an extensive literature showing that the lack of information available for screening borrowers reinforces local credit relationships, as information about borrowers is more easily available at that level (Cull et al., 2006; Fafchamps, 2004; Kumar and Matsusaka, 2009). As the evidence shows, in these environments alternative credit relationships are more difficult to establish, validating exclusion as a punishment[5]. Of course this generates other types of inefficiencies as funds can not be allocated to the best projects. But in that case the role of CI in attenuating them is less clear, as information would constrain their scope anyway.

Recursive Competitive Equilibrium

The aggregate state of the world is described by (K, z). The evolution of K is governed by the function $K' = \mathrm{K}(K, z)$, which is exogenously given for all agents. The dynamic program problem facing the representative entrepreneur is

$$V(K,z) = \max_{k,n} \left\{ u(c) + \beta V(K', z') \right\}$$

subject to

$$c = y - w(K,z)n - (r(K,z) + \delta)k,$$

[4]Kletzer and Wright (2000) show punishment strategies under which a renegotiation-proof, self-enforced contract between a borrower and multiple lenders exists. Although the actions off the equilibrium path are different, the outside value is equal to the value of a reversion to permanent autarky for the borrower. Permanent reversion to autarky could also be sustained under imperfect information, with a borrower type that values honesty for its own sake, as modelled by Cole and Kehoe (1995). Exclusion from trading relationships as a punishment has also been documented empirically in situations where law enforcement is extremely inefficient or nonexistent (Greif, 1993; McMillan and Woodruff, 1999; La Ferrara, 2003).

[5]Some examples are very informative about the effect of the lack of information networks on credit relationships. In China around 1700 credit supply was dominated by the Shanxi people, so if corruption occurred, they could very easily locate the family of the borrower (Peng, 1994). In India in 1970, Timberg and Aiyar (1984) show that it was common for financer brokers to never take new borrowers, and to keep only children and grandchildren of businessmen with whom they and his father and grandfather had done business as clients.

and an incentive compatibility (IC) constraint,

$$u(c)+\beta V(K',z')\geq\rho\left[u\left(y-w(K,z)n\right)+\beta V^{d}((1-\delta)k;K',z')\right]+(1-\rho)u(c).$$

This IC constraint ensures that the entrepreneur does not find it optimal to default, and reflects the fact that the market anticipates default decisions[6]. The function $V^d(\bar{k}';K',z')$ is the continuation value of defaulting, and it is defined by the following problem[7],

$$V^{d}(\bar{k}';K',z')=\max_{n'}\left\{u(\bar{y}'-w'(K',z')n')+\beta V^{d}(\bar{k}'';K'',z'')\right\}$$

subject to

$$\bar{y}'=z'^{1-\alpha}\bar{k}'^{\alpha}n'^{\upsilon}$$
$$\bar{k}''=(1-\delta)\bar{k}'$$

The dynamic problem facing the representative consumer is standard, as he only observes prices,

$$U(b;K,z)=\max_{c,b'}\left\{\frac{c^{1-\sigma}-1}{1-\sigma}+\beta U(b';K',z')\right\}$$

subject to

$$c+b'=w(K,z)+b(1+r(K,z))$$

The consumer is also constrained by the standard transversality condition. The competitive equilibrium can now be defined:

Definition 1. *A competitive equilibrium is a set of decision functions $c^c=\mathrm{C}(K,z)$, $b'=\mathrm{B}(K,z)$, and $n=\mathrm{N}(K,z)$, a set of pricing functions $w=\mathrm{W}(K,z)$ and $r=\mathrm{R}(K,z)$, and an aggregate law of motion for the capital stock $K'=\mathrm{K}(K,z)$, such that,*

1. *Entrepreneurs solve their dynamic programming problem, given $\mathrm{K}(\cdot)$, $\mathrm{W}(\cdot)$ and $\mathrm{R}(\cdot)$, with the equilibrium solution satisfying $n=\mathrm{N}(k,z)$.*

2. *Consumers solve their dynamic programming problem, given $\mathrm{K}(\cdot)$, $\mathrm{W}(\cdot)$ and $\mathrm{R}(\cdot)$, with the equilibrium solution satisfying $c^c=\mathrm{C}(K,z)$ and $b'=\mathrm{B}(K,z)$.*

3. *Market clearing conditions, $C=Y+(1-\delta)K-K'$ and $N=1$, hold each period.*

It is easy to show that this model converges to a balanced growth path. In particular, along this path the interest rate is constant and c^c grows at a constant rate. Let us call this rate γ. Since

[6]This constraint may be imposed by financial intermediaries, from which entrepreneurs may borrow only until they do not find it optimal to default.

[7]For simplicity it is assumed that the risk neutral entrepreneur does not replace the fraction of capital that depreciates each period.

all the variables on the RHS of equation (2) and c^e, grow at a constant rate, they must do it at the same rate γ. Moreover, using the production function we have that $\gamma = \mu\gamma^{\alpha}$, which implies $\gamma = \mu^{1/(1-\alpha)}$. Notice that this is true whether the IC constraint is binding or not. Therefore given the conjectured asymptotic growth rate for all variables, one can impose a transformation that will render them stationary in the limit[8]. This transformation consists of defining the new variables $\hat{x}_t = x_t/g_x^t$, where g_x is the growth rate of some variable x_t when $t \to \infty$. The transformed dynamic programming problems are presented in Appendix A. The main differences with respect to the original model are the discount factors, which now incorporate all information related to the non transitional dynamics of the economy. Now $\beta\gamma$ is the discount factor for consumers and entrepreneurs that have not defaulted, while for entrepreneurs that have previously defaulted the discount rate is now $\beta\bar{\gamma} = \beta\gamma^{\omega/(1-\upsilon)}(1-\delta)^{\alpha/(1-\upsilon)} < \beta\gamma$. The fact that $\bar{\gamma} < \gamma$ means that future growth in utility falls after defaulting.

Perfect Enforceability (PE)

When there is perfect enforcement of contracts, i.e. $\rho = 0$, the model simplifies to the standard neoclassical growth model, but with decreasing returns to scale. In this case entrepreneurs equalize marginal productivities to factor prices and consumers set consumption growth according to a standard Euler equation. A well known result for this kind of model, to be proved below, is that $\forall \hat{K} < \hat{K}^{\text{ss}}$, $\Delta\hat{K} > 0$, where $\hat{K}^{\text{ss}}$ is the transformed level of capital in steady-state and Δ denotes the one-period change in a variable. As capital increases in the transition to the steady-state, output and wages rise while the interest rate falls. This implies that during the transition the interest rate is higher than the subjective discount rate, generating an increasing path for consumption. An additional feature of the PE equilibrium, which is key in analyzing the IE equilibrium later, is that the rate of growth (or decrease) of all variables falls during the transition. As the return on capital falls when the economy approaches its steady-state, capital accumulation slows down, lowering output growth, the growth rate of wages, and the rate at which the interest rate decreases. The next proposition describes the transition of the economy from an initial low capital stock to its balanced growth path under PE.

Proposition 1. *Suppose $\rho = 0$ and $\hat{K} < \hat{K}^{ss}$. Then,*

$$\Delta\hat{K} > 0,\ \Delta\hat{w} > 0,\ \Delta r < 0,\ \Delta\hat{C} > 0,\ \textit{and}\ \Delta\hat{Y} > 0,$$

and,

$$\Delta\left|\frac{\Delta x}{x}\right| = \Delta\left|g_x\right| < 0,$$

for $x = \hat{K}, \hat{w}, r, \hat{C}, \hat{Y}$.

[8] In Appendix A the asymptotic growth rates off the equilibrium path are derived.

Proof. See Appendix B. ■

Imperfect Enforceability (IE)

Under IE of contracts, i.e. $\rho > 0$, the IC constraint is relevant, so we now study its binding pattern. First rewrite the IC constraint of the transformed problem described in Appendix A in the following way,

$$IC(\hat{K}) = \beta\left[\gamma V(\hat{K}') - \rho\bar{\gamma}V^d(\hat{k};\hat{K}')\right] - \rho\left[u(\hat{y} - \hat{w}(\hat{K})) - u(\hat{c})\right]$$

Here the first term of the RHS is the future cost of defaulting, while the second term is the current benefit of default. In equilibrium $IC(\hat{K}) \geq 0$. Since entrepreneurs are risk neutral, the current benefit of defaulting is just $\rho(\hat{y} - \hat{w}(\hat{K}) - \hat{c}) = \rho(r(\hat{K}) + \delta)\hat{k}$. Thus, in equilibrium, the following must hold,

$$IC(\hat{K}) = \beta\left[\gamma V(\hat{K}') - \rho\bar{\gamma}V^d(\hat{k};\hat{K}')\right] - \rho(r(\hat{K}) + \delta)\hat{k} \geq 0 \quad (3)$$

Using the optimal demand for labor, the continuation value of honoring the contract, $V(\hat{K}')$, and of defaulting, $V^d(\hat{k};\hat{K}')$, can be expressed recursively by

$$V(\hat{K}') = (1-\upsilon)\hat{y}' - (r' + \delta)\hat{k}' + \beta\gamma V(\hat{K}'')$$

$$V^d(\hat{k};\hat{K}') = (1-\upsilon)\hat{z}\hat{k}^{\alpha}n'^{\upsilon} + \beta\bar{\gamma}V^d(\hat{k};\hat{K}'')$$

So the next period flow utility if the entrepreneur honors the contract is output net of factor payments, while utility if the entrepreneur defaults is the value of output, using the stock of capital acquired at the moment of defaulting (which is constant in the transformed problem), net of labor income.

First let us analyze the steady state of this economy. In this case all endogenous variables are constant, so condition (3) holds if and only if,

$$IC(\hat{K}^{ss}) = \phi\left(1 + \frac{\omega}{\alpha}\right)\ \alpha\frac{\hat{y}^{ss}}{\hat{k}^{ss}} - (r^{ss} + \delta) \geq 0$$

where

$$\phi = \left(\frac{\beta\gamma}{1-\beta\gamma} - \frac{\beta\rho\bar{\gamma}}{1-\beta\bar{\gamma}}\right) / \left(\rho + \frac{\beta\gamma}{1-\beta\gamma}\right) > 0$$

It is easy to see that if $\phi(1 + \omega/\alpha) \geq 1$, the constraint will not bind in steady state and the PE allocation, where $\alpha\hat{y}^{ss}/\hat{k}^{ss} = r^{ss} + \delta$, will result. Otherwise imperfect enforceability of contracts distorts the steady state equilibrium. The following proposition formalizes this result and establishes the existence and uniqueness of the equilibrium.

Proposition 2. *There is a unique steady-state equilibrium with a locally unique path leading to it. In particular, the following holds in steady-state,*

$$\Omega \; \alpha \frac{\hat{Y}^{ss}}{\hat{K}^{ss}} = \frac{\gamma^{\sigma}}{\beta} - 1 + \delta = r^{ss} + \delta,$$

where

$$\Omega = min\left\{1, \phi\left(1 + \frac{\omega}{\alpha}\right)\right\}.$$

Proof. See Appendix B. ■

As in the standard neoclassical growth model, there is a unique steady-state. Using a linear approximation in the neighbourhood of the steady-state, the proposition also shows that there is a locally unique path leading to it[9]. The proposition also shows that, in steady state, the IC constraint will be more likely to bind in a sector which is more capital intensive -the larger is α- and in the sector with lower rents under first best allocations -the lower is ω.

In the next section the model is extended to include two sectors that differ in capital intensity. In this case the IC constraint will be binding in the capital intensive sector if (but not only if) it is binding in the labor intensive sector. This generates a misallocation of resources that affects aggregate output through a lower TFP. Finally, since ϕ is decreasing in ρ, the constraint will be tighter and, if binding, the distortion will be larger. Also notice that if $\rho = 0$ then $\phi = 1$, and the constraint is not binding in steady state. If the constraint is binding in steady state, then a lower level of capital must be observed in equilibrium, so the entrepreneur finds optimal to honor the contract and repay to consumers. This raises the output to capital ratio relative to the PE case, in line with the condition in Proposition 2. As output falls when the constraint binds, labor demand and wages also fall.

During the transition the incentives to default depend on the future path of the economy. Any effect of the constraint in the future will change equilibrium allocations, affecting how binding is the current constraint as well. However, it is useful to first analyze the constraint assuming that PE allocations hold throughout the transition and in steady state. In order to do this, use the FOC for capital to substitute $(r + \delta)\hat{k}$ with $\alpha\hat{y}$ in expression (3). Rearranging terms and aggregating over all the entrepreneurs, we can express the IC constraint under PE allocations (IC^{PE}) as,

$$IC^{\text{PE}}(\hat{K}) = \beta\left[\gamma\tilde{V}(\hat{K}, \hat{K}') - \rho\bar{\gamma}\tilde{V}^{d}(\hat{K}, \hat{K}')\right] - \rho\alpha \geq 0$$

[9] To analyze the global dynamics of the economy the transversality condition and similar arguments used for the standard model can be applied here. A higher growth rate in the stock of capital during the transition may exist if agents expect higher growth rates in the future. But this can only be sustained if capital grows forever, which violates the transversality condition. On the other hand, lower growth rates would make the capital stock hit zero in finite time, violating the consumer's maximization problem.

where

$$\tilde{V}(\hat{K},\hat{K}') = (1-\alpha-\upsilon)\,\frac{\hat{Y}'}{\hat{Y}} + \beta\gamma\tilde{V}(\hat{K},\hat{K}'')$$

$$\tilde{V}^d(\hat{K},\hat{K}') = (1-\upsilon)\left(\frac{\hat{w}}{\hat{w}'}\right)^{\frac{\upsilon}{1-\upsilon}} + \beta\bar{\gamma}\tilde{V}^d(\hat{K},\hat{K}'')$$

We can interpret $\tilde{V}$ and $\tilde{V}^d$ as the continuation utility of honoring and not honoring contracts relative to its current gain. Then, under PE allocations, the relative continuation utility of honoring the contract depends positively on the future growth rate of output. The higher is the former, the higher is the growth rate of rents when the entrepreneur maintains access to consumer savings. Likewise, the relative continuation utility of defaulting depends negatively on the future growth on wages. If the entrepreneur is excluded from financial markets then the future path for rents is totally determined by the cost of the only variable factor of production, labor. As described above, under PE allocations the growth rate of wages and output slows down as time passes[10]. Therefore the relative continuation utility of honoring the contract, $\tilde{V}$, decreases over time, while the relative continuation utility of not honoring the contract, $\tilde{V}^d$, increases over time. This observation leads to the following proposition.

Proposition 3. *If $\Omega = 1$, PE allocations are the outcome $\forall t$ if $\hat{K}_0 \leq \hat{K}^{ss}$. Otherwise, if $\Omega < 1$, $\forall \rho \in [0,1]$, $\exists K^* > 0$, where $K^* \leq \hat{K}^{ss}$, such that, if $\hat{K} < K^*$, $IC(\hat{K}) > 0$, and if $K^* \leq \hat{K}$, $IC(\hat{K}) = 0$.*

Proof. See Appendix B. ■

As the economy approaches its steady state, it becomes more attractive to default, as the net cost of doing so decreases. Since the cost converges monotonically to its steady state value, this implies that the IC constraint will not be binding at any point during the transition if it is not binding along the balanced growth path. Otherwise it must bind at some point. The proposition shows that this happens at some positive level of capital for any value of ρ, meaning that there is always some range for capital where the constraint is not binding. This result comes from the fact that the marginal productivity of capital, and so the growth rate of output, converges to infinity as capital converges to zero.

Additionally Proposition 3 states that once the constraint is binding, it never ceases to bind. Above we showed that under PE allocations the value of honoring the contract is decreasing during the transition. But the statement here is stronger since it takes into account future IE allocations. The intuition is similar though. Suppose it is not true that the constraint remains binding throughout the transition and there exists a period t when the constraint does not bind. Then, after t, the

[10]In fact the two variables grow at the same rate. We still distinguish between them because in the next section, with two sectors, this equivalence does not hold.

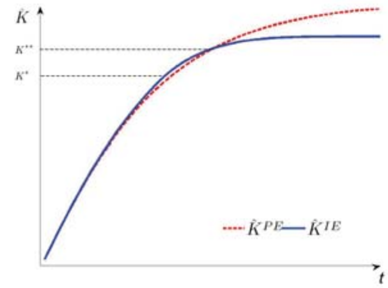

Figure 2: Imperfect vs. Perfect Enforceability Equilibriums

economy will start growing as in the PE case, i.e. at a decreasing rate. Thus the growth rate from t to $t+1$, which is what affects default decisions in period t, will be higher than the growth rate from $t+1$ to $t+2$, which affects the default decision in $t+2$. But this means that the incentives to default are higher in $t+1$ than in t, and so the constraints must bind in period $t+1$ as well.

The IE equilibrium can now be characterized. If $\Omega \leq 1$, at some point PE allocations are no longer feasible and capital accumulation slows down because of the fall in the interest rate. Thus $r\hat{k}$ falls in expression (3), so the constraint holds with equality. From Proposition 2 we know that, as the economy converges to the steady state, a larger fraction of the adjustment is achieved through the lower stock of capital. Although for the entrepreneur the adjustment has an ambiguous effect on the incentives to default, especially when far from the steady state when the interest rate channel is more important, the effect is unambiguously bad for consumers. Before the constraint binds, as future expected income falls, they increase savings and so the aggregate stock of capital during that period is larger than in the PE equilibrium outcome. The following proposition compares the path for capital under PE and IE.

Proposition 4. *Take the sequence $\{\hat{\boldsymbol{K}}_s\}_{s=0}^{\infty}$ as the equilibrium sequence of capital under PE ($\rho = 0$). Fix $\hat{K}_0 = \hat{\boldsymbol{K}}_0$. Then, if $\Omega < 1$, $\exists K^{**} > K^*$, such that, if $\hat{K}_t = K^{**}$, $\hat{K}_s > \hat{\boldsymbol{K}}_s$ if $0 < s < t$, and $\hat{K}_s < \hat{\boldsymbol{K}}_s$ if $s > t$.*

Proof. See Appendix B. ∎

Figure 2 shows the path for capital under PE and under IE when the constraint is binding in steady state. Below the first threshold for capital, $\hat{K}^*$ as defined in Proposition 3, the constraint is not binding, but higher savings generate a faster growth of capital under IE. [This is not a sentence.] Above this point the difference in capital levels closes as the constraint becomes binding and so the growth rate of capital falls under IE relative to PE allocations. The gap is eliminated when the economy achieves the level of capital $\hat{K}^{**}$ as defined in Proposition 4. From that point on the level of capital under IE lies below the PE equilibrium level and the difference converges to the constant gap described in Proposition 2.

Property Right Institutions

The focus of this paper is the effect of CI on economic development. But the distinction between these types of institutions and PRI is crucial to understand the conflicting results of past empirical work. Moreover, it allows one to study the effect of CI in the presence of other distortions in the economy. In particular, if low quality PRI affects the steady-state level of income per capita, then the model will exhibit conditional convergence under PE. This facilitates mapping the model into an empirical exercise.

Thomas and Worrall (1994), Acemoglu et al. (2008a), and Aguiar and Amador (2010) are some of the papers that analyze government lack of commitment regarding expropriation. They focus on self-enforcing equilibriums, where allocations are constrained by the possibility of reverting to the worst equilibrium for the government if it deviates. The latter may be a high-tax, low-investment equilibrium or losing in a political election. As they do not display transitional dynamics in the absence of frictions it is difficult to infer how expropriation incentives vary along the development process.

To analyze this issue suppose that expropriation is carried out by a self-interested politician who can only be imperfectly controlled through elections. In this context losing an election is the penalty after deviation, as in Acemoglu et al. (2008a)[11]. Suppose that the politician consumes tax revenues, and that he also has the technology to expropriate the aggregate stock of capital. If he does so, he can consume a fraction θ of it, where $0 \leq \theta \leq 1$. Only distortionary taxes are allowed. To simplify the analysis the representative consumer sets the tax rate through elections. It is clear that he always tries to avoid expropriation. Therefore he solves his dynamic problem as defined above, with the budget constraint adjusted by the tax, and subject to the following IC constraint for the politician,

$$W_t = \sum_{s=0}^{\infty} \beta_g^s \, u(T_{t+s}) \geq u(\theta k_t) \qquad \forall t$$

where W_t is the expected discounted utility of the politician, β_g is his discount rate, u is a concave function, and $u(0) = 0$, and T are total rents, or revenues in excess to those used to finance public

[11] Dictatorships have been identified as extreme cases of bad PRI, as they are not constrained by voting. Although they may be constrained by other means, the problem here is simplified assuming that voting is always possible. Notice however that in the case of a dictatorship, the tax may be set by government and the penalty may be a reversion to a high-tax, low-investment equilibrium, with similar implications.

expenditures[12]. The optimization problem is then constrained by a condition that ensures the utility of the politician derived from the present value of rents, which are financed by taxes, is larger or equal to the utility of consuming the fraction of the stock of capital that is not lost when expropriation occurs.

In this environment the value of expropriating is increasing during the transition, which might generate incentives to postpone expropriation and with that the distortions derived from larger rents[13]. But the effect of an increasing expropriation value on the binding pattern of the government's IC constraint depends critically on the discount rate of the politician. Lower discount rates make the option to wait less attractive. Indeed, the short horizon of governments relative to the length of the transition makes it unlikely that the politician would be willing to wait for a long period of time before deciding to expropriate. This is captured in most political economy models, where politicians are less patient than citizens. Although a lower discount rate also affects the incentives to default for entrepreneurs, this problem is different from imperfect enforcement since waiting is not behind the result in Proposition 3. Entrepreneurs may be better off honoring the contract even if they do not have the option to default in the future, something that does not happen in the case of the politician given his incentives to expropriate capital.

The study of these issues is left for future research. Here the extreme case of a myopic government is assumed , so $\beta_g = 0$. Additionally suppose for simplicity that the government can only tax capital returns. If this is the case then the government will not expropriate if,

$$T = \tau r k \geq \theta k$$

where τ is the tax rate on capital returns. The representative consumer will always choose $\tau r k = \theta k$, which implies $\tau = \theta / r$. Therefore, in this specific environment, low quality PRI are equivalent to a tax of θ on capital, as the return is now $(1 + r(1 - \tau)) = 1 + r - \theta$.

If we interpret the parameter θ as the efficiency of PRI then, unlike CI, PRI affect output throughout the development process. The model can be easily modified to include this feature because it is equivalent to an increase on the subjective discount rate $\bar{\beta}$. It is well known that this generates a slowdown in the growth process. The reduction in the expected return reduces savings, lowering capital accumulation and the growth rate of output and wages. Therefore the

[12] This setting is very general. For instance, in the environment studied by Thomas and Worrall (1994), the RHS would the value of expropriating the investment made by a foreign firm in the country, and the LHS would be the present value of the share of government profits. If the government expropriates there is no foreign investment in the future so elections are not needed to control the government.

[13] The solution to these models also displays back-loading of incentives, which also may postpone distortions. However, the expectation of higher taxes in the future may reduce current investment, lowering growth and the value of waiting. Moreover, it might be optimal to choose a higher tax rate today even if the politician prefers to wait, to relax the constraint in the future. This is another manifestation of back-loading the contract (Thomas and Worrall, 1994; Acemoglu et al., 2008a).

relative continuation utility of honoring the contract, $\tilde{V}$, falls, while the relative continuation utility of defaulting, $\tilde{V}^d$, rises. It follows that this type of friction brings forward the time at which the IC constraint becomes binding.

If we interpret the parameter θ more broadly, as an indicator of the different distortions affecting the steady-state of the economy, then its inclusion in the model illustrates that the effects of CI on output per capita depend on the distance from the steady-state, and not necessarily on the level of development of the country. Only when steady-states are the same among countries will differences in the value of income per capita contain all the necessary information to predict the effect of CI, because in that case these differences are due to transitional dynamics and not to these distortions. This needs to be accounted for in the empirical exercise.

Two Sectors, Misallocation, and TFP

As shown in Proposition 2, the incentives to default in steady state, and therefore the consequences of financial frictions, depend positively on the intensity with which capital is used in production. Since steady state distortions are also associated with distortions during the transition to the steady state, in an environment with different sectors of production differing on capital intensity we would observe a misallocation of resources in the economy. This would also affect income per capita but now through a lower TFP instead of a slower accumulation of capital. This is in line with the evidence identifying TFP as the main channel through which legal institutions affect GDP per capita (Beck et al., 2000), and as the main source of output per worker differences across countries (Hall and Jones, 1999).

Suppose now there are two types of entrepreneurs, each with measure 1. Each entrepreneur has access to one of two technologies, which differ in factor intensities. Denote by $j = m$ the capital-intensive sector, or manufacturing, and $j = a$ the labor-intensive sector, or agriculture. Denote by $i = c, e_j$ consumers and entrepreneurs with access to technology j respectively. Technologies can be described by the following expression for $j = m, a$,

$$y_j = k_j^{\alpha_j} n_j^{\upsilon_j}$$

where k_j and n_j are capital and labor allocated to sector j respectively, and α_j and υ_j are positive constants. Assume that both technologies show decreasing returns to scale and that they are both equally intensive in the fixed factor, so $\omega = 1 - \alpha_a - \upsilon_a = 1 - \alpha_m + \upsilon_m > 0$, and $\alpha_m > \alpha_a$[14].

[14] It is assumed there is no TFP growth at the firm level in this case. As shown in the baseline model this complicates the exposition since the model needs to be transformed to work with a stationary model, but it is not relevant for the main results. This is the case even when the two sectors differ in TFP growth because the specification of the utility function implies that agents spend a fixed fraction of their nominal income in each good and hence the relative price adjusts so the value of each sector grows at the same rate in the long-run, resulting in the same dynamics for the IC constraint.

Preferences are unchanged but now the instantaneous utility function depends on the consumption of both goods under the following specification,

$$u(c) = c_a^{\eta} c_m^{1-\eta}$$

where $0 < \eta < 1$ is a constant. The price of the capital-intensive good is normalized to 1, while the price of the labor-intensive good is p. For notational purposes the price of good j is denoted by p_j, so henceforth $p_j = 1$ if $j = m$, and p otherwise. The total value of output in the economy is

$$Y = y_m + p y_a$$

Only the capital-intensive good can be used as capital, which depreciates at a rate δ each period. This implies the following market clearing conditions for each sector,

$$C_m = \sum_i c_m^i = y_m + (k_m + k_a)(1 - \delta) - k'_m - k'_a \tag{4}$$

$$C_a = \sum_i c_a^i = y_a \tag{5}$$

where c_j^i is total consumption of good j by agents $i = c, e_a, e_m$. Everything else, including the defaulting technology and the institutional environment is unchanged.

We solve this model numerically. Although it is possible to prove similar results to the ones stated in propositions 1 to 4 above, here we only describe how these propositions may be adapted to the two-sector economy[15]. Now the problem facing the type j entrepreneur is

$$V(K) = \max_{k_j, n_j, c_m, c_a, c_m^d, c_a^d} \{u(c) + \beta V(K)\}$$

subject to

$$\begin{aligned} c_m + p(K)c_a &= p_j(K)y_j - w(K)n_j - (r(K) + \delta)k_j \\ c_m^d + p(K)c_a^d &= p_j(K)y_j - w(K)n_j \end{aligned}$$

$$u(c) + \beta V(K) \geq \rho \left[u(c) + \beta V^d(k_j; K') \right] + (1 - \rho)u(c).$$

Where

$$V^d(k_j; K') = \max_{n'_j, c'^d_m, c'^d_a} \left\{ u(c'^d) + \beta V^d(k_j; K'') \right\}$$

subject to

$$c'^d_m + p'(K')c'^d_a = p'_j(K') {z'_j}^{1-\alpha_j} k_j^{\alpha_j} {n'_j}^{\upsilon_j} - w'(K')n'_j.$$

[15] A formal analysis, including the proofs to the propositions for the two-sector economy, is reported in a previous version of this paper, which is available upon request.

And the consumers' problem is

$$U(b;K) = \max_{c_m,c_a,n,b'} \left\{ \frac{u(c)^{1-\sigma}-1}{1-\sigma} + \beta U(b';K') \right\}$$

subject to

$$c_m + p(K)c_a + \mu_m b' = w(K) + b(1+r(K)).$$

We define the recursive competitive equilibrium for the two-sector economy next,

Definition 2. *A competitive equilibrium is a set of decision functions $c^i = \mathrm{C}^i(K)$, $b' = \mathrm{B}(K)$, $k_j = \mathrm{K}_j(K)$, and $n_j = \mathrm{N}_j(K)$, for $j = a, m$ and $i = c, e_j$, a set of pricing functions $w = \mathrm{W}(K)$, $r = \mathrm{R}(K)$, and $p = \mathrm{P}(K)$, and an aggregate law of motion for the capital stock $K' = \mathrm{K}(K)$, such that*

1. *Type i entrepreneurs solve their dynamic programming problem, given $W(\cdot)$, $R(\cdot)$, $P(\cdot)$, with the equilibrium solution satisfying $k_j = \mathrm{K}_j(K)$, $n_j = \mathrm{N}_j(K)$, and $c^i = \mathrm{C}^i(K)$.*

2. *Consumers solve their dynamic programming problem, taking as given the functions $W(\cdot)$, $R(\cdot)$, and $P(\cdot)$, with the equilibrium solution satisfying $c^c = \mathrm{C}^c(K)$ and $b' = \mathrm{B}(K)$.*

3. *The economy wide resource constraints (4) and (5), the clearing conditions for the labor and credit markets, $1 = n_a + n_m$ and $b = k_a + k_m$, and the consistency condition, $\mathrm{K}(K) = \mathrm{K}_m(K) + \mathrm{K}_a(K)$, hold each period.*

Under PE this economy follows a similar path in terms of aggregate variables compared to the one-sector model previously analyzed[16]. Once we have a similar result to Proposition 1 the predictions for the IE economy are easy to obtain since each sector faces a similar constraint to the one defined in expression (3), after adjusting the value of output in the labor intensive sector by the relative price. Then we obtain a sector-specific threshold for the IC constraint in steady state, $\Omega_j(\alpha_j) = \phi(1 + \alpha_j/\omega)$ for $j = a, m$, where the constraint is binding in steady state in sector j if $\Omega_j < 1$. Since $\Omega_a > \Omega_m$, this happens in the capital intensive sector if (but not only if) it is also binding in the labor intensive sector. In the case of Proposition 3, since the incentives to default

[16]The main difference is that growth in each sector varies depending on the consumers' elasticity of substitution, σ. In particular, the growth in the stock of capital raises output in the capital intensive sector and lowers output in the labor intensive sector (a Rybczynski effect). The change in supply on the other hand generates an increase in the relative price, as relative demand is fixed in nominal terms. This offsets the effects on production (a Stopler-Samuelson effect), and thus the final effect on sectoral production is ambiguous. But total expenditures on both goods grow during the transition, and so the value of output in the labor intensive sector grows as well. As output in the capital intensive sector is also used as capital, the rise in demand does not necessarily translate to output growth. However, the growth rate of investment depends on σ. If the latter is high enough we can observe a positive growth rate in capital intensive output.

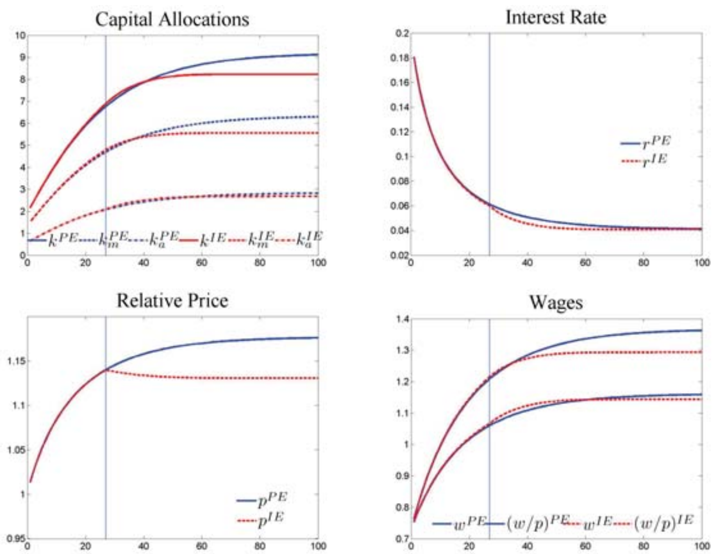

Figure 3: Imperfect Enforceability Equilibrium

are still increasing there exists a threshold for capital such that in at least one sector the constraint is binding for every value of capital above that threshold. Finally, since Proposition 4 concerns the aggregate stock of capital in the economy, the same argument can be used to show its validity in the two-sector economy.

The numerical solution to the model is shown in Figure 3. It is assumed that $\Omega_m < 1 < \Omega_a$, so the constraint is only binding in the capital intensive sector in steady state. As consumers anticipate the fall in future income due to the constraint, the negative income effect makes them reduce consumption and increase savings. Then capital grows at a faster rate before the constraint becomes binding. At the moment this happens, which is marked with a vertical line in the graphs, there is a reallocation of resources, as total capital adjusts slowly. In this period less capital is allocated to the capital intensive sector and more capital is allocated to the labor intensive sector. This reallocation of capital among sectors raises wages and generates a fall in the relative price of the good produced in the labor intensive sector, as demand falls for both goods proportionally. Therefore, despite the reallocation of resources, the value of output falls in both sectors. The interest rate now is equal, in equilibrium, to the marginal productivity of capital in the unconstrained sector, i.e. the labor intensive sector. Therefore the fall in the relative price and the reallocation of resources to this sector reduces the interest rate relaxes the IC constraint for the capital intensive sector and, together with the fall in total income, reduces the rate at which capital is accumulated in the economy. The latter effect lowers the growth rate of output and wages in both sectors. The economy converges to its steady state described above with lower capital and lower output in both sectors.

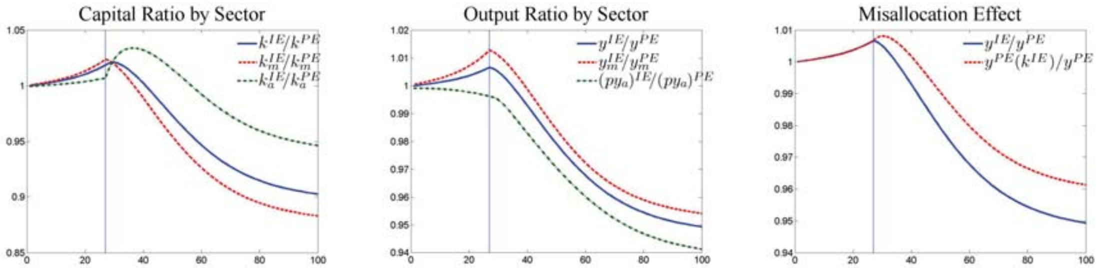

Figure 4: The Misallocation Effect

In Figure 4 the comparison between the IE and PE equilibrium allocations can be seen more clearly. Initially both sectors attract more capital, especially the one that is capital intensive. Labor is also reallocated to that sector, so output falls in the labor intensive sector under IE. But when the constraint becomes binding, this sector expands and the capital intensive sector shrinks. Total output falls due to this inefficient reallocation of resources. Eventually the slow down in aggregate capital accumulation affects both sectors, and both start to shrink relative to the PE case until they converge to their steady state levels. In terms of the value of output, both sectors shrink after the constraint becomes binding because of the fall in the relative price of the good produced in the labor intensive sector. In the last graph in Figure 4 the effect on total output per capita is divided into a capital accumulation effect and a misallocation effect. The red line shows the income ratio which can be achieved if the stock of capital resulting from the IE equilibrium could be allocated efficiently. Therefore this ratio shows the output gap due to the capital accumulation effect. The difference between the red line and the blue line is then the misallocation effect. As shown in the graph the misallocation of resources toward the labor intensive sector generates the fall in output initially, while the capital accumulation effect becomes more important thereafter.

3 The Evidence

The previous section shows that the quality of CI affects income per capita, but only under certain conditions. In particular, propositions 2, 3, and 4 imply that this effect would realize only after a certain level of capital has been accumulated, and that this level of capital depends on its steady-state level. Moreover, if the quality of CI remains constant, the effects on the economy will persist throughout the transition and along the balanced growth path. This is the main implication of the model and the focus of the empirical exercise. Following previous empirical work on the link between the quality of institutions and income per capita, cross-country regressions are implemented. This section explains the assumptions and modifications to previous specifications needed to test the main implications of the model. We then describe the identification strategy, the data used in the regressions, and finally present results.

Empirical Strategy

We start with the regression equation estimated by Acemoglu and Johnson (2005). Define y_{ti} as the log of GDP per capita in country i and period t. Suppose θ_i and ρ_i capture the exogenous component of the quality of PRI and CI in country i respectively, as defined in the model. This equation takes the following form,

$$y_{ti} = \alpha_0 + \alpha_1(1 - \theta_i) + \alpha_2\rho_i + \epsilon_i \tag{6}$$

Acemoglu and Johnson (2005) estimate this equation for a large sample of countries and find that α_1 is positive and significant, while α_2 is not significant.

Because the steady-state level of output per capita is determined by θ_i and ρ_i in the model, we can estimate the regressions implemented by Barro (1991), Barro and Sala-i-Martin (1992), and Barro and Sala-i-Martin (2004),

$$y_{ti} = \beta_0 + \beta_1(1 - \theta_i) + \beta_2\rho_i + \beta_3 y_{\tau i} + \zeta_i \tag{7}$$

where $\tau < t$, and conditional convergence implies $\beta_3 < 1$. This means that, controlling for the steady-state value of output per capita, or θ_i and ρ_i, transitional dynamics imply that low income countries grow faster than high income countries. Once we have an unambiguous and negative relationship between the level of income per capita at τ and the subsequent growth of the economy between τ and t, we have, according to the model, an unambiguous and positive relationship between the level of income at τ and the effect of ρ_i on the subsequent growth of the economy. Therefore we introduce an interaction term between ρ_i and $y_{\tau i}$ to estimate the following regression,

$$y_{ti} = \gamma_0 + \gamma_1(1 - \theta_i) + \gamma_2\rho_i + \gamma_3 y_{\tau i} + \gamma_4\rho_i y_{\tau i} + \upsilon_i \tag{8}$$

where $\partial y_{ti}/\partial \rho_i = \gamma_2 + \gamma_4 y_{\tau i}$ keeping θ_i constant. The model predicts $\gamma_4 > 0$. Therefore, after estimating Equation (6) to confirm the results by Acemoglu and Johnson (2005), and estimate Equation (7) to confirm the existence of conditional convergence, we estimate Equation (8) to validate the main implication of the model.

An alternative strategy to test this implication is to compare the effects of CI among initially high and low income countries. Although this does not address the problem of different steady-states, and we therefore expect weaker results, it is very simple to implement. Moreover it is not necessary to assume that steady-states are the same among countries. As rich countries have transitioned toward their steady-states and expected growth is close to its long-run level, better CI are needed in order to achieve the first best level of income according to the model. In the case of initially low income economies, some of them are poor because of low steady-states, and then CI should be relevant as well. But in this group we also observe countries that grow at high rates for long periods of time, meaning that they were initially far from their steady-states. This is the case of Korea and Taiwan for instance. These countries should lower the value of the coefficient on CI for this group of economies[17]. It follows that, even though for individual countries the relationship between income and the effect of CI is ambiguous because of different steady-states, on average this would not be the case; a larger effect would be expected in the group of initially rich economies. An additional test will be to split the sample of countries according to income per capita and estimate Equation (6) for each group.

A further prediction of the model is that, assuming constant steady-states, the effect of CI should become larger as time goes by, because countries approach their balanced growth path. Although steady-states may change, the literature on institutions shows that they tend to be very persistent. We use this fact in our identification strategy described below, as events that occurred centuries ago affect the quality of institutions today. As institutions determine the steady-state according to the model, it follows that, on average, steady-states have not changed substantially. It is easy to show that if the coefficient on the indicator for institutional quality falls (remains constant) when the lagged value of GDP per capita is included in equation (6), it means that the latter was (was not) affected by the quality of the corresponding institution. Additionally, under measurement problems the inclusion of the lagged value of GDP per capita can reduce the significance of the coefficients if it contains better information about institutional quality. But this happens only in the case that institutional quality had an effect on the lagged value of GDP per capita. Then, to validate this additional implication of the model, we analyze differences between α_2 and β_2.

Identification

The literature linking institutions and long-run growth is large, as described above. The main empirical problem facing these studies is that available measures of institutional quality are outcomes and therefore they are affected by actual economic conditions, making causal relationships difficult to identify. To overcome this problem past studies have used instruments to capture the exogenous component of the quality of institutions. These instruments are based on the idea that the nature of the institutional framework is highly persistent and was mainly shaped by the influence of European countries. In the case of CI it has been widely documented that the main exogenous variation comes from differences in legal traditions spread by European countries through conquest, imitation, and colonization (Levine, 2005; La Porta et al., 2008). On the other hand,

[17] It is interesting to note that the growth rate variance in the group of low income economies is almost three times the variance in the group of rich economies.

Acemoglu et al. (2002) propose a measure of initial endowments as instruments. They show that relatively rich areas in 1500 are now relatively poor countries. Their explanation is that in poorer areas Europeans established institutions of private property that favoured long-run growth, while in richer areas they established extractive institutions, which discourage investment and economic development (see also Engerman and Sokoloff (2002)). Therefore indicators related to initial endowments are good instruments to capture the exogenous component of PRI quality. In particular, Acemoglu et al. (2002) show that urbanization and population density in 1500 strongly reflect these determinants. Following this idea, Acemoglu et al. (2001) propose a measure of settler mortality as an alternative instrument, suggesting that better institutions were established in places where Europeans could settle.

As noted above, Acemoglu and Johnson (2005) take advantage of the strong link between the quality of CI and legal origin on the one hand, and the quality of PRI and initial endowments on the other, to identify the exogenous component of each of these highly correlated variables, and further to unbundle their effects on income per capita and financial development. The same strategy is used in this paper to identify the effect of these institutions on income per capita for a sample of former colonies since the theory outlined by Acemoglu et al. (2002) between initial endowments and institutional quality applies only to these countries. However, the model presented in this paper can be applied to any economy, and so CI could have shaped the economic development of the colonizers during the last century as well. Including more countries not only improves the results but also allows us to keep a relatively large number of countries in each group when the sample is split between high and low income economies. Beyond this sample-size effect, the fact that former colonies are poorer on average than European countries impedes the identification of CI effects due to a sample-selection effect. To overcome this problem an alternative identification strategy is conducted, based on the idea that, especially in the first stages of development, PRI regulated the relationship between the government or elites, and the rest of the population, while CI regulated the relationship mostly among individuals within elite groups[18].

The case of former colonies is illustrative in this respect. The existence of native populations in the colonies led Europeans to systematically establish more inefficient PRI there than in their home countries. Natives provided a supply of labor that could be forced to work (Acemoglu et al., 2002). More generally, the relevance of being a colony has been captured by the use of time since independence as an explanatory variable for PRI quality (Beck et al., 2003; Acemoglu et al., 2008b). On the other hand CI did not have to adapt systematically to the new environment in former colonies. Papers focusing solely on the effects of legal institutions on economic outcomes, which include European countries in their estimations, do not distinguish between the efficiency of legal

[18]This idea is related to the argument by North et al. (2009), who argue that the origin of legal systems lies in the definition of elite privileges to resolve conflicts among its members (North et al. (2009), p.49)

systems between home countries and former colonies (La Porta et al., 1998, 1999, 2008; Djankov et al., 2008). In fact, one of the main findings by Djankov et al. (2003) is that court efficiency and their ability to deliver justice are determined by the characteristics of legal procedure, rather than the general underdevelopment of the country. This has been documented by historians as well[19]. Ultimately however, the validity of this strategy to identify the comparative effect of both types of institutions must be checked empirically, as Acemoglu and Johnson (2005) do for the initial endowments and legal origin indicators.

Ethno-linguistic fractionalization captures the idea behind the identification strategy just proposed, and is an available method for a large number of countries. In ethnically diverse countries it would be less likely to find sound PRI, as heterogeneity translates into ethnic differences between the elites or the government and the rest of the population. Many papers have found a statistically significant relationship between fractionalization and institutional quality, e.g. Alesina et al. (2003) and Beck et al. (2003), and related economic policies, e.g. Easterly and Levine (1997). As CI regulate the relationship between members within the elite, we do not expect a significant effect of this variable on the quality of CI. Legal origin is used for capturing the exogenous component of CI, as it is also available for a large sample of countries. The source for this variable is Djankov et al. (2008), who focus on the legal origin of a country's bankruptcy laws. It is important to control for others factors in the first-stage, particularly the degree of influence of colonizers had in former colonies. Latitude is available for a large sample of countries, and captures, besides other geographical features, factors affecting the incentives for settlement by the colonialists, since tropical endowments represent an inhospitable disease environment for them (Easterly and Levine, 2003). Latitude has been used among others by Hall and Jones (1999), La Porta et al. (1999), Beck et al. (2003), and Easterly and Levine (2003), and we expect it to have a significant effect on the quality of the two types of institutions.

As a measure of CI quality the contract enforcement indicator constructed by Djankov et al. (2008) is used. The authors survey insolvency practitioners from 88 countries about how debt enforcement will proceed against an identical hotel about to default on its debt. They use data on time, cost, and the likely disposition of the assets to construct a measure of the efficiency of debt enforcement in each country. This is the best available indicator for capturing the parameter ρ in the model since it explicitly includes most of the costs of debt enforcement, and large costs deter legal actions against fraudsters by creditors[20]. Results are also presented with the index

[19] For instance, Haring (1947) concludes that "*basically, however, people in the Indies, especially in the domain of private law, lived accordingly to the same judicial criteria as in Spain*" (Haring (1947), p.110), while Rothermund (2007) concludes that in Africa and Asia, "*...the legal systems were taken over by nationalists without any criticism. They had* [not] *protested neutral manifestations* [of foreign rule] *such as laws on the statute books*" (Rothermund (2007), p.252).

[20] I drop Angola out of the sample because it is an outlier and biases the results, especially when only former

	CI_1 (1)	CI_2 (2)	PRI_1 (3)	PRI_2 (4)	CI_1 (5)	CI_2 (6)	PRI_1 (7)	PRI_2 (8)	CI_1 (9)	CI_2 (10)	PRI_1 (11)	PRI_2 (12)
Constant	3.400***	4.670***	4.952***	6.235***	4.281***	3.976***	7.964***	8.422***	3.091***	4.611***	6.422***	6.447***
	0.115	*0.172*	*0.208*	*0.142*	*0.482*	*0.425*	*0.764*	*0.492*	*0.170*	*0.317*	*0.262*	*0.341*
English Legal Origin	0.842***	−1.966***	0.024	0.239	0.563***	−2.108***	−0.206	0.148	1.104***	−2.232***	0.037	0.677
	0.175	*0.229*	*0.388*	*0.226*	*0.215*	*0.230*	*0.394*	*0.266*	*0.194*	*0.322*	*0.429*	*0.442*
Log Population Density in 1500	0.014	0.064	−0.497***	−0.320***								
	0.040	*0.069*	*0.101*	*0.064*								
Log Settler Mortality					−0.193*	0.174*	−0.630***	−0.485***				
					0.107	*0.093*	*0.150*	*0.101*				
Urbanization in 1500									0.043***	0.029	−0.148***	−0.033
									0.016	*0.031*	*0.033*	*0.035*
R^2	0.421	0.603	0.271	0.284	0.439	0.667	0.236	0.360	0.566	0.652	0.297	0.133
Observations	34	48	64	62	31	40	49	50	31	34	36	37

Table 1: First-Stage Regressions for CI and PRI, Former Colonies

of legal formalism constructed by Djankov et al. (2003), which is a measure of the number of legal proceedings arising from the collection of a bounced check. This index does not measure costs explicitly, although the authors show that it is correlated with the delay in the resolution of disputes.

For PRI indicators, Acemoglu and Johnson (2005) use constraints on the executive from the Polity IV database as their preferred measure. This index measures explicitly how constrained the executive is in making arbitrary decisions. They also use the risk of expropriation ICRG index. As noted by Acemoglu and Johnson (2005), the latter measure is an equilibrium outcome, determined by the actions taken by both the citizens and the elites. Moreover one of its components is Law and Order, which is an assessment of the strength and impartiality of the legal system and the popular observance of the law. For these reasons the constraints on the executive is the preferred measure used here, while the ICRG index is included only for comparison and robustness[21].

Finally, the source for GDP per capita is Maddison (2008). For τ in Equation (7) the year 1950 is used because it is the earliest for which data on GDP per capita for a large number of developing countries is available[22]. As the dependent variable we use GDP per capita in 2006. For a list of the countries included in the estimations see Appendix C.

colonies are used. In log terms, as used in the estimations, the value of this variable for Angola is 0.18. That means more than 4.5 standard deviations below the average (3.8) and more than 2 standard deviations below the second worst value, which is 1.9 for Turkey.

[21] For both constraints on the executive and the ICRG index we use the average since 1990.

[22] Maddison (2008) reports data on GDP per capita for earlier periods. The sample is relatively large only for 1913 and 1870, but still the number of countries used in the estimations would not be larger than 30.

Empirical Results

Table 1 shows the first-stage regressions for the sample of former colonies. The dependent variables are the log of contract enforcement (CI_1), legal formalism (CI_2), constraints on the executive (PRI_1), and the ICRG index (PRI_2). As expected legal origin has a strong and significant effect on the CI measures and a non significant effect on the PRI measures, in all the specifications. In the case of initial endowments, only when population density is used we observe a significant effect on PRI but not on CI indicators. Because of this and the fact that the sample is larger when population density is used, the second-stage is estimated using this variable as the instrument. In Table 2 the first-stage regressions for the full sample of countries are shown. As expected we can see that legal origin (fractionalization) has a significant effect on the CI (PRI) quality indicators, and a non-significant effect on PRI (CI) indicators, confirming the identification strategy proposed above. Also as expected, latitude is highly significant for all the institutional indicators.

The second-stage results are presented in Table 3 when only former colonies are included, so legal origin and population density in 1500 are used as instruments. Conversely in Table 4, when all the countries are included, legal origin, fractionalization, and latitude are the instruments. Results are as expected. The first 6 columns show the results for the full sample. The first three columns use contract enforcement as the CI indicator, while columns (4) to (7) use legal formalism. CI is not significant when the interaction term is not included. This confirms the results by Acemoglu and Johnson (2005). When controlling for GDP per capita the coefficients on CI are unchanged. We can see in this case that conditional convergence is only significant when all countries are included. Notice however that the coefficient on the lagged value of GDP per capita is also capturing some effects of PRI, whose coefficient drops when that variable is included in Table 3. This can offset the effect of transitional dynamics on the value of the lagged GDP coefficient, especially when there are measurement problems in the PRI indicators. When the interaction term is included we observe the expected results: the effect of CI is larger in initially rich countries, controlling for the steady-state. The effect is significant for levels of GDP per capita in 1950 shown by conditioning on 30% and 20% of the richest countries in that year, depending on the sample of countries used in the estimation (last row in the tables). This does not necessarily imply that only this fraction of richest economies are affected by CI, as the same steady-state level is assumed in this case.

Columns (7) to (10) in tables 3 and 4 show the baseline specifications for the group of richer (than the median) economies in 1950. Recall that it does not need to be true that richer economies in 1950 were closer to their steady-states, as steady-states may differ. However, as explained above, we may expect that on average the effect of CI is stronger in the group of initially rich economies. This is because the existence of some fast growing countries in the group of initially low income economies, like Korea and Taiwan, lowers the estimated coefficient for that group according to the model. When including only countries that were richer than the median in 1950 we can see that

	CI_1 (1)	CI_2 (2)	PRI_1 (3)	PRI_2 (4)
Constant	3.267***	4.870***	4.901***	5.958***
	0.191	*0.285*	*0.428*	*0.267*
English Legal Origin	0.668***	−1.546***	0.281	0.297
	0.105	*0.211*	*0.281*	*0.232*
Fractionalization	−0.369	0.022	−1.346**	−1.007**
	0.289	*0.396*	*0.623*	*0.452*
Latitude	1.401***	−2.175***	3.324***	3.369***
	0.357	*0.528*	*0.682*	*0.531*
R^2	0.382	0.482	0.328	0.509
Observations	61	76	75	76

Table 2: First-Stage Regressions for CI and PRI, All Countries.

the coefficients on CI become significant. Results are weak when all the countries are included in the estimations. This may be a sign that, in this case, the relationship between initial GDP per capita and subsequent growth is also weak.

If we accept the idea that the persistence of institutions generates persistence of steady-state levels, the results shown above may be informative about the additional prediction of the model regarding the time series dimension: assuming constant steady-states, the effect of CI should become larger as time goes by, because countries approach their balanced growth path. Take the results for initially rich countries (columns (7) trough (10) in tables 3 and 4). While the coefficients on CI do not change when including GDP per capita in 1950 for the case of former colonies (Table 3), they do when all the countries are included in the estimations (Table 4). Thus, CI did not affect GDP per capita before 1950 in former colonies, but they did have an impact in the new countries included in the estimations when fractionalization is used. As most of these countries are rich European countries (see Appendix C), and they were probably on, or close to, their balanced growth path in 1950, this would be in line with the predictions of the model[23].

As shown in tables 1 and 2, legal origin affects CI but not PRI, but initial endowments, particularly population density in 1500 and fractionalization, affect PRI but not CI. Thus, it is possible to implement our tests using instruments as explanatory variables for GDP per capita today. This exercise may be useful to infer the effects of each type of institution without a specific measure of their quality. Acemoglu et al. (2002) perform a similar exercise for former colonies. The authors find a negative and statistically significant effect of initial endowments on today's GDP per capita.

[23]To see when CI started to affect GDP per capita in initially rich former colonies, different lags of GDP per capita may be included in the baseline specifications. Results show that the coefficient on CI starts to decline around 1980, which coincides with a reduction in the average growth rate of GDP per capita in former colonies, particularly in Africa and in Latin America. In the case of developed countries, based on the results by Rajan and Zingales (2003), La Porta et al. (2008), and Musacchio (2010) described in Section 1, the effect should have taken place not before the twentieth century.

	Full Sample						*GDP pc 1950 > median*			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Constant	4.22^{***}	1.58	15.14^{**}	3.89^{***}	2.06^{*}	−5.13	2.48^{**}	3.20^{**}	7.20^{***}	5.83^{***}
	1.43	*1.32*	*6.11*	*0.86*	*1.24*	*3.44*	*1.08*	*1.25*	*1.32*	*1.87*
Log Enforcement Efficiency	−0.06	0.11	-3.22^{**}				0.81^{***}	0.59^{**}		
	0.28	*0.17*	*1.34*				*0.31*	*0.28*		
Legal Formalism				0.02	−0.05	2.12^{*}			-0.34^{***}	-0.26^{**}
				0.12	*0.07*	*1.15*			*0.13*	*0.12*
Constraints on Executive	0.84^{***}	0.45	0.43	0.84^{***}	0.42	0.38	0.63^{***}	0.73^{*}	0.56^{***}	0.53
	0.15	*0.38*	*0.38*	*0.15*	*0.38*	*0.38*	*0.15*	*0.38*	*0.16*	*0.38*
Log GDP per capita in 1950		0.55	−1.28		0.59	1.54^{***}		−0.07		0.14
		0.41	*1.03*		*0.41*	*0.40*		*0.45*		*0.42*
Log GDP per capita in 1950 × Enforcement Efficiency			0.45^{**}							
			0.18							
Log GDP per capita in 1950 × Legal Formalism						-0.28^{*}				
						0.14				
R^2	0.38	0.67	0.69	0.38	0.67	0.69	0.54	0.65	0.54	0.65
Observations	48	48	48	48	48	48	24	24	24	24
CE is significant above:			7.71			7.91				
Fraction of countries			0.34			0.26				

Table 3: Second-Stage Regressions, Former Colonies.

This is what they call the Reversal of Fortune. As is more relevant for this paper, they also show that after controlling for these features, other possible explanatory variables, including legal origin, do not have a statistically significant effect on today's GDP per capita.

Table 5 uses legal origin, population density in 1500, and fractionalization as explanatory variables. Confirming the Acemoglu et al. (2002) results, the effect of legal origin on the unconditional level of GDP per capita is not significant when controlling for initial endowments (columns (1) and (4)). When including GDP per capita in 1950 the coefficient on legal origin rises and becomes significant when all countries are included, while the coefficient on initial endowments falls and becomes insignificant when using the sample of former colonies. Again conditional convergence is not strong in the sample of former colonies, but it is highly significant when all countries are included. In columns (3) and (6) the interaction effect is also included and expected results are confirmed. Controlling for the steady-state using the endowment variables, the richer is the country initially, the larger is the effect of legal origin on the growth of GDP per capita thereafter. The effect of CI becomes significant at levels of GDP per capita shown by one third to one half of the countries at that time, depending on the sample used in the estimations. In the last four columns of Table 5 the baseline specifications are implemented for the sub-sample of countries that were richer than the median in 1950. We can see that the effect of English legal origin is positive and significant in all the specifications. As noted above this is in line with the model predictions if, on average, high income countries were closer to their steady-states than low income countries in 1950.

	Full Sample						GDP pc 1950 > median			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
Constant	3.83***	4.52***	19.32**	3.71***	3.33***	−7.69*	4.71***	6.50***	6.99***	7.59***
	0.66	*1.31*	*7.72*	*0.60*	*1.02*	*4.41*	*0.50*	*1.36*	*1.37*	*1.28*
Log Enforcement Efficiency	−0.12	−0.21	−3.95**				0.58*	0.25		
	0.32	*0.28*	*1.88*				*0.31*	*0.38*		
Legal Formalism				0.01	−0.04	3.40**			−0.20*	−0.08
				0.08	*0.07*	*1.35*			*0.12*	*0.13*
Constraints on Executive	0.96***	1.08***	0.94***	0.90***	0.71***	0.84***	0.42**	0.86**	0.54***	0.94***
	0.15	*0.25*	*0.22*	*0.07*	*0.18*	*0.18*	*0.21*	*0.36*	*0.16*	*0.25*
Log GDP per capita in 1950		−0.13	−1.97*		0.22	1.47***		−0.42		−0.46**
		0.25	*1.03*		*0.23*	*0.54*		*0.27*		*0.24*
Log GDP per capita in 1950 × Enforcement Efficiency			0.49**							
			0.22							
Log GDP per capita in 1950 × Legal Formalism						−0.43***				
						0.16				
R^2	0.55	0.73	0.71	0.67	0.69	0.72	0.61	0.66	0.60	0.66
Observations	76	76	76	76	76	76	38	38	38	38
CE is significant above:			8.55			8.13				
Fraction of countries			0.14			0.25				

Table 4: Second-Stage Regressions, All Countries.

Taking all the results together we can conclude that the effect of CI on GDP per capita during the last 60 years is significant only in economies that were relatively close to their steady-states in 1950. These results do not translate into PRI, which have a significant effect on GDP per capita in all specifications. This confirms the idea that, unlike CI, PRI affect income per capita throughout the development process. The evidence also shows that the effect of CI occurred first in developed countries, which may be explained, according to the model, by the fact that these countries transitioned toward their steady-states earlier.

4 Conclusions

This paper studies the effect of CI on development. A growth model with endogenous financial frictions induced by imperfect enforceability of contracts is presented. The key assumption is that after defaulting producers are not able to take full advantage of future production opportunities. This generates the main implication of the model: financial frictions are more important when expected growth is low, because in that case self-enforcement incentives are weak. As high quality CI reduce the benefits of defaulting, they are irrelevant when self-enforcement incentives are strong. But otherwise, low quality CI slow down capital accumulation and economy-wide TFP growth. After embedding these features into the standard neoclassical growth model the paper predicts that the effect of the quality of CI on GDP per capita depends on the distance between current

	Full Sample						GDP pc 1950 > median			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	8.487***	1.819	3.928***	9.455***	3.080***	3.660***	8.574***	4.461***	9.761***	5.416***
	0.110	*1.242*	*1.339*	*0.139*	*0.875*	*1.093*	*0.118*	*1.460*	*0.114*	*1.184*
English Legal Origin	−0.198	0.126	−2.640**	0.241	0.324*	−0.757	0.577**	0.565**	0.690***	0.577***
	0.229	*0.147*	*1.254*	*0.242*	*0.168*	*1.385*	*0.275*	*0.244*	*0.158*	*0.163*
Log population density in 1500	−0.334***	−0.084	−0.092				−0.246***	−0.116		
	0.060	*0.076*	*0.076*				*0.060*	*0.075*		
Fractionalization				−2.527***	−1.546***	−1.538***			−2.212***	−1.778***
				0.361	*0.312*	*0.311*			*0.388*	*0.315*
Log GDP per capita in 1950		0.879***	0.596***		0.802***	0.727***		0.531***		0.523***
		0.162	*0.173*		*0.105*	*0.135*		*0.188*		*0.144*
Log GDP per capita in 1950 × English Legal Origin			0.373**			0.144				
			0.164			*0.175*				
R^2	0.375	0.669	0.687	0.391	0.704	0.707	0.536	0.651	0.452	0.602
Observations	48	48	48	76	76	76	24	24	38	38
Legal Origin significant above:			7.697			7.346				
Fraction of Countries			0.368			0.579				

Table 5: Legal Origin, Initial Endowments, and GDP per capita.

output and its steady-state level. The closer the economy is to its steady-state, the larger are the effects of the quality of CI on income per capita. Unlike CI, the effect of PRI on output does not depend on the stage of development of a country.

Empirically the model predicts that, controlling for the steady-state level of output per capita, we should observe a larger effect of CI in richer economies because they are closer to their steady-states. The paper implements cross-country regressions to test these implications. The empirical evidence is in line with the predictions of the model. The main findings are (1) the effect of CI on output per capita growth in the last 60 years is significant only for countries that were relatively close to their steady-states in 1950 and for countries relatively rich in 1950, and (2) the effect of PRI on growth is always significant.

The results in this paper may be useful to explain the high persistence in the quality of CI. This follows from the fact that, according to the model, their quality is irrelevant for growth for a long period of time. The paper has also important policy implications. In particular the effects of growth enhancing reforms may have a larger effect in the presence of inefficient CI, since they may make them irrelevant. But as diminishing returns slow down the effects of these reforms on growth, these inefficient institutions may become binding, affecting long-run economic growth again.

Appendix A: The Transformed Dynamic Programming Problems

Given that $\hat{z}$ is constant, the aggregate state of the world is now described by $\hat{K}$. First it is necessary to compute the steady-state growth of consumption for an entrepreneur that has defaulted in a previous period t^*. Income for this entrepreneur in period $t > t^*$ is $z_t \bar{k}_t^\alpha n_t^\upsilon - w_t n_t$, which, using the demand for labor, is

$$(1-\upsilon)\left[\frac{\upsilon^\upsilon z_t \bar{k}_t^\alpha}{w_t^\upsilon}\right]^{\frac{1}{1-\upsilon}}$$

using $\bar{k}_t = (1-\delta)\bar{k}_{t-1}$, and the asymptotic growth rate of w, the asymptotic growth rate of income and, given $\sigma^e = 0$, of consumption, will be

$$\gamma^d = \gamma^{\frac{1-\alpha-\upsilon}{1-\upsilon}}(1-\delta)^{\frac{\alpha}{1-\upsilon}}$$

Now $\hat{c}_t^d = c_t^d/(\gamma)^{t^*}(\gamma^d)^{t-t^*}$ can be defined, which will be constant in steady-state. For $t > t^*$, $u(c^d) = \gamma^{t^*}(\gamma^d)^{t-t^*}u(\hat{c}^d)$, and $V_{jt+1}^d(\bar{k}; K') = \gamma^{t^*}(\gamma^d)^{t-t^*}V_{jt+1}^d(\hat{k}; \hat{K}')$. For non-defaulting entrepreneurs and consumers, consumption of good j grows at the constant rate γ as noted in the text. Then we define $\hat{c}_t^i = c_t^i/\gamma^t$ for $i = c, e$, which will be constant in steady-state, and $u(c^i) = \gamma^t u(\hat{c}^i)$. The last step is to transform the budget constraints and the market clearing conditions. Notice that in every case the LHS and RHS grow at the same rate in steady state so transforming them is simple. When savings are included however we have $b_{t+1}/\gamma^t = \gamma b_{t+1}/\gamma^{t+1} = \gamma \hat{b}_{t+1}$. This adjustment is made to the budget constraint and the market clearing conditions. Now the transformed problem facing the entrepreneur is

$$V(\hat{K}) = \max_{\hat{k},n}\left\{u(\hat{c}) + \beta\gamma V(\hat{K})\right\}$$

subject to

$$\hat{c} = \hat{y} - \hat{w}(\hat{K}) - (r(\hat{K}) + \delta)\hat{k}$$

$$u(\hat{c}) + \beta\gamma V(\hat{K}) \geq \rho\left[u(\hat{y} - \hat{w}(\hat{K})) + \beta\bar{\gamma}V^d(\hat{k}; \hat{K}')\right] + (1-\rho)u(\hat{c}),$$

where

$$V^d(\hat{k}; \hat{K}') = \max_{n'}\left\{u(\hat{y}' - \hat{w}'(\hat{K}')) + \beta\bar{\gamma}V^d(\hat{k}; \hat{K}'')\right\}$$

And the transformed consumers' problem will be

$$U(\hat{b}; \hat{K}) = \max_{\hat{c},\hat{b}'}\left\{\frac{\hat{c}^{1-\sigma} - 1}{1-\sigma} + \beta\gamma^{1-\sigma}U(\hat{b}'; \hat{K}')\right\}$$

subject to

$$\hat{c} + \gamma\hat{b}' = \hat{w}(\hat{K}) + \hat{b}(1 + r(\hat{K}))$$

Finally, the transformed market clearing condition is,

$$\hat{C} = \sum_i \hat{c}^i = \hat{Y} + (1-\delta)\hat{K} - \gamma\hat{K}'$$

Appendix B: Proofs

Proof of Proposition 1

It is straightforward to see that the competitive equilibrium is efficient when $\rho = 0$, in the sense that it coincides to the solution to the following central planner recursive problem,

$$W(\hat{k}) = \max_{\hat{k}', \hat{c}^c, \hat{c}^{ej}} \lambda u(\hat{c}^c) + (1-\lambda) u(\hat{c}^e) + \beta \gamma^{1-\sigma} W(\hat{k}')$$

subject to (1) and (2), and where $0 < \lambda < 1$ is set arbitrarily but it is not a choice variable. The static problem for the central planner consists on the allocation of output net of savings between consumers and entrepreneurs. The solution to the dynamic problem is described by the policy function $\hat{k}' = g(\hat{k})$. The FOC and the envelope condition are the following,

$$\gamma u_{\hat{c}}(\hat{k}, \hat{k}') = \beta \gamma^{1-\sigma} W_{\hat{k}'}(\hat{k}') \tag{9}$$

$$W_{\hat{k}}(\hat{k}) = u_{\hat{c}}(\hat{k}, \hat{k}') \left(\alpha \hat{z} \hat{k}^{\alpha-1} + (1-\delta) \right) \tag{10}$$

where it is clear that $W(\hat{k})$ is increasing and concave on $\hat{k}$. Another property of this problem is that $g(\hat{k})$ is increasing on $\hat{k}$. To see this suppose that it is not true and $g(\hat{k})$ is decreasing on $\hat{k}$. Then $\exists\ \hat{k}_t,\ \hat{k}_\tau$ such that $\hat{k}_\tau > \hat{k}_t$ and $g(\hat{k}_\tau) < g(\hat{k}_t)$. Because $W_{\hat{k}}(\hat{k})$ is decreasing on $\hat{k}$ (by concavity and monotonicity of W), we have $W_{g(\hat{k}_\tau)}(g(\hat{k}_\tau)) > W_{g(\hat{k}_t)}(g(\hat{k}_t))$. This and (9) imply $u(\hat{k}_\tau, g(\hat{k}'_\tau)) < u(\hat{k}_t, g(\hat{k}'_t))$ and so $g(\hat{k}_t) > g(\hat{k}_\tau)$, which is a contradiction. Now it is possible to show that $d\hat{k} > 0, \forall \hat{k} < \hat{k}^{\text{ss}}$. Suppose that $\hat{k}^*$ and $\hat{k}'^*$ are part of the solution sequence, with $\hat{k}'^* = g(\hat{k}^*)$. By concavity of W we know $(\hat{k}^* - \hat{k}'^*) \left(W_{\hat{k}} - W_{\hat{k}'} \right) \leq 0$. Using (9) and (10), this expression becomes,

$$(\hat{k}^* - \hat{k}'^*) \left(\alpha \hat{z} \hat{k}^{\alpha-1} + (1-\delta) - \frac{\gamma^\sigma}{\beta} \right) \leq 0$$

Notice that in steady-state (9) and (10) imply

$$\alpha \hat{z} (\hat{k}^{\text{ss}})^{\alpha-1} + (1-\delta) = \frac{\gamma^\sigma}{\beta} \tag{11}$$

so we have

$$(\hat{k}^* - \hat{k}'^*) \left(\hat{k}^{\alpha-1} - (\hat{k}^{\text{ss}})^{\alpha-1} \right) \leq 0$$

Therefore, if $\hat{k} < \hat{k}^{\text{ss}}$, then $\hat{k} < \hat{k}'$, and so capital increases during the transition. From (1) we know output is also increasing, and so entrepreneurs' consumption is increasing as well. From the FOC for the entrepreneurs' problem, $\alpha \hat{z}^{1-\alpha} \hat{k}^{\alpha-1} = r + \delta$ and $\upsilon \hat{z}^{1-\alpha} \hat{k}^{\alpha} = \hat{w}$, we know that r is decreasing and $\hat{w}$ is increasing during the transition. These equations also imply that if the growth rate of capital decreases during the transition the same happens with output, entrepreneurs' consumption, and wages, and the opposite happens with the interest rate. Using the FOC for the consumer's problem, and (11) we get,

$$\left(\frac{\hat{c}^c}{\hat{c}^{c\prime}} \right)^{-\sigma} = \frac{\beta}{\gamma^\sigma}(1 + r') = \frac{1 + r'}{1 + r^{\text{ss}}}$$

from where we conclude, by the same argument used to prove that capital is increasing, that consumption is increasing during the transition. It also follows from this expression and the fact that the interest rate falls. that the growth rate of consumption is decreasing during the transition. Then the last step is to prove that the growth rate of capital is decreasing during the transition. In order to do this we adapt the proof in Barro and Sala-i-Martin (2004) to discrete time and decreasing returns to scale. The growth rate of $\hat{k}$ is $g_{\hat{k}} = \bar{g}_{\hat{k}}/\gamma$, where

$$\bar{g}_{\hat{k}} = \frac{\hat{y}}{\hat{k}} - \frac{\hat{c}}{\hat{k}} + (1+\gamma-\delta) = \frac{(1-\omega)\hat{y}}{\hat{k}} - \frac{\hat{c}^c}{\hat{k}} - (1+\gamma-\delta)$$

Thus it is enough to show that $\Delta(\bar{g}_{\hat{k}}) < 0$. Differentiating the expression above we get

$$\Delta(\bar{g}_{\hat{k}}) = g_{\hat{k}}(1-\omega)\left[\frac{\partial \hat{y}}{\partial \hat{k}} - \frac{\hat{y}}{\hat{k}}\right] - \frac{\hat{c}^c}{\gamma\hat{k}}\left(g_{\hat{k}} - \gamma g_{\hat{c}^c}\right)$$

or,

$$\Delta(\bar{g}_{\hat{k}}) = -g_{\hat{k}}\frac{(1-\omega)(1-\alpha)\hat{y}}{\hat{k}} + \frac{\hat{c}^c}{\gamma\hat{k}}\left[(1+r-\gamma) + \frac{\hat{w}-\hat{c}^c}{\gamma\hat{k}} - \gamma g_{\hat{c}^c}\right]$$

Define $A = (1+r) - \gamma(1+g_{\hat{c}^c})$. The only case when $\Delta(\bar{g}_{\hat{k}})$ can be positive is when the term inside the square brakets is positive. Then the rest of the proof assumes that this is the case, and so

$$\frac{\hat{c}^c}{\gamma\hat{k}} < \frac{\hat{w}}{\gamma\hat{k}} + A$$

But given this inequality, and knowing that $(1-\omega)(1-\alpha) > \upsilon$ and $\gamma > 1$, we get

$$\Delta(\bar{g}_{\hat{k}}) < -\frac{\hat{w}}{\hat{k}}(1+r-\gamma-A) + A\left[A + \frac{\hat{w}-\hat{c}^c}{\hat{k}}\right]$$

Notice that the term inside the first parenthesis is $\gamma g_{\hat{c}^c} > 0$, so, given the inequality above, only if $A > 0$ the RHS can be positive. Then assume $A > 0$ for the rest of the proof. Suppose for now that the following is true,

$$\frac{\hat{c}^c}{\hat{k}} > \left[1 + \frac{\hat{w}}{\hat{k}(1+r-\gamma)}\right]A \tag{12}$$

then,

$$\Delta(\bar{g}_{\hat{k}}) < -\frac{\hat{w}}{\hat{k}}(1+r-\gamma-A) + A^2 + \frac{A\hat{w}}{\hat{k}} - \left[1 + \frac{\hat{w}}{\hat{k}(1+r-\gamma)}\right]A^2$$

and it takes just algebra to show that

$$\Delta(\bar{g}_{\hat{k}}) < -\frac{\hat{w}}{\hat{k}(1+r-\gamma)}(\gamma g_{\hat{c}^c})^2 < 0$$

so capital grows at a decreasing rate during the transition. Then the last step is to show that expression (12) holds. First, adding the consumers' budget constraints and using the FOC for any period τ we get[24],

[24]This expression is actually an inequality, because when initial capital is included in the denominator, the RHS falls. Since we are trying to get that inequality this does not affect the proof.

$$\hat{c}^c_\tau = \frac{(1+r_\tau)^{1/\sigma}\sum_{t=\tau}^{\infty}\frac{r_t\hat{k}_\tau+\gamma^{(t-\tau)}\hat{w}_t}{\prod_{s=\tau}^{t}(1+r_s)}}{\sum_{t=\tau}^{\infty}\beta^{1/\sigma(t-\tau)}\prod_{s=\tau}^{t}(1+r_s)^{(1/\sigma-1)}}$$

It is easy to see that $\hat{c}^c_\tau$ is decreasing on r_{τ^*}, for any $\tau^* > \tau$, if $\sigma \leq 1$. If $\sigma > 1$ the denominator decreases with r_{τ^*} so it is not clear if in that case $\hat{c}^c_\tau$ is increasing or decreasing on r_{τ^*}. To see that it is decreasing take the case when $\sigma \to \infty$, which is the case when the effect of r_{τ^*} on the denominator is the largest. In that case we have

$$\hat{c}^c_\tau(\sigma \to \infty) = \frac{\sum_{t=\tau}^{\infty}\frac{r_t\hat{k}_\tau+\gamma^{(t-\tau)}\hat{w}_t}{\prod_{s=\tau}^{t}(1+r_s)}}{\sum_{t=\tau}^{\infty}\frac{1}{\prod_{s=\tau}^{t}(1+r_s)}}$$

Notice that $\Delta(r_t\hat{k}_\tau + \gamma^{(t-\tau)}\hat{w}_t) = \Delta r_t(\hat{k}_\tau - \gamma^{t-\tau}\hat{k}_t) + \gamma^{t-\tau}(\gamma-1)\hat{w}_t > 0$. Thus $\hat{c}^c_\tau$ is decreasing on r_{τ^*} for $\sigma > 1$ as well. As it is increasing on $\hat{w}$, we can replace r_t and $\hat{w}_t$ by their initial levels, r_τ and $\hat{w}_\tau$, and get the following inequality,

$$\begin{aligned}\hat{c}^c_\tau &> \frac{\sum_{t=\tau}^{\infty}\left(\frac{r_\tau\hat{k}_\tau+\gamma^{(t-\tau)}\hat{w}_\tau}{(1+r_\tau)^{t-\tau}}\right)}{\sum_{t=\tau}^{\infty}\left(\beta^{1/\sigma}(1+r_\tau)^{1/\sigma-1}\right)^{(t-\tau)}}\\ &= \left[\hat{k}_\tau + \frac{\hat{w}_\tau}{(1+r_\tau-\gamma)}\right]\left(1+r_\tau-(\beta(1+r_\tau))^{1/\sigma}\right) = \left[\hat{k}_\tau + \frac{\hat{w}_\tau}{(1+r_\tau-\gamma)}\right]A\end{aligned}$$

where the last equality follows from the consumer's FOC. This proves that (12) holds and that the growth rate of capital is decreasing during the transition.

Proof of Proposition 2

The last part of the proposition follows directly from the text, and together with the FOC for labor and the market clearing condition, they constitute a system of 3 equations in 3 unknowns $(\hat{K}, \hat{w}, \hat{C})$. There exists only one solution, and therefore there exists only one steady-state equilibrium. The value of the rest of the endogenous variables $(\hat{y}, \hat{c}^c, \hat{c}^e)$ follows from (1) and the entrepreneur's budget constraint. To show that there is a locally unique path leading to the steady-state we can approximate the dynamic behavior of the nonlinear system by the behavior of the linearized system around the steady state. Using the consumer's Euler equation and the market clearing condition, the linear approximation around the steady state is the following,

$$\begin{aligned}\begin{bmatrix}\Delta\hat{C}\\ \Delta\hat{K}\end{bmatrix} &= \begin{bmatrix}((\beta(1+r'))^{1/\sigma}/\gamma-1)\hat{C} & (\beta(1+r'))^{1/\sigma-1}(\partial r/\partial\hat{K})\hat{C}/(\sigma\gamma)\\ -1 & \alpha\hat{z}^{1-\alpha}\hat{k}^{\alpha-1}-(1+\delta-\gamma)\end{bmatrix}_{SS}\begin{bmatrix}\hat{C}-\hat{C}^{ss}\\ \hat{K}-\hat{K}^{ss}\end{bmatrix}\\ &= \begin{bmatrix}0 & -A\\ -1 & B\end{bmatrix}\begin{bmatrix}\hat{C}-\hat{C}^{ss}\\ \hat{K}-\hat{K}^{ss}\end{bmatrix}\end{aligned}$$

where, using the expression from the proposition, $B = (1/\Omega)(\gamma^\sigma/\beta-1+\delta)-(1+\delta-\gamma) \geq (\gamma^\sigma/\beta-1)+(\gamma-1) > 0$. When the constraint is not binding, $-A = \beta\alpha(\alpha-1)\hat{z}^{1-\alpha}\hat{K}^{ss\alpha-2}\hat{C}^{ss}/(\sigma\gamma^\sigma) < 0$. When it is binding the IC constraint needs to be used to compute the partial derivative. Doing this and then using the expression from the proposition to evaluate it in steady state we get $-A = -\beta\Omega\alpha\hat{z}^{1-\alpha}\hat{K}^{ss\alpha-2}\hat{C}^{ss}/(\sigma\gamma^\sigma) < 0$. Then in either case $A > 0$. After some algebra we get,

$$\hat{K}'' - (2+B)\hat{K}' + (1+B-A)\hat{K} + A\hat{K}^{ss} = 0$$

The roots of the characteristic equation are given by,

$$\lambda_i = \frac{2+B \pm \sqrt{(2+B)^2 - 4(1+B-A)}}{2}$$

Since $(2+B)^2 > 4(1+B-A)$, the two roots are real. It follows also that the larger root is larger than one, while the smaller is positive and lower than one. This means there is a locally unique path leading to the steady-state.

Proof of Proposition 3

Lemma 1. *Suppose $IC(\hat{K}') = 0$, then,*

$$\hat{K}' = \mathrm{K}(\hat{K}) \ < \ \mathrm{K}_{\rho=0}(\hat{K}),$$

where $\mathrm{K}_{\rho=0}(\hat{K})$ is the law of motion for capital assuming $\rho = 0$ in the next period only.

Proof. First notice from Proposition 2 that $\hat{K}^{\text{ss}} = \mathrm{K}(\hat{K}^{\text{ss}}) \leq \mathrm{K}_{\rho=0}(\hat{K}^{\text{ss}})$. Now suppose the statement in the lemma is not true. Then at some point $\hat{K}' = \mathrm{K}(\hat{K}) \geq \mathrm{K}_{\rho=0}(\hat{K})$. As $\hat{K}$ is given, so are $\hat{w}$ and r. But then, from the consumers' budget constraint, $\hat{c}^c \leq \hat{c}^c_{\rho=0}$. This, and the fact that $r' < r'_{\rho=0}$ implies $\hat{c}'^c < \hat{c}'^c_{\rho=0}$ in the consumer's Euler equation. Also $\hat{w}' > \hat{w}'_{\rho=0}$, and then, using the budget constraint, $\hat{K}'' = \mathrm{K}(\hat{K}') > \mathrm{K}_{\rho=0}(\hat{K}')$. Repeating the same logic we get that $\hat{K}^{\text{ss}} = \mathrm{K}(\hat{K}^{\text{ss}}) > \mathrm{K}_{\rho=0}(\hat{K}^{\text{ss}})$, which is a contradiction. ■

For the case when $\Omega = 1$ it is enough to show that $IC^{\text{PE}}(\hat{K})$ is strictly decreasing on $\hat{K}$. To show this it is enough to show that $\tilde{V}(\hat{K}, \hat{K}')$ is strictly decreasing, and $\tilde{V}^d(\hat{K}, \hat{K}')$ is strictly increasing, on $\hat{K}$. First define the sequences $\{g_t\}_{t=0}^{\infty}$ and $\{V_t\}_{t=0}^{\infty}$, where $\forall t$,

$$V_t = \sum_{s=t}^{\infty} \lambda^{s-t} \left[\prod_{h=t}^{s} g_h \right]$$

with $\lambda < 1$. Notice first that $V_{t+1} - V_t = V_{t+1}(1 - \lambda g_t) - g_t$. Now if $\{g_t\}_{t=0}^{\infty}$ is strictly increasing then

$$V_{t+1} > \sum_{s=t+1}^{\infty} \lambda^{s-t-1} g_{t+1}^{s-t} = \frac{g_t}{1 - \lambda g_t} \tag{13}$$

Therefore $V_{t+1} - V_t > 0$, and so $\{V_t\}_{t=0}^{\infty}$ is also strictly increasing. Alternatively, if $\{g_t\}_{t=0}^{\infty}$ is strictly decreasing then the inequality is the opposite in (13), and $\{V_t\}_{t=0}^{\infty}$ is also strictly decreasing. Define $g_t = 1 + g_Y$, which is strictly decreasing from Proposition 1, and $\lambda = \beta\gamma$, so $V_t = \frac{\tilde{V}(\hat{K}, \hat{K}')}{\omega}$ is strictly decreasing. Finally define $g_t = (1 + g_w)^{-\upsilon/(1-\upsilon)}$, which is strictly increasing from Proposition 1, and $\lambda = \beta\bar{\gamma}$, so $V_t = \frac{\tilde{V}^d(\hat{K}, \hat{K}')}{(1-\upsilon)}$ is strictly increasing.

When $\Omega < 1$ first we show that if $IC_t(\hat{K}_t) = 0$ then $IC_s(\hat{K}_s) = 0 \ \forall s > t$ Suppose this is not true. Then we have $IC_t(\hat{K}_t) = 0$, $IC_{t+i}(\hat{K}_{t+i}) > 0$, for $i = 1, ..., h-1$, and $IC_{t+h}(\hat{K}_{t+h}) = 0$. The last equality comes from Proposition 2. To save notation let us define $V_t = V(\hat{K}_t)$ and $V_{t+m/t} = V^d(\hat{K}_t, \hat{K}_{t+m})$. The last expression is the entrepreneur's utility at $t + m$, when he defaulted at t. Notice that

$$IC_t(\hat{K}_t) = 0 \ \rightarrow \ \frac{\beta\gamma V_{t+1} - \rho\beta\bar{\gamma} V^d_{t+1/t}}{\rho(r_t + \delta)\hat{K}_t} = 1 \ \rightarrow \ \frac{\beta\gamma V_{t+1} - \rho\beta\bar{\gamma} V^d_{t+1/t}}{\rho\alpha\hat{Y}_t} < 1$$

$$IC_{t+1}(\hat{K}_{t+1}) > 0 \;\rightarrow\; \frac{\beta\gamma V_{t+2} - \rho\beta\bar{\gamma}V^d_{t+2/t+1}}{\rho\alpha\hat{Y}_t} > 1$$

because the constraint binds in the first case, and so $(r_t+\delta)\hat{K}_t < \alpha\hat{Y}_t$, and because it does not bind in the second case. Using the fact that $\alpha\hat{Y}_{t+i} = r_{t+i}\hat{K}_{t+i}$ for $i = 1, ...h-1$, these expressions become,

$$\frac{1}{\rho\alpha}\left[\beta\gamma\omega\frac{\hat{Y}_{t+1}}{\hat{Y}_t} - \rho\beta\bar{\gamma}(1-\upsilon)\left(\frac{\hat{w}_{t+1}}{\hat{w}_t}\right)^{\frac{\upsilon}{\upsilon-1}} + (\beta\gamma)^2\omega\frac{\hat{Y}_{t+2}}{\hat{Y}_t} - \rho(\beta\bar{\gamma})^2(1-\upsilon)\left(\frac{\hat{w}_{t+2}}{\hat{w}_t}\right)^{\frac{\upsilon}{\upsilon-1}} + \right.$$
$$\left. ... + (\beta\gamma)^{h-2}\frac{V_{t+h-1}}{\hat{Y}_t} - \rho(\beta\bar{\gamma})^{h-2}\frac{V_{t+h-1/t}}{\hat{Y}_t}\right] < 1 \tag{14}$$

$$\frac{1}{\rho\alpha}\left[\beta\gamma\omega\frac{\hat{Y}_{t+2}}{\hat{Y}_{t+1}} - \rho\beta\bar{\gamma}(1-\upsilon)\left(\frac{\hat{w}_{t+2}}{\hat{w}_{t+1}}\right)^{\frac{\upsilon}{\upsilon-1}} + (\beta\gamma)^2\omega\frac{\hat{Y}_{t+3}}{\hat{Y}_{t+1}} - \rho(\beta\bar{\gamma})^2(1-\upsilon)\left(\frac{\hat{w}_{t+3}}{\hat{w}_{t+1}}\right)^{\frac{\upsilon}{\upsilon-1}} + \right.$$
$$\left. ... + (\beta\gamma)^{h-2}\frac{V_{t+h}}{\hat{Y}_{t+1}} - \rho(\beta\bar{\gamma})^{h-2}\frac{V_{t+h/t+1}}{\hat{Y}_{t+1}}\right] > 1 \tag{15}$$

Since the constraint is not binding we can use the argument used for the case when $\Omega = 1$ to show that each of the first $h-1$ terms in the first expression is greater than the corresponding term in the second expression. Then,

$$\frac{(\beta\gamma)^{h-2}V_{t+h-1} - \rho(\beta\bar{\gamma})^{h-2}V_{t+h-1/t}}{(\beta\gamma)^{h-2}V_{t+h} - \rho(\beta\bar{\gamma})^{h-2}V_{t+h/t+1}} < \frac{\hat{Y}_t}{\hat{Y}_{t+1}} < \frac{\hat{Y}_{t+h-1}}{\hat{Y}_{t+h}}$$

where the last inequality follows from Proposition 1 and Lemma 1. Then we have,

$$m_1 = \frac{(\beta\gamma)^{h-2}V_{t+h-1} - \rho(\beta\bar{\gamma})^{h-2}V_{t+h-1/t}}{\hat{Y}_{t+h-1}} < \frac{(\beta\gamma)^{h-2}V_{t+h} - \rho(\beta\bar{\gamma})^{h-2}V_{t+h/t+1}}{\hat{Y}_{t+h}} = m_2$$

Now define the following expressions,

$$A_1 = \rho(\beta\bar{\gamma})^{h-1}\left[\frac{V^d_{t+h/t+h-1} - V^d_{t+h/t}}{\hat{Y}_{t+h-1}}\right] > 0$$

$$A_2 = \rho(\beta\bar{\gamma})^{h-1}\left[\frac{V^d_{t+h+1/t+h} - V^d_{t+h+1/t+1}}{\hat{Y}_{t+h}}\right] > 0$$

Suppose for now that $A_1 > A_2$, so $m_1 - A_1 < m_2 - A_2$. Since $\gamma > \bar{\gamma}$,

$$m_1 - A_1 > (\beta\gamma)^{h-2}\omega - \frac{\rho(\beta\bar{\gamma})^{h-2}\hat{z}\hat{K}^\alpha_t n^\upsilon_{t+h-1}}{\hat{Y}_{t+h-1}} + \frac{(\beta\gamma)^{h-2}\left(\beta\gamma V_{t+h} - \rho\beta\bar{\gamma}V^d_{t+h/t+h-1}\right)}{\hat{Y}_{t+h-1}}$$

For m_2 we have,

$$m_2 - A_2 = \frac{(\beta\gamma)^{h-2}\left((1-\upsilon)\hat{Y}_{t+h} - (r_{t+h}+\delta)\hat{K}_{t+h}\right) - \rho(\beta\bar{\gamma})^{h-2}\hat{z}\hat{K}^\alpha_{t+1}n^\upsilon_{t+h} + (\beta\gamma)^{h-1}V_{t+h+1} - \rho(\beta\bar{\gamma})^{h-1}V^d_{t+h+1/t+h}}{\hat{Y}_{t+h}}$$

Using again $\gamma > \bar{\gamma}$, and also that $\alpha\hat{Y}_{t+h} = (r_{t+h}+\delta)\hat{K}_{t+h} = (\beta\gamma V_{t+h+1} - \rho\beta\bar{\gamma}V^d_{t+h+1/t+h})/\rho$ because $t+h$ is the first period when $IC(\hat{K}) = 0$,

$$m_2 - A_2 > (\beta\gamma)^{h-2}(1-\upsilon) - \rho\alpha(\beta\gamma)^{h-2}\left(\frac{1}{\rho} - 1\right) - \frac{\rho(\beta\bar{\gamma})^{h-2}\hat{z}\hat{K}^\alpha_{t+1}n^\upsilon_{t+h}}{\hat{Y}_{t+1}}$$

Notice that in the last expressions n is different from one, and depends on current wages and the stock of capital the entrepreneur kept when defaulted. Because $m_1 - A_1 < m_2 - A_2$, we have

$$\frac{\left(\beta\gamma V_{t+h} - \rho\beta\gamma V^d_{t+h/t+h-1}\right)}{\alpha\rho\hat{Y}_{t+h-1}} < 1 + \frac{1}{\alpha}\left(\frac{\bar{\gamma}}{\gamma}\right)^{h-2}\left(\frac{\hat{z}\hat{K}_t^{\alpha} n^{\upsilon}_{t+h-1}}{\hat{Y}_{t+h-1}} - \frac{\hat{z}\hat{K}^{\alpha}_{t+1} n^{\upsilon}_{t+h}}{\hat{Y}_{t+h}}\right) < 1$$

where the last inequality follows from the fact that Proposition 1 and Lemma 1 imply, when using the optimal demand for labor,

$$\frac{\hat{z}\hat{K}_t^{\alpha} n^{\upsilon}_{t+h-1}}{\hat{Y}_{t+h-1}} - \frac{\hat{z}\hat{K}^{\alpha}_{t+1} n^{\upsilon}_{t+h}}{\hat{Y}_{t+h}} = \left(\frac{\hat{Y}_t}{\hat{Y}_{t+h-1}}\right)^{\frac{1}{1-\upsilon}} - \left(\frac{\hat{Y}_{t+1}}{\hat{Y}_{t+h}}\right)^{\frac{1}{1-\upsilon}} < 0.$$

But this contradicts $IC_{t+h-1}(\hat{K}_{t+h-1}) > 0$, so if $IC_t(\hat{K}_t) = 0$ then $IC_s(\hat{K}_s) = 0\ \forall s > t$. Therefore to get this contradiction we need to show $A_1 > A_2$, or $(A_1 - A_2)/(\beta\bar{\gamma})^{h-1} > 0$. Using the optimal demand for labor we have,

$$\begin{aligned}
\frac{A_1 - A_2}{(\beta\bar{\gamma})^{h-1}} &= \left(\frac{\hat{Y}_{t+h-1}^{\frac{\upsilon}{1-\upsilon}} - \hat{Y}_t^{\frac{\upsilon}{1-\upsilon}}}{\hat{Y}_{t+h-1}}\right)\left(\hat{Y}_{t+h}^{\frac{-1}{1-\upsilon}} + \beta\bar{\gamma}\textstyle\sum_{s=0}^{\infty}(\beta\bar{\gamma})^s\hat{Y}_{t+h+1+s}^{\frac{-1}{1-\upsilon}}\right) - \left(\frac{\hat{Y}_{t+h}^{\frac{\upsilon}{1-\upsilon}} - \hat{Y}_{t+1}^{\frac{\upsilon}{1-\upsilon}}}{\hat{Y}_{t+h}}\right)\textstyle\sum_{s=0}^{\infty}(\beta\bar{\gamma})^s\hat{Y}_{t+h+1+s}^{\frac{-1}{1-\upsilon}} \\
&> \left(\frac{\hat{Y}_{t+h}^{\frac{\upsilon}{1-\upsilon}} - \hat{Y}_{t+1}^{\frac{\upsilon}{1-\upsilon}}}{\hat{Y}_{t+h}}\right)\left(\hat{Y}_{t+h}^{\frac{-1}{1-\upsilon}} - (1-\beta\bar{\gamma})\textstyle\sum_{s=0}^{\infty}(\beta\bar{\gamma})^s\hat{Y}_{t+h+1+s}^{\frac{-1}{1-\upsilon}}\right) \\
&> \left(\frac{\hat{Y}_{t+h}^{\frac{\upsilon}{1-\upsilon}} - \hat{Y}_{t+1}^{\frac{\upsilon}{1-\upsilon}}}{\hat{Y}_{t+h}}\right)\left(\hat{Y}_{t+h}^{\frac{-1}{1-\upsilon}} - \hat{Y}_{t+h+1}^{\frac{-1}{1-\upsilon}}\right) > 0
\end{aligned}$$

where the first inequality follows from Proposition 1 and Lemma 1.

Now it is left to show $\hat{K}^* > 0$. Take the limit of $IC(\hat{K})$ when $\hat{K}$ goes to zero. The only term that does not converge to zero, independently of ρ, is $V(\hat{K}, \hat{K}')$ because of Proposition 2. It follows that $\forall\rho \in [0, 1]$, $lim_{\hat{K}\to 0} IC(\hat{K}) > 0$. Then it is not the case that the constraint is always binding, implying the existence of $\hat{K}^*$ and the statement in the proposition.

Proof of Proposition 4

Suppose $\hat{K}_t > \mathbf{K}_t$ if $\hat{K}_t \le K^*$. Then, by Proposition 2 and Lemma 1, we know $\exists! s$ where $\hat{K}_s = \hat{\mathbf{K}}_s$ and $\hat{K}_s > K^*$. Call this level $\hat{K}^{**}$. Thus it is enough to show that $\hat{K}_t > \hat{\mathbf{K}}_t$ if $\hat{K}_t \le K^*$. Since the constraint is not binding when $\hat{K}_t \le K^*$, remember that $(r_t + \delta) = \alpha\hat{Y}_t/\hat{K}_t$. Suppose $\hat{C}^c_0 \ge \hat{\mathbf{C}}^c_0$, since $\hat{K}_0 = \hat{\mathbf{K}}_0$, from the market clearing condition we have $\hat{K}_1 \le \hat{\mathbf{K}}_1$. But then $r_1 \ge \mathbf{r}_1$, implying using the consumers' Euler equation, $\hat{C}^c_1 \ge \hat{\mathbf{C}}^c_1$ (and $\hat{C}^c_1/\hat{C}^c_0 \ge \hat{\mathbf{C}}^c_1/\hat{\mathbf{C}}^c_0$). Repeating this argument we obtain $\hat{K}^* \le \hat{\mathbf{K}}^*$ and $\hat{C}^{*c}/\hat{C}^{*c}_{-1} \ge \hat{\mathbf{C}}^{*c}/\hat{\mathbf{C}}^{*c}_{-1}$. But we need $r^* < \mathbf{r}^*$ to have $IC(\hat{K}^*) = 0$, implying, using the consumers' Euler equation that $\hat{C}^{*c}/\hat{C}^{*c}_{-1} < \hat{\mathbf{C}}^{*c}/\hat{\mathbf{C}}^{*c}_{-1}$, which is a contradiction. The only possibility is then $\hat{C}^c_0 < \hat{\mathbf{C}}^c_0$, when, using the same argument above, $\hat{K}_t > \hat{\mathbf{K}}_t$ if $\hat{K}_t \le K^*$.

Appendix C: Sample

		Former Colony	Enforcement Efficiency	Legal Formalism	Constraints on Executive	ICRG Index	English LO	Pop. Density in 1500	Settler Mortality	Urbanization in 1500	Fraction-alization	Latitude	GDP pc 2006	GDP pc 1950
1	Argentina	√	3.58	5.40	5.47	6.43	0	0.11	3.58	0	0.18	0.38	9.18	8.51
2	Australia	√	4.48	1.80	7	8.35	1	0.03	4.48	0	0.11	0.30	10.10	8.91
3	Austria		4.36	3.52	7	8.13	0		4.36		0.03	0.52	10.04	8.22
4	Bangladesh	√		3.24	4.82	4.95	1	23.70		8.5	0.00	0.27	6.95	6.29
5	Belgium		4.51	2.73	7	8.01	0		4.51		0.36	0.56	10.04	8.61
6	Bolivia	√		5.75	7	5.48	0	0.83		10.6	0.60	0.19	7.93	7.56
7	Botswana	√	4.24	4.08	6.59	7.65	1	0.14	4.24		0.38	0.24	8.44	5.85
8	Brazil	√	2.60	3.06	6	6.36	0	0.12	2.60	0	0.06	0.11	8.71	7.42
9	Bulgaria		3.83	4.57	7	6.82	0		3.83		0.12	0.48	8.96	7.41
10	Canada	√	4.53	2.09	7	8.11	1	0.02	4.53	0	0.38	0.67	10.13	8.89
11	Chile	√	3.71	4.57	7	7.80	0	0.80	3.71	0	0.05	0.33	9.43	8.21
12	China		3.78	3.41	3	6.93	0		3.78		0.23	0.39	8.71	6.10
13	Colombia	√	4.17	4.11	6.24	5.54	0	0.96	4.17	7.9	0.06	0.04	8.69	7.67
14	Costa Rica	√	3.22	5.48	7	6.79	0	1.54	3.22	9.2	0.05	0.11	8.92	7.58
15	Cte d'Ivoire	√		3.65	3	4.09	0	4.23			0.86	0.09	7.00	6.95
16	Denmark		4.34	2.55	7	8.09	0		4.34		0.03	0.62	10.11	8.85
17	Dom. Rep.	√	2.56	4.08	5.65	6.26	0	1.46	2.56	3	0.01	0.21	8.30	6.93
18	Ecuador	√	2.97	4.92	6.59	5.60	0	2.17	2.97	10.6	0.33	0.02	8.23	7.53
19	Egypt	√	3.35	3.79	3	6.23	0	100.46	3.35	14.6	0.02	0.30	8.12	6.81
20	El Salvador	√	3.63	4.60	5	6.39	0	1.54	3.63	9.2	0.05	0.15	7.95	7.31
21	Finland		4.53	3.14	7	8.74	0		4.53		0.11	0.71	10.05	8.36
22	France		3.99	3.23	6	7.39	0		3.99		0.15	0.51	10.00	8.55
23	Germany		4.04	3.51	7	7.65	0		4.04		0.04	0.57	9.91	8.26
24	Ghana	√		2.65	4.31	6.56	1	4.23			0.71	0.09	7.32	7.02
25	Greece		3.99	3.99	7	7.29	0		3.99		0.08	0.43	9.64	7.56
26	Guatemala	√	3.60	5.68	4.94	6.37	0	1.54	3.60	9.2	0.48	0.17	8.35	7.64
27	Honduras	√	3.61	4.90	5	5.77	0	1.54	3.61	9.2	0.10	0.17	7.69	7.18
28	Hong Kong	√	4.48	0.73	0	7.78	1	0.09	4.48	3	0.24	0.25	10.29	7.70
29	Hungary		3.84	3.42	7	7.65	0		3.84		0.07	0.52	9.14	7.82
30	India	√		3.34	7	6.12	1	23.70		8.5	0.74	0.22	7.87	6.43
31	Indonesia	√	3.22	3.90	3.94	5.37	0	4.28	3.22	7.3	0.69	0.06	8.30	6.69
32	Ireland		4.50	2.63	7	8.51	1		4.50		0.09	0.59	10.23	8.15
33	Israel		4.19	3.30	7	6.35	1		4.19		0.33	0.35	9.74	7.94
34	Italy		3.81	4.04	7	7.44	0		3.81		0.04	0.47	9.89	8.16
35	Jamaica	√	4.23	2.34	7	6.91	1	4.62	4.23	3	0.01	0.20	8.25	7.19
36	Japan		4.56	2.98	7	7.88	1		4.56		0.01	0.40	10.02	7.56
37	Jordan		3.80	3.52	3	7.11	0		3.80		0.03	0.34	8.54	7.42
38	Kenya	√		3.09	3.88	5.58	1	2.64			0.83	0.01	6.97	6.48
39	Korea		4.48	3.37	6	7.12	1		4.48		0.00	0.41	9.82	6.75
40	Malawi	√		2.95	4.12	5.65	1	0.79			0.62	0.15	6.48	5.78
41	Malaysia	√	3.88	2.34	4.29	7.48	1	1.22	3.88	7.3	0.61	0.03	9.17	7.35
42	Mexico	√	4.28	4.71	5.06	7.07	0	2.62	4.28	14.8	0.17	0.26	8.96	7.77
43	Morocco	√	3.74	4.71	2.88	6.95	0	9.08	3.74	17.8	0.35	0.36	8.10	7.28
44	Namibia	√	3.81	3.82	5	7.50	1	0.14	3.81		0.73	0.24	8.36	7.68
45	Netherlands		4.55	3.07	7	8.16	0		4.55		0.06	0.58	10.07	8.70
46	New Zealand	√	4.51	1.58	7	8.47	1	0.37	4.51	3	0.15	0.46	9.82	9.04
47	Nigeria	√		3.19	3	4.47	1	4.23			0.86	0.11	7.24	6.62
48	Norway		4.52	2.95	7	8.31	0		4.52		0.07	0.69	10.24	8.60
49	Pakistan	√		3.76	4.35	4.72	1	23.70		8.5	0.62	0.33	7.68	6.47
50	Panama	√	3.76	5.84	6	7.25	0	1.54	3.76	9.2	0.19	0.10	8.72	7.56
51	Paraguay	√	2.53	5.91	6.47	5.65	0	0.50	2.53	0	0.41	0.26	8.03	7.37
52	Peru	√	3.73	5.60	4.94	5.91	0	1.56	3.73	10.5	0.43	0.11	8.44	7.74
53	Philippines	√	2.86	5.00	6.12	6.19	0	1.68	2.86	3	0.72	0.14	7.92	6.98
54	Poland		4.22	4.15	6.59	6.98	0		4.22		0.04	0.58	9.11	7.80
55	Portugal		4.41	3.93	7	7.84	0		4.41		0.00	0.44	9.57	7.64
56	Romania		2.40	4.42	5.82	6.79	0		2.40		0.12	0.51	8.38	7.07
57	Senegal	√		4.72	4.24	5.96	0	4.23			0.78	0.16	7.27	7.14
58	Singapore	√	4.57	2.50	3	8.11	1	0.09	4.57	3	0.32	0.01	10.18	7.70
59	South Africa	√	3.68	1.68	7	6.90	1	0.49	3.68		0.83	0.32	8.41	7.84
60	Spain		4.41	5.25	7	7.57	0		4.41		0.27	0.44	9.85	7.69

		Former Colony	Enforcement Efficiency	Legal Formalism	Constraints on Executive	ICRG Index	English LO	Pop. Density in 1500	Settler Mortality	Urbanization in 1500	Fraction-alization	Latitude	GDP pc 2006	GDP pc 1950
61	Sri Lanka	√	3.82	3.78	5.12	5.11	1	15.47	3.82	8.5	0.33	0.08	8.39	7.13
62	Sweden		4.45	2.98	7	8.52	0		4.45		0.07	0.69	10.08	8.82
63	Switzerland		4.10	3.13	7	8.56	0		4.10		0.31	0.52	10.09	9.11
64	Taiwan		4.54	2.37	5.53	7.46	0		4.54		0.26	0.26	9.90	6.83
65	Thailand		4.01	3.14	6.29	6.51	1		4.01		0.36	0.17	9.02	6.71
66	Tunisia	√	4.04	4.05	2.71	7.19	0	11.70	4.04	12.3	0.07	0.38	8.63	7.02
67	Turkey		1.89	2.53	7	6.72	0		1.89		0.16	0.43	8.97	7.39
68	Uganda	√		2.61	2.65	5.48	1	7.51			0.84	0.01	6.82	6.53
69	UK		4.53	2.58	7	7.81	1		4.53		0.11	0.60	10.05	8.84
70	US	√	4.45	2.62	7	7.66	1	0.09	4.45	0	0.21	0.42	10.34	9.17
71	Uruguay	√	3.35	4.05	7	7.18	0	0.11	3.35	0	0.07	0.37	9.05	8.45
72	Venezuela	√	2.57	6.01	5.47	5.14	0	0.44	2.57	0	0.05	0.09	9.17	8.92
73	Zambia	√		2.13	4.76	6.02	1	0.79			0.83	0.17	6.65	6.49
74	Zimbabwe	√		3.11	2.65	4.16	1	0.79			0.60	0.22	6.87	6.55
75	Mozambique	√		4.49	3.76	6.58	0	1.28			0.79	0.20	7.58	7.03
76	Vietnam	√		3.25	3	6.74	0	6.14		0	0.12	0.23	7.87	6.49

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