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# Collateral Constraints and Legal Protection of Lenders: A Macroeconomic Perspective

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## Abstract

We identify countries that establish collateral-based lending systems with a small-open-economy version of Nobuhiro Kiyotaki and John Moore's (1997) model. We find that 47 countries in 1980s and 48 countries in 1990s out of 98 countries establish collateral-based lending systems. We also investigate the origin of collateral-based lending systems and find that if a country offers good legal protection for lenders, then a collateral-based lending system is more likely to be embedded in that country.

**Keywords:** Credit constraints; Collateral-based lending; Legal protection of lenders; Kiyotaki-Moore model.

**JEL Classification Numbers:** E10; E51; F41; K10

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# 1 Introduction

Collateral-based lending systems seem prevalent in most countries. However, it is not obvious whether it is actually embedded in all countries. It is important to investigate whether a collateral-based lending system functions in an economy because many researchers often presume collateral constraints when studying business cycles or economic growth.

The importance of credit market imperfections in understanding macroeconomic phenomena has been emphasized ever since the seminal paper by Ben Bernanke and Mark Gertler (1989).<sup>1</sup> More recently, a large number of articles have attempted to address topics in financial crises, in which credit market imperfections play an important role. However, if collateral-based lending is not embedded in an economy, one will be at a risk of deriving inadequate policy implications from models with collateral constraints.

To the best of our knowledge, however, few studies have focused on the fundamental question concerning which countries establish collateral-based lending systems in their financial sectors, although, as cited below, there are some articles that investigate lending systems in specific countries. One of the objectives of this paper is to detect countries that establish collateral-based lending systems with only macroeconomic data.<sup>2</sup> We also address

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<sup>1</sup>Typical examples of empirical studies on finance and growth include Robert G. King and Ross Levine (1993), Ross Levine, Norman Loayza, and Thorsten Beck (2000), and Phillepe Aghion, Peter Howitt, and David Mayer-Foulkes (2005). See also Jeremy Greenwood and Boyan Jovanovic (1990), Oded Galor and Joseph Zeira (1993), Jeremy Greenwood and Bruce D. Smith (1997), and Phillepe Aghion, Peter Howitt, and David Mayer-Foulkes (2005) for the theoretical literature on finance and growth. For business cycles and credit market imperfections, see Nobuhiro Kiyotaki and John Moore (1997) and Kiminori Matsuyama (2007) among others. For financial market globalization and credit market imperfections, see Matsuyama (2004). Matsuyama (2008) provides a clear review of the macroeconomic implications of credit market imperfections.

<sup>2</sup>The role of collateral has been investigated both theoretically and empirically in the literature on banking. Theoretically, it has been demonstrated that the problems of adverse selection and moral hazard are mitigated by collateral. See Helmut Bester (1985, 1994) and Arnoud W.A. Boot, Anjan V. Thakor, and Gregory F. Udell (1991) among others. Moreover, Michael Manove, A Jorge Padilla, and Marco Pagano (2001) show that collateral is a substitute for screening and monitoring efforts of creditors, whereas Stanley D. Longhofer and Joao A.C. Santos (2000) demonstrate that it is a complement to them. Empirically, the role of collateral in relationship lending has been extensively studied. For surveys of recent research on relationship lending, see Arnoud W.A. Boot (2000) and Elyas Elyasiani and Lawrence G. Goldberg (2004). Evidence for the role of collateral in relationship lending is mixed. For instance, a negative relationship of collateral with relationship lending is found by Allen N. Berger and Gregory F. Udell (1995), Dietmar Harhoff and Timm Körting (1998), Ivan E. Brick and Darius Palia (2007), and Gabriel Jiménez, Vicente Salas, and Jesus Saurina (2006), whereas a positive relationship is demonstrated by

a question about the origin of collateral-based lending. In particular, we demonstrate that the legal protection of lenders promotes the establishment of a collateral-based lending system.

By a “collateral-based lending system,” we mean a system in which collateral holding is a requirement for borrowers to access credit in the financial market. In the literature on banking, researchers have investigated lending systems in specific countries with microeconomic data. For example, in the United States, where the financial sector is fully developed, most agents can access credit, even if they do not hold collateral, whereas some agents are prevented from accessing credit for other reasons. Robert E. Hall and Frederic S. Mishkin (1982) and Tullio Jappelli (1990) estimate that approximately 20 percent of the United States consumers are credit-constrained. According to the 1983 Survey of Consumer Finances, only 8.6 percent of the rejected applicants for credit were rejected because they had insufficient assets as collateral. The rest of the rejected applicants were rejected for other reasons.<sup>3</sup>

According to research on Italy’s lending system by Daniela Fabbri and Mario Padula (2004), whether households hold sufficient collateral does not matter for their obtaining credit from financial intermediaries.<sup>4</sup> This means that even though households hold sufficient collateral, they cannot easily acquire credit from financial intermediaries. Whether they can access credit depends upon the legal enforceability of each judicial district in Italy.

A further example is “related lending” in Mexico, which has been investigated by Rafael La Porta, Florencio López-de-Silanes, and Guillermo Zamarripa (2003). According to their research, due to the privatization of government-owned commercial banks from the late 1980s to the early 1990s, banks were obtained by local families that already controlled industrial firms. In Mexico, related lending was unregulated in 1990s, and during this time, banks owned by local families largely loaned to their related parties with lower collateral requirements compared to unrelated parties. This lending behavior weakens a collateral lending system.

From these studies, we predict that collateral lending systems are not established in the United States, Italy, or Mexico. Indeed, our estimation

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Hans Degryse and Patrick Van Cayseele (2000) and Arito Ono and Ichiro Uesugi (2009). In this paper, we do not address a question about the role of collateral at a microeconomic level. Our perspective is macroeconomic, and again our objective is to search out countries with collateral-based lending systems comprehensively.

<sup>3</sup>For a summary of the survey, see table 1 of Tullio Jappelli (1990).

<sup>4</sup>See table 3 of Daniela Fabbri and Mario Padula (2004).

results are consistent with this prediction.

By contrast, collateral-based lending systems seem to be used in Costa Rica and Japan. As demonstrated by Alexander Monge-Naranjo, Javier Cascante, and Luis J. Hall (2001), borrowers' collateral holding is one of the most important criteria when they are granted loans by financial intermediaries. Their paper reports that Costa Rica's financial sector establishes a collateral-based lending system. Likewise, there is much evidence of Japan's banking sector that, as long as borrowers held land as collateral, they could access credit in the 1980s and 1990s. According to Mitsuhiro Fukao (2003), due to the deregulation of a financial sector in Japan since the mid-1980s, large listed companies gradually shifted their financial resources from banks to the capital markets. As a result, banks were urged to find a new market, and most banks commenced real estate lending, where their judgments on investment projects associated with loans relied exclusively on whether borrowers held collateral with little attention to the cash flow of the investment projects. Fukao's research tells us that Japan's lending system seems to have gradually shifted toward collateral-based lending since the mid 1980s. Moreover, Arito Ono and Ichiro Uesugi (2009) provide evidence from Japan's small and medium-sized enterprise market that more than 70% of the investigated firms pledge collateral. These observations from the cases of Costa Rica and Japan are consistent with our estimation results.

One additional example is the case of Thailand's lending system. Lukas Menkhoff, Doris Neuberger, and Chodechai Suwanaporn (2006) provide evidence that collateral-based lending is prevalent in Thailand and conclude that collateral seems to be more important in an emerging market than in a developed one. Chutatong Charumilind, Raja Kali, and Yupana Wiwattanakantang (2006) reveal not only relationship lending but also collateral-based lending in long-term loan contracts in Thailand before the financial crisis in 1997. Firms that had close relationships with banks needed much less collateral to obtain long-term loans than those without such relationships. The practice of relationship lending weakened the collateral lending system, as in the case of Mexico. Nevertheless, we find from their examination that the collateral-based lending system functioned steadily before the crisis.<sup>5</sup> These microeconomic findings are also consistent with our findings.

While using microeconomic data, as was performed in the studies cited above, seems suitable for addressing our questions, we incur a great cost to examine many countries with microeconomic data for each country. In this

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<sup>5</sup>See tables 4 and 5 of Charumilind, Kali, and Wiwattanakantang (2006).

paper, we develop a dynamic general equilibrium model following Kenneth Kasa (1998) and Takuma Kunieda and Akihisa Shibata (2005), which is a small-open-economy version of Nobuhiro Kiyotaki and John Moore's (1997) model (KM model, henceforth) to test whether a collateral-based lending system is established in a country with only macroeconomic data. To address our questions, we first derive a closed-form solution for the current account dynamics associated with private credit. The KM model is suitable for investigating whether a collateral-based lending system is established in a country because in their model, potential borrowers can access credit in the financial market only when they hold collateral. In other words, if the KM model is statistically rejected in a country, then we judge that collateral-based lending is not a major lending system in that country.

We presume that an answer to the second question about the origin of collateral-based lending is in the rule of law. The relationship of the rule of law with the development of financial sectors has been investigated in the extensive literature since the pioneering work of Rafael La Porta, Florencio López-de-Silanes, Andrei Shleifer, and Robert W. Vishny (1997, 1998).<sup>6</sup> According to these authors, the development of a country's financial market is restricted by the degree of legal protection of outside investors. If laws are protective of lenders, they are willing to lend borrowers and thus, the development of the financial sector is promoted. Meanwhile, if laws are not protective of lenders, the financial sector is stagnant. They demonstrate that historical legal origins account for the contemporary structure of laws and financial development. However, this literature has not focused on the relationship between the type of the lending system and the degree of the legal protection of lenders. Our research sheds light on this point.

We experiment on 98 countries. We find that collateral-based lending systems are established in approximately half of the estimated countries and that countries with good legal protection of lenders are more likely to establish collateral-based lending systems.

This paper proceeds as follows. In the next section, we provide a theoretical ground for our empirical study. In section 3, we describe the data for our estimation. In section 4, we compare the estimation results of the United States and Japan, and in section 5 we show the estimation results for the other countries. In section 6, we study the origin of collateral-based lending. Section 7 contains our concluding remarks.

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<sup>6</sup>For this literature, see Rafael La Porta, Florencio López-de-Silanes, and Andrei Shleifer (2008).

## 2 Theoretical Ground

In the appendix, we obtain a closed-form solution for the current account dynamics associated with private credit by following Kasa (1998) and Kuniieda and Shibata (2005). The closed-form solution for the current account dynamics around the steady state of the economy is given by:

$$CA_t = \beta R CA_{t-1} + \beta \Delta Z_t - (1 - \beta) \Psi \lambda \hat{x} \Delta PC_{t-1}, \quad (1)$$

where  $CA$ ,  $PC$ , and  $\hat{x}$  are the current account, private credit, and land held by borrowers in the steady-state, respectively.  $Z$  is a so-called net output, which is defined by the output minus the sum of investment and government expenditure, and  $\Delta$  stands for the first difference in the variable.  $\lambda$  is the proportion of collaterally constrained agents, and  $\Psi$  is a constant defined in the appendix. The parameters,  $\beta$  and  $R$ , are the subjective discount factor and the world interest rate, respectively. See the appendix for more details.

If there are collaterally constrained agents, then it follows that  $\lambda > 0$  in Eq.(1). Intuitively, production resources are allocated inefficiently if agents in the economy are collaterally constrained. In particular, the land is less allocated to borrowers and more allocated to savers in our model compared to the case in which a credit market is perfect. In this situation, if the collateral constraint is relaxed at time  $t - 1$  due to an anticipation of an increase in the land price, then constrained borrowers raise their borrowing and investment in land. Accordingly, production inefficiency is corrected and the aggregate production in the whole economy will increase at time  $t$ . The increase in production leads to an increase in total savings in the whole economy, which positively affects the current account. The term  $\beta \Delta Z_t$  in Eq.(1) reflects this effect.

The reallocation of land from unconstrained agents to constrained agents does not affect the consumption behavior of unconstrained agents. This is because their investment in the land market and savings in the credit market are perfect substitutes in their consumption smoothing. Therefore, the Euler equation of an unconstrained agent, Eq.(12), in the appendix, is not subject to the land price. This means that, without technological shocks which affect the agents' permanent income, the reallocation of land does not affect the consumption of the unconstrained agents.

By contrast, the consumption behavior of constrained agents is affected by the land price, as observed with Eq.(16) in the appendix. As the land price increases, each constrained agent's consumption increases as well. Due

to credit constraints, their investment in the land market and saving in the credit market are not perfect substitutes for them. It is better for them to raise borrowing and invest more in land because their marginal revenue involving an increase in the land price is greater than the market interest rate. Then, their consumption smoothing is subject to the land price, even though technological shocks, which affect the agents' permanent income, do not occur. Accordingly, the aggregate consumption in the whole economy goes up as the land price increases. This phenomenon is reflected in the third term of Eq.(1), which negatively affects the current account.

If there are no collaterally constrained agents, then it follows that  $\lambda = 0$  in Eq.(1). We statistically examine whether  $\lambda = 0$  or not, where the null hypothesis is  $\lambda = 0$  and the alternative hypothesis is  $\lambda > 0$ . If we cannot reject the null hypothesis for a country under a reasonable size of the test, we infer that a theoretical model with collateral constraints cannot be applied to the country and thus a collateral-based lending system is not established in the country, whereas if we reject the null hypothesis, we think of the country as being collaterally constrained.

While we basically use Eq.(1) to examine the hypothesis, we have two additional estimable equations. The first is Eq.(34) in the appendix, which is inserted below:

$$\Delta q_{t+1} = \Psi \Delta PC_t. \quad (2)$$

This equation is used as the first test of the existence of collateral-based lending if the land price is observable. If there are no collaterally constrained borrowers, Eq.(2) does not hold and there is thus no direct relationship between the first difference in the land price and the lagged first difference in private credit.

The second equation is Eq.(23) in the appendix, which is rewritten as follows:

$$CA_t = \beta R CA_{t-1} + \beta \Delta Z_t - (1 - \beta) \lambda \hat{x} \Delta q_t, \quad (3)$$

where  $q_t$  is the land price. In these equations, if  $\lambda = 0$ , the coefficients of  $\Delta q_t$  are equal to zero. As long as we obtain the data for land prices, we can statistically examine the significance of the coefficient of  $\Delta q_t$ . If the null hypothesis of  $\lambda = 0$  is rejected in a country, we conclude that a collateral-based lending system is established in the country.

If we observe land prices, we can use Eqs.(2) and (3).<sup>7</sup> However, the number of countries for which the data for land prices are available is limited.

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<sup>7</sup>One might argue that there are assets that can be collateral other than land. For



Moreover, the data for private credit are available in most countries. In addition, the quality of the data for land prices is not high. If we try to assemble the data for land prices, we can hardly avoid using “the house price index” as a proxy for a land price in most countries. By contrast, we can collect accurate (or at least, more accurate than land prices) data for private credit. Therefore, a closed-form solution for the current account associated with private credit is fascinating to us when examining our model. In this paper, we will use the two estimable equations (2) and (3) for two countries in particular, the United States and Japan, to see their contrasting outcomes.

The other question of our paper concerns the origin of collateral-based lending. We presume that the answer to this question is in the rule of law. By empirically estimating Eq.(1), we judge whether a collateral-based lending system is established in a country and create an index to which a 1 is assigned if a collateral-based lending system is present and a 0 otherwise. The index is regressed on the measure of legal protection and other control variables to determine whether legal protection is the origin of collateral-based lending.

### 3 Data

Depending upon data availability, we prepared an annual dataset of 98 countries. In the process of data gathering, we eliminated countries for which we could not observe data points for at least 19 years. In the second column of table A2 in the online appendix, the estimation period for each country is entered, where the maximum and minimum numbers of observations are forty-six and eighteen, respectively.<sup>89</sup>

To obtain the data for the current account,  $CA$ , and the net output,  $Z$ , we assembled the gross national product (GNP), the gross domestic product (GDP), aggregate consumption, aggregate investment, government expenditure, exports, and imports from the database of International Financial Statistics, which was created by the International Monetary Fund. All these

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instance, asset-based lending to small firms associated with inventories is becoming popular in the United States. Nevertheless, we use only land prices to examine Eqs. (2) and (3) because we believe that land is still common collateral in a collateral-based lending system.

<sup>8</sup>Note that the lagged current account is incorporated in the estimation equation. That is why our minimum number of observations is eighteen and not nineteen.

<sup>9</sup>For some eurozone countries, we gave up using the data from approximately 1999 onward to avoid the risk of data discontinuity. There are missing data points of private credit around those years and the database of International Financial Statistics arranges the data points in question in different tables from approximately 1999 onward for some eurozone countries.

variables are deflated by the consumer price index.

The data for the current account,  $CA$ , are generally computed from GNP, aggregate consumption, aggregate investment, and government expenditure. For some countries, however, GNP, aggregate consumption, or government expenditure is not available. In these cases, we compute the current account from exports and imports, although the net investment income from abroad is not taken into account. Because most countries for which we cannot observe those variables are less developed, small countries, the net investment income from abroad in these countries is assumed to be so small that we may ignore them in computing the current account.<sup>10</sup> The net output is computed as the gross domestic product minus aggregate investment and government expenditure.

The data for private credit were collected from the database of the financial structure created by Ross Levine, Norman Loayza, and Thorsten Beck (2000) and updated by them in 2010. In the database, we have a variable entitled “Private Credit by Deposit Money Banks and Other Financial Institutions/GDP,” which is the private credit/GDP ratio. To obtain the data for private credit,  $PC$ , we multiply the real gross domestic product by the ratio.

For Japan’s land price, the Nationwide Urban Land Price Index created by the Japan Real Estate Institute is used. In particular, we use the land price index of all urban land (DPL1) and the land price index of six major cities (DPL2) in the dataset. For the United States’ land price, we assembled the data for the price index for residential land from the dataset entitled “Decennial Census of Housing-Based price index: aggregate land data, annual, 1930-2000,” which is created by Morris A. Davis and Jonathan Heathcote (2007).<sup>11</sup> Every land price index is deflated by the consumption price index to derive real land prices.

Table A1 in the online appendix provides the Mackinnon approximate  $p$ -values of the Dickey-Fuller test (henceforth, the DF test) under the null hypothesis of a unit root. The statistics of the Kwiatkowski-Phillips-Schmidt-Shin (1992) test (henceforth, the KPSS test) under the null hypothesis of stationarity are presented in table A1 as well.<sup>12</sup> The last column of table

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<sup>10</sup>One exception is Netherlands. Aggregate consumption of that country is unavailable from 1969 to 1979.

<sup>11</sup>See footnote 24 of the article by Davis and Heathcote (2007) for more details of the dataset.

<sup>12</sup>See Denis Kwiatkowski, Peter C.B. Phillips, Peter Schmidt, and Yongcheol Shin (1992).

A1 provides a diagnosis for the stationarity for each variable. See the online appendix for the discussion about the stationarity tests.

While we judge from the stationarity tests that the first differences in the net output of all the 98 countries follow stationary processes, the stationarity (with or without trend) of the current account cannot be accepted for the countries labeled “caution” in the diagnosis and cannot be determined for the countries labeled “mixed.” However, for the inter-temporal budget constraint of a country to be satisfied, the country’s current account must follow a stationary process with or without trend if the first difference in the net output follows a stationary process.<sup>13</sup> Likewise, if the first difference in the net output follows a stationary process, then the first difference in private credit must follow a stationary process such that the intertemporal budget constraints of individuals are satisfied. In other words, from a theoretical viewpoint, if  $DZ$  follows a stationary process (with or without trend), then the variables,  $CA$  and  $DPC$ , should be stationary. Because we cannot imagine countries that do not take notice of their budget constraints, we have good reason to assume that these variables follow stationary processes.

## 4 Comparison of the United States and Japan

Eq.(2) is used as the first pass to detect the presence of collateral-based lending. If agents in a country face collateral constraints, there is a positive, linear relationship between the first difference in the land price and the lagged first difference in the private credit. The anticipation of an increase in the land price leads to an increase in private credit.

Figure 1 provides scatter plots of Japan’s private credit versus its (real) land price as an example for this relationship. In all of the panels in figure 1, the horizontal line shows the first difference in the land price and the vertical line shows the lagged first difference in private credit. Both panel A and panel B use the land price index of all urban land (DPL1)<sup>14</sup> In the panels, we observe a positive relationship between an increase in the land price and a lagged increase in private credit as predicted by our model. The data points of private credit in 2002 and 2003 are extremely small as seen in panel A and they can be thought of as outliers.<sup>15</sup> In panel B, these two outliers are

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<sup>13</sup>This claim is proven by Bharat Trehan and Carl E. Walsh (1991).

<sup>14</sup>Even though we use the land price index of six major cities (DPL2), we obtain a similar result.

<sup>15</sup>The cause of these outliers is probably so-called “internet bubbles,” which burst in 2001.

eliminated from our sample: we still see the positive relationship.

[Figure 1 around here]

[Figure 2 around here]

We next examine the United States economy. Figure 2 provides a scatter plot of the United States private credit versus its real land price. In contrast to Japan's case, there is a negative relationship between the two variables, which contradicts the hypothesis of collateral-based lending. This negative relationship is statistically significant (although we do not report this).

Let us now estimate Eq.(3) to test whether the coefficient of  $\Delta q_t$  is equal to zero. In all the ordinary least square (OLS) estimations in table 2, the coefficients of  $\Delta q_t$  are negative and significant for the Japanese economy. These results are consistent with our model. The absolute values of the coefficients when we use the land price index of all urban land are much greater than when we use the land price index of six major cities.

While we obtain the results consistent with collateral-based lending from the OLS estimations,  $\Delta q_t$  could be an endogenous variable because capital inflow possibly pushes up the land price. To address the endogeneity problem, we perform instrumental variable (IV) estimations. We use the lagged first difference of private credit as an instrumental variable because if our model is applicable to a country, the lagged first difference of private credit affects the current account only through  $\Delta q_t$ , as seen in Eqs. (1) and (2).<sup>16</sup> In columns (3) and (7), only the one-period-lagged first difference of private credit is used as an instrumental variable. The coefficients of  $\Delta q_t$  are negative and significant in both cases. Moreover, the  $F$ -values for the tests of excluded instruments in the first-stage regressions are greater than 10, implying that there are no symptoms of weak instruments in either case. In columns (4) and (8), we use the one-to-four-period-lagged first differences of private credit as instrumental variables. In both cases, the coefficients of  $\Delta q_t$  are negative and significant as in the other estimations. While the Hansen tests of overidentifying restrictions do not reject the orthogonality conditions in both cases, the  $F$ -value for the test of excluded instruments in the first-stage regressions in estimation (8) is less than 10, showing the symptom of weak instruments. However, the  $p$ -value of the LM test for the significance

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<sup>16</sup>Our estimation period is truncated in 2001. If we include the data points in 2002 and 2003, the IV estimations are weakly identified, probably because of the outliers of private credit in 2002 and 2003.

of the first difference of the land price, which is robust to weak instruments, is 0.013 in estimation (8).<sup>17</sup>

In contrast with Japan, in the OLS estimations for the United States, the coefficients of  $\Delta q_t$  are negative but insignificant. As in the case of Japan, we perform the IV estimations. While there is no symptom of weak instruments in estimation (11), the coefficient of  $\Delta q_t$  is insignificant and positive. Although there is a symptom of weak instruments in estimation (12), the  $p$ -value of the LM test for the significance of the first difference of the land price is 0.813. Judging from the results of the United States, a model with collateral constraints cannot be applied to the United States economy.

[Table 1 around here]

Finally, we estimate Eq. (1). The results of the OLS estimation for Eq.(1) are reported in table 2. For the Japanese economy, as in the case in which we use the land price, the coefficients are negative and significant over the whole estimation period. To examine whether there is a structural change we conduct the Chow test, finding that after 1983, borrowers in Japan face collateral constraints, whereas before 1983, borrowers did not face collateral constraints. For the United States, borrowers never face collateral constraints over the whole estimation period. We conduct the Chow test for the United States economy; however, we find no structural changes. One possible reason for the results of the United States is that the United States financial market is fully developed and firms often raise funds by direct finance from capital markets.<sup>18</sup>

## 5 Estimation Results

In the previous section, we have demonstrated that the Japanese economy is collaterally constrained, whereas the United States economy is not collaterally constrained. In examining countries other than Japan and the United States, we encounter a difficulty in collecting the data for the land prices.

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<sup>17</sup>See Keith Finlay and Leandro M. Magnusson (2009) for more information on the LM test.

<sup>18</sup>One might say that a small-open-economy version of the KM model, where the world interest rate is exogenously given, is not appropriate for an investigation of the United States economy. However, the assumption for a small open economy should not be an obstacle to our analysis. This is because, even though we consider a model in which the United States is a large country,  $\Delta q_t$  would correlate with  $\Delta PC_{t-1}$  in a positive way if borrowers in the United States faced credit constraints.

For many countries, the land price data do not exist, and in other countries where the land price data do exist, the available data points are too few to be estimated.

In contrast with the land price data, the data for private credit are available for many countries; therefore, we provide empirical evidence for 98 countries by estimating Eq.(1), which is associated with private credit. Although we can provide only one kind of empirical evidence, if the coefficient of  $\Delta PC_{t-1}$  is negative and significant, then we judge that a collateral-based lending is established in a country.

Table A2 in the online appendix provides the empirical results. We estimate Eq.(1) both with and without a constant term. We also conduct the Chow test to investigate a structural change in each country. More concretely, we open a test window from 1970 to 1999 (depending upon the data availability) and conduct the Chow test for each year. If the  $F$  value for the Chow test is significant for a year and at a maximum compared to the other years, we regard the year as a breaking point. If the statistical significance of the coefficient of  $\Delta PC_{t-1}$  changes before and after the breaking point, then we enter the result of the Chow test in table A2. Due to limitations of space, we discuss only countries indicating distinctive results. See table 2, which is extracted from table A2 in the online appendix.

[Table 2 around here]

## **The United Kingdom**

The United Kingdom economy is collaterally constrained over the whole estimation period. However, if we investigate the economy in more detail by conducting the Chow test, we find that there is a breaking point in 1992. In 1992, the Pound Crisis occurred in the United Kingdom. Before the crisis, the coefficient of  $\Delta PC_{t-1}$  is negative and significant, whereas after the crisis, the coefficient is negative but insignificant. However, we may well judge that the UK economy establishes a collateral-based lending system over the estimation period overall because the coefficient of  $\Delta PC_{t-1}$  is negative and significant for the whole estimation period.

## **East Asian Countries**

There are three countries, Korea, Malaysia, and Thailand among East Asian countries that exhibit distinctive estimation results. The common experience

of these three countries is that they underwent financial crises in 1997. Interestingly, the consequences of the estimations are similar among these three countries. It follows from the Chow tests that there is a breaking point in 1998 for the Korean and Malaysian economies. Likewise, there is a breaking point in 1997 for Thailand's economy.

As is similar to the UK economy, before the crises, these three countries are collaterally constrained, whereas after the crises, they are not. Unlike the UK economy, however, the results do not indicate that they face collateral constraints over the whole period. Although it must be true that financial systems of the three countries changed after the crises, the investigations for each country are beyond the scope of this paper.

## **Costa Rica and Kenya**

Costa Rica and Kenya are interesting cases of our estimations. As can be observed in table 2, the estimation for the whole period shows that the coefficients of  $\Delta PC_{t-1}$  are insignificant in both countries. However, we identify breaking points for both countries. If we divide the estimation period into the two sub-periods according to their breaking points, then the coefficients of  $\Delta PC_{t-1}$  in the periods both before and after each breaking point become significant in both countries. From these two examples, we understand the importance of identifying a structural change in an economy.

# **6 The Origin of Collateral-Based Lending**

## **6.1 Index for Collateral-Based Lending**

This section investigates our second question, that is, we detect the origin of the collateral-based lending system. Particularly, we seek an answer to this question in the legal protection of lenders. Strengthened legal protection relaxes credit market imperfections and gives constrained agents opportunities to borrow more easily in the financial market than when legal protection is weak (La Porta et al., 1997, 1998; Fabbri and Menichini, 2004). This is because an improvement of legal protection increases default costs and leads to the resolution of asymmetric information.

Meanwhile, there is a reason why an improvement of legal protection promotes collateral-based lending in an economy. The length of a judicial process is one of the legal enforcement costs associated with protection of lenders. If a trial is very long, lenders face risks of unexpected changes in the value of

collateral (Tullio Jappelli, Marco Pagano, and Magda Bianco, 2005). For instance, suppose that legal protection of lenders is so weak in an economy that formalism overgrows in justice and trials take long time (Simeon Djankov, Rafael La Porta, Florencio López-de-Silanes, and Andrei Shleifer, 2003). If the value of collateral changes during a long trial, the dispute becomes horribly complicated. Therefore, in an economy with weak legal protection of lenders, collateral-based lending hardly develops. We demonstrate this hypothesis below.

We have to make decisions about our investigation. We focus on lending systems in the 1980s and 1990s because by concentrating on these two decades, we can collect as many samples as possible. If we study the 2000s, the number of data points of the index for collateral-based lending is significantly reduced. Similarly, if we study the 1960s and 1970s, the number of data points of legal protection critically decreases as well. The criterion in creating the indices is as follows.<sup>19</sup>

1. If the coefficient of  $\Delta PC_{t-1}$  in Eq.(1) is negative and significant at the 5% level for the one-sided test in estimation either with or without a constant over the whole estimation period, then 1 is assigned to the indices for both the 1980s and the 1990s. However, as with Belize, if the estimation period for a country starts with 1986 or later, we eliminate it from a sample set for the 1980s. Likewise, as with Germany, if the estimation period for a country ends before 1990, it is eliminated from a sample set for the 1990s.
2. If the coefficient of  $\Delta PC_{t-1}$  in Eq.(1) is not significantly negative, we proceed to the Chow test in the country. If the coefficient of  $\Delta PC_{t-1}$  is negative and significant at the 5% level for the one-sided test for more than five years in 1980-1989, then 1 is assigned to the index for the 1980s. Similarly, if the coefficient is significantly negative for more than five years in 1990-1999, then 1 is assigned to the index for the 1990s.
3. If neither of the above two steps assigns 1, then we assign 0 to the indices both for the 1980s and the 1990s.

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<sup>19</sup>Although one might argue that we can use the estimated values of the coefficient of  $\Delta PC_{t-1}$  as the index for collateral-based lending, we cannot do this. This is because  $CA$  and  $\Delta Z$  are not comparable between countries and because our model specifies the different values of coefficients of  $\Delta PC_{t-1}$  between countries, for example, depending upon the land endowments.



According to the index for collateral-based lending, we report that 47 countries had collateral-based lending systems in the 1980s and 48 countries had them in the 1990s. While it is difficult to check the robustness of our indices, our indices are consistent with the microeconomic empirical findings discussed in the introduction. That is, collateral lending systems are not established in the United States, Italy, or Mexico, but are established in Costa Rica, Japan, and Thailand.

Let us now test the origin of collateral-based lending by estimating the following equation:

$$I_i = \alpha + \beta_1 L_i + X_i \beta_2 + \epsilon_i,$$

where  $I_i$  denotes the index for collateral-based lending of country  $i$ ,  $L_i$  is a measure of the quality of legal protection of lenders,  $X_i$  is a set of other control variables including a measure of urbanization in 1950, financial openness in the 1980s or the 1990s, and a measure of economic development in 1970, and  $\epsilon_i$  is an error term. Urbanization probably affects lending systems. Intuitively, as many people come to live in urban areas, information about borrowers is shared among financial intermediaries. Therefore, they can easily screen prospective borrowers if urbanization proceeds, and good borrowers will be more likely to access credit even without collateral. Meanwhile, in an era of financial globalization, external pressure promotes the restructuring of the domestic financial system. To control for this effect on collateral-based lending, we incorporate financial openness in the right-hand side of the estimation equation. Finally, per capita GDP in 1970 is used as a control variable for the degree of economic development, which probably affects the lending systems of a country.

In running regressions, we have to care about an endogeneity problem associated with legal protection. This is because there is a possibility of a reverse causality such that, if a country employs a collateral-based lending system, the government arranges the law supporting the collateral-based lending system. To address this endogeneity problem, we estimate a probit model with endogenous explanatory variables. In estimating this model, we use conditional maximum likelihood estimators.<sup>20</sup>

We adopt legal origins and a measure of human capital as instrumental variables for legal protection. Legal origin theory advocated by La Porta et al. (1997, 1998) tells us that when the common or civil law was introduced in a country via conquest or colonization, not only the rules but also

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<sup>20</sup>See Jeffrey Marc Wooldridge (2002, pp.472-477) for details.

human capital and the ideologies of the legal system were transplanted into the country. The protection of property rights in common law countries is stronger than in civil law countries. This theory suggests that legal protection as an institution in a country is affected by legal origins. In addition to legal origins, we assume that human capital accumulation from 1960 to 1980 or to 1990 positively affects the development of a legal system of a country.

## 6.2 Data

We use “Chain Area 2” from the database of James D. Gwartney, Joshua C. Hall, and Robert Lawson (2010) as a measure of legal protection. This measure reflects the rule of law, security of property rights, an independent judiciary, and an impartial court system. We collected the indices of 1980 and of 1990 entered in “Chain Area 2” of the database. For robustness checks for our results, we use the “rule of law,” assembled from the database of Daniel Kaufmann, Aart Kraay, and Massimo Mastruzzi (2010), as a measure of legal protection as well. This measure is a weighted average of variables, such as individuals’ perceptions of the effectiveness and predictability of the judiciary and the enforcement of contracts. We assembled the indices of 1996 and of 1998 entered in the sheet of “rule of law.”

The measure of urbanization was taken from the database produced by the United Nations (2010), the Department of Economic and Social Affairs, Population Division. We use “Percentage of Population Residing in Urban Areas” in File 2 of the database of “World Urbanization Prospects: The 2009 Revision.” To avoid an endogeneity problem associated with this measure, we use the index of 1950. As a measure of financial openness, we use the Chinn-Ito index, which is a *de jure* measure of capital account openness index developed by Menzie D. Chinn and Hiro Ito (2008). The Chinn-Ito index reflects capital control policies and measures the intensity of capital controls. To produce measures for the financial openness of the 1980s and 1990s, we averaged the data points from 1980 to 1989 and from 1990 to 1999. Because capital control policies are implemented without targeting specific lending systems, we regard the Chinn-Ito index as exogenous.

As a measure of economic development in 1970, we collected the real gross domestic product per capita (current price) in 1970 from the Penn World Table 6.3, produced by Alan Heston, Roberst Summers, and Bettina Aten (2009). The data for legal origins were gathered from Rafael La Porta, Florencio López-de-Silanes, Andrei Shleifer, and Robert W. Vishny (1999).

As a measure of human capital, we assembled the data for “Average Year of Total Schooling” as in 1960 from the full dataset of “Population Aged 25 and Over” produced by Robert J. Barro and Jong-Wha Lee (2010). The “European settler mortality” rates were collected from Daron Acemoglu, Simon Johnson, and James A. Robinson (2001). These mortality rates are of soldiers, bishops, and sailors who settled in colonies from the seventeen to nineteenth centuries.

### 6.3 Results

Table 3 reports the results of the probit estimation without instrumental variables. All the regressions in the table indicate that the coefficients of legal protection in 1980s and in 1990s are positive and significant at the conventional significance level. This implies that good legal protection promotes a collateral-based lending system. In other words, if an economy is endowed with good legal protection of lenders, they can access credit as long as borrowers hold collateral.

In most regressions, the coefficients of urbanization are negative and significant. This consequence may be caused by most people coming to live in urban areas, in which case information about borrowers is commonly used by financial intermediaries. As a result, these financial intermediaries can easily screen prospective borrowers from a pool of potential borrowers. As urbanization proceeds, prospective borrowers will access credit even without collateral. Financial openness seems to negatively affect collateral-based lending; however, this relationship is not significant. The degree of development does not enter significantly in any of the regressions, although it seems to positively affect collateral-based lending.

[Table 3 around here]

The results of table 3 might be subject to an endogeneity problem. This is because if an economy exhibits a germ of collateral-based lending, the government may try to support the lending system by enacting laws that accommodate the system. Therefore, we also estimate a probit model with endogenous explanatory variables. For the estimation, the instrumental variables are the legal origins and the average years of total schooling in 1960 (School 60, henceforth), which is a proxy for human capital in 1980s and 1990s.

[Table 4 around here]

Table 4 reports the results of probit estimation with instrumental variables. It provides similar results to those in table 3, except for the insignificance of legal protection in column (8). This implies that the results of table 3 are robust. For the validity of instrumental variables, the J tests of overidentifying restrictions do not reject the orthogonality conditions in all estimations.<sup>21</sup> The  $F$ -values for the tests of excluded instruments in the first-stage regressions are greater than 10 for four cases out of eight, implying that in those four cases there are no symptoms of weak instruments.<sup>22</sup> Therefore, for these four cases, the instruments are considered to be valid. Although the  $F$ -values for the tests of excluded instruments in the first-stage regressions are less than 10, the LM tests, which are robust to weak instruments, indicate the significance of the coefficients of legal protection, except for the estimation in columns (7) and (8).

We infer from our estimation that good legal protection of lenders is an important institutional factor for an economy to establish a collateral-based lending system. Our estimation also indicates that urbanization weakens a collateral-based lending system.

## 6.4 Robustness

### 6.4.1 European Settler Mortality as an Instrument

A simultaneous equation model is sometimes sensitive to the choice of instrumental variables. For a robustness check, we also use the “European settler mortality” rate of Acemoglu et al. (2001) as an instrumental variable for legal protection. They propose a theory of institutional differences among countries colonized by Europeans. According to their theory, different colonization policies created different institutions. The feasibility of settlement of colonized places determined the colonization strategy. For instance, if disease in a location undermined European settlement, Europeans did not settle in that place. Instead, they were more likely to form an extractive system in those places. By contrast, if European settlers did not encounter significant disease-related impediments, they transplanted good institutions protecting property rights into these places. In these cases, the colonial state and institutions continue up to the present day. This theory supports use of the early mortality rate as an instrumental variable for the legal protection of lenders.

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<sup>21</sup>See Keith Finlay and Leandro M. Magnusson (2009) for more information on the J test.

<sup>22</sup>The  $F$ -values greater than 10 satisfy the “rule of thumb” proposed by Douglas Staiger and James H. Stock (1997).

The number of countries for which we can obtain the data for “European settler mortality” is limited, and our observations are at most 52. As seen in table 5, the estimation results are similar to those of table 3. Although all the  $F$ -values for the tests of excluded instruments are less than 10, the Anderson-Rubin (AR) tests for the significance of an endogenous variable, which are robust to weak instruments, report that legal protection enters significantly in all cases.

[Table 5 around here]

#### 6.4.2 Another Measure of Legal Protection

We use another measure of legal protection of lenders, which is the “rule of law” created by Kaufmann et al. (2010). Unfortunately, the “rule of law” is available only from 1996 onward. Therefore, our estimation focuses only on the 1990s. We assembled the data for the “rule of law” of 1996 and 1998.

Table 6 indicates that all of the coefficients of legal protection except for one case are positive and significant at the conventional significance level. The signs of the coefficients and the significance of urbanization are almost the same as those of the previous regressions. All the  $F$ -values for the tests of excluded instruments are greater than 10, implying that there are no symptoms of weak instruments. The J tests do not reject the orthogonality conditions in any of the regressions.

[Table 6 around here]

## 7 Concluding Remarks

We have used a small-open-economy version of Nobuhiro Kiyotaki and John Moore’s model to judge whether a collateral-based lending system is embedded in an economy. If Kiyotaki and Moore’s model is statistically accepted in a country, we consider that the country establishes a collateral-based lending system. From our estimation, we find that collateral-based lending systems are embedded in approximately half of the 98 countries.

This paper could be a caveat against the reckless use of a model with collateral constraints. Researchers often presume collateral constraints when investigating macroeconomic phenomena. However, if a collateral-based lend-

ing system is not established in an economy, we may deduce inadequate policy implications from a theoretical model with collateral constraints.

Moreover, we have investigated the origin of collateral-based lending systems. We find that the legal protection of lenders supports the establishment of collateral-based lending systems. This result is robust without being subject to an endogeneity problem associated with the legal protection of lenders. We also find that urbanization negatively affects the establishment of collateral-based lending systems. This is possibly because if people come to live in urban areas, information about borrowers is commonly used by financial intermediaries and thus can easily screen potential borrowers. Consequently, prospective borrowers will access credit, even without collateral. Of course, this is a possible hypothesis, and we need a more elaborate analysis on this issue.

## Appendix

### Model

A country is assumed to be a small open economy facing a world interest rate. The economy consists of savers and borrowers. Borrowers are collaterally constrained. The total population in the economy is normalized to one and the ratio of borrowers to savers is  $\lambda:1 - \lambda$ , where  $\lambda \geq 0$  is a constant. Each borrower is identical in the sense that he/she has the same preference and the same technology. Likewise, each saver is identical in the same sense.

Each borrower is endowed with a linear production technology,  $y_{t+1} = ax_t$ , whose input is land. Here,  $a$ ,  $x_t$ , and  $y_{t+1}$  represent a constant productivity parameter, land held by a borrower at time  $t$ , and his/her output at time  $t + 1$ , respectively. While a borrower borrows resources from the financial market, he/she faces a credit constraint associated with the value of collateral at each time.

Each saver is endowed with two kinds of production technologies. While the two production technologies create the same output, their inputs are different. One uses land  $x_t^*$  as input:

$$G_1(x_t^*),$$

where  $G_1' > 0$  and  $G_1'' < 0$ .  $G_1$  satisfies Inada conditions:  $\lim_{x^* \rightarrow 0} G_1'(\cdot) = \infty$ ,  $\lim_{x^* \rightarrow \infty} G_1'(\cdot) = 0$  and  $G_1(0) = 0$ . The other technology uses capital  $k_t^*$  as

input:

$$G_2(k_t^*),$$

where  $G_2' > 0$  and  $G_2'' < 0$ .  $G_2$  satisfies Inada conditions as well. Following Kiyotaki and Moore (1997), technical conditions on the parameters are imposed:

$$a > R\beta a > G_1'((1 - R\beta)\bar{X}/(1 - \lambda)), \quad (4)$$

where  $\bar{X}$  is the total amount of land and  $R > 1$  is the world interest rate, which is exogenously given.<sup>23</sup>  $\beta \in (0, 1)$  is the subjective discount rate, which is common between borrowers and savers. By Eq.(4), we exclude economically meaningless solutions of the model. Because each saver is endowed with the two kinds of technologies, his output at time  $t + 1$  is given by:

$$y_{t+1}^* = G_1(x_t^*) + G_2(k_t^*).$$

The instantaneous utility functions of both types of agents are assumed to be identical; specifically, these are given by  $\ln c_t + \ln g_t$  and  $\ln c_t^* + \ln g_t$  where  $c$  and  $c^*$  are the consumption of a borrower and a saver, respectively.  $g$  is the total government expenditure, which is exogenously determined by the government; accordingly, we can omit  $\ln g$  from the maximization problems of agents.

A borrower maximizes his lifetime utility as follows:

$$\max \sum_{t=0}^{\infty} \beta^t \ln c_t \quad (5)$$

$$\text{s.t.} \quad c_t + q_t(x_t - x_{t-1}) + Rb_{t-1} = (1 - \tau)ax_{t-1} + b_t, \quad (6)$$

$$b_t \leq R^{-1}q_{t+1}x_t, \quad (7)$$

where Eqs.(6) and (7) are the flow budget constraint and the credit constraint, respectively.  $b$  is debt if positive or savings if negative,  $q$  is the land price, and  $\tau$  is the tax rate imposed on the output. The online appendix proves that there exists time  $T$ , such that from time  $T$  onward, credit constraints given by Eq.(7) are always binding. Henceforth, we focus on a case where the credit constraints are always binding.

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<sup>23</sup>For simplicity, it has been assumed that each borrower is endowed with only one production technology, whose input is land. One could imagine that while each borrower can access another production technology as savers, which is linear with respect to capital, this productivity is extremely low compared with the world interest rate.

The first-order conditions for a borrower are given by:

$$\frac{1}{c_t} - \beta R \frac{1}{c_{t+1}} - \phi_t = 0 \quad (8)$$

$$-\frac{q_t}{c_t} + \beta[(1 - \tau)a + q_{t+1}] \frac{1}{c_{t+1}} + R^{-1} q_{t+1} \phi_t = 0, \quad (9)$$

where  $\phi_t$  is a co-state variable of the credit constraint at time  $t$ . The necessary and sufficient conditions for the optimality of this maximization problem consist of Eqs.(8) and (9) as well as the transversality conditions,  $\lim_{t \rightarrow \infty} R^{-t} b_t = \lim_{t \rightarrow \infty} \beta^t (q_t x_t / c_t) = 0$ .

Likewise, a saver's maximization problem is given by:

$$\max \sum_{t=0}^{\infty} \beta^t \ln c_t^* \quad (10)$$

$$\begin{aligned} \text{s.t.} \quad & c_t^* + q_t(x_t^* - x_{t-1}^*) + I_t^* + Rb_{t-1}^* \\ & = (1 - \tau)[G_1(x_{t-1}^*) + G_2(k_{t-1}^*)] + b_t^*, \end{aligned} \quad (11)$$

where  $I_t^* = k_t^* - (1 - \delta)k_{t-1}^*$ .

The first-order conditions for a saver are given by:

$$c_{t+1}^* = \beta R c_t^* \quad (12)$$

$$\frac{(1 - \tau)G_1'(x_t^*)}{u_t} = R \quad (13)$$

$$(1 - \tau)G_2'(k_t^*) = R + \delta - 1, \quad (14)$$

where  $u_t = q_t - q_{t+1}/R$ . Eq.(12) is the Euler equation, and Eq.(13) and Eq.(14) are the intra-temporal optimality conditions in the land market and in the capital market, respectively.<sup>24</sup> The necessary and sufficient conditions for the optimality of this maximization problem consist of Eqs.(12)-(14) as well as the transversality conditions,  $\lim_{t \rightarrow \infty} R^{-t} b_t^* = \lim_{t \rightarrow \infty} \beta^t (q_t x_t^* / c_t^*) = 0$ .

Because Eq.(7) is binding, the budget constraint of a borrower, Eq.(6), is reduced to:

$$c_t + u_t x_t = (1 - \tau) a x_{t-1}. \quad (15)$$

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<sup>24</sup>To be accurate, to ensure that all the savers remain savers over their lifetimes, the assets held by savers in the steady state,  $-\hat{b}^*$ , must be greater than zero. As seen in the later,  $-\hat{b}^*$  is given by  $-\hat{b}^* = [\delta \hat{k}^* - (1 - \tau)(G_1(\hat{x}^*) + G_2(\hat{k}^*))]/(R - 1)$ , where  $\hat{x}^* = G_1'^{-1}(R\beta a)$  and  $\hat{k}^* = G_2'^{-1}((R + \delta - 1)/(1 - \tau))$  are the land and capital stocks held by a saver in the steady state, respectively. We impose the parameter conditions so that  $-\hat{b}^* > 0$ .



From Eqs.(8) and (9), we obtain a new Euler equation:

$$c_{t+1} = \frac{(1-\tau)a\beta}{u_t} c_t. \quad (16)$$

From Eqs.(15) and (16), the optimal consumption is obtained as follows:

$$c_t = (1-\beta)[(1-\tau)ax_{t-1} + q_t x_{t-1} - Rb_{t-1}] = (1-\beta)(1-\tau)ax_{t-1}. \quad (17)$$

From Eqs.(13), (15), and (17), we obtain a dynamical system with respect to  $x_t$  as follows:

$$G'_1\left(\frac{\bar{X} - \lambda x_t}{1-\lambda}\right)x_t = R\beta ax_{t-1}.$$

Because  $R\beta a > G'_1(\bar{X}/(1-\lambda))$ , this dynamical system has a unique non-trivial steady state  $\hat{x}$ , which is an inner point. The steady state is stable because the linear approximation of the dynamical system is  $x_t - \hat{x} = \frac{\beta Ra}{\beta Ra - \frac{\lambda}{1-\lambda} G''_1 \hat{x}} (x_{t-1} - \hat{x})$ , where  $|\frac{\beta Ra}{\beta Ra - \frac{\lambda}{1-\lambda} G''_1 \hat{x}}| < 1$ . Additionally, it can be shown that the equilibrium sequences of all variables converging to their steady states satisfy the transversality conditions.<sup>25</sup>

Because the lifetime utility is log-linear, the consumption function of a saver is derived as follows:

$$c_t^* = (1-\beta)[(1-\tau)y_t^* - I_t^* + q_t x_{t-1}^* - Rb_{t-1}^* + \sum_{j=0}^{\infty} R^{-j} \pi_{t+j}], \quad (18)$$

where  $\pi_t = (1/R)((1-\tau)y_{t+1}^* - I_{t+1}^*) - u_t x_t^*$ .

To derive the current account dynamics, we aggregate the consumption functions for all the agents. From Eqs.(17) and (18), the aggregate consumption function is given by:

$$C_t = (1-\beta)[Z_t + q_t \bar{X} + R F_{t-1} + (1-\lambda) \sum_{j=0}^{\infty} R^{-j} \pi_{t+j}], \quad (19)$$

where  $C_t = \lambda c_t + (1-\lambda)c_t^*$ ,  $Z_t = (1-\tau)[\lambda y_t + (1-\lambda)y_t^*] - (1-\lambda)I_t^*$ , and  $F_{t-1} = -(\lambda b_{t-1} + (1-\lambda)b_{t-1}^*)$ . Here, we note that  $F_{t-1}$  is the net foreign asset held by the country at time  $t-1$ . The first difference of Eq.(19) is obtained as follows:

$$\Delta C_t = (1-\beta)[\Delta Z_t + \Delta q_t \bar{X} + R \Delta F_{t-1} + (1-\lambda) \sum_{j=0}^{\infty} R^{-j} \Delta \pi_{t+j}]. \quad (20)$$

---

<sup>25</sup>While it is complicated to investigate the equilibrium sequence  $\{q_t\}$ , it can be shown that  $\{q_t\}$  converges to  $\hat{q} = \frac{a(1-\tau)}{R-1}$ .

By linearizing  $\sum_{j=0}^{\infty} R^{-j} \Delta \pi_{t+j}$  around the steady state, we have  $\sum_{j=0}^{\infty} R^{-j} \Delta \pi_{t+j} = -\hat{x}^* \Delta q_t$  where  $\hat{x}^*$  is the land held by a saver in the steady state. By using this equation, Eq.(20) is reduced to:

$$\Delta C_t = (1 - \beta)[\Delta Z_t + (\bar{X} - (1 - \lambda)\hat{x}^*)\Delta q_t + R\Delta F_{t-1}]. \quad (21)$$

Meanwhile, it follows from the national income identity that:<sup>26</sup>

$$CA_t = RCA_{t-1} + \Delta Z_t - \Delta C_t, \quad (22)$$

where  $CA_t = \Delta F_t$  is the current account at time  $t$ . From Eqs.(21) and (22), we obtain a dynamic equation for the current account:

$$CA_t = \beta R CA_{t-1} + \beta \Delta Z_t - (1 - \beta)(\bar{X} - (1 - \lambda)\hat{x}^*)\Delta q_t. \quad (23)$$

The closed-form expression of Eq.(23) is the same as the one Kunieda and Shibata (2005) derive.

Linearizing  $Rb_t = q_{t+1}x_t$  around the steady state, we have:

$$R(b_t - \hat{b}) = \hat{x}(q_{t+1} - \hat{q}) + \hat{q}(x_t - \hat{x}).$$

By taking the first difference of this equation, it follows that:

$$R\Delta b_t = \hat{x}\Delta q_{t+1} + \hat{q}\Delta x_t. \quad (24)$$

Because  $\bar{X} = \lambda x_t + (1 - \lambda)x_t^*$ , Eq.(23) becomes:

$$CA_t = \beta RCA_{t-1} + \beta \Delta Z_t - (1 - \beta)\lambda \hat{x} \Delta q_t. \quad (25)$$

Because we have  $x_t - \hat{x} = \Phi(x_{t-1} - \hat{x})$  around the steady state where  $\Phi := \frac{\beta Ra}{\beta Ra - \frac{\lambda}{1-\lambda} \hat{G}_1'' \hat{x}}$ , it follows that

$$\Delta x_t = \Phi \Delta x_{t-1}$$

and thus:

$$\Delta x_t = \Phi^{t-1} \Delta x_1. \quad (26)$$

From Eq.(13), we have  $(1 - \tau)G_1'(\frac{\bar{X} - \lambda x_t}{1 - \lambda}) = Rq_t - q_{t+1}$ , which is expanded around the steady state as follows:

$$-\frac{\lambda(1 - \tau)}{1 - \lambda} \hat{G}_1'''(x_t - \hat{x}) = R(q_t - \hat{q}) - (q_{t+1} - \hat{q}),$$

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<sup>26</sup>We should note that the national income identity is  $Z_t + RF_{t-1} = F_t + C_t$ .

where  $\hat{G}_1'' = G_1''(\hat{x}^*)$ . From this, we obtain:

$$\Delta q_{t+1} = R\Delta q_t + \frac{\lambda(1-\tau)}{1-\lambda}\hat{G}_1''\Delta x_t. \quad (27)$$

By substituting Eq.(26) into Eq.(27), we have:

$$\Delta q_{t+1} = R\Delta q_t + \frac{\lambda(1-\tau)}{1-\lambda}\hat{G}_1''\Phi^{t-1}\Delta x_1. \quad (28)$$

The solution for Eq.(28) is given by:

$$\Delta q_t = \left(\frac{\Delta q_1}{\Phi} - \lambda\tilde{\Phi}\right)\Phi R^{t-1} + \lambda\tilde{\Phi}\Phi^t, \quad (29)$$

where  $\tilde{\Phi} = \frac{(1-\tau)\hat{G}_1''\Delta x_1}{(1-\lambda)(\Phi^2 - R\Phi)}$ . It must hold that  $\Delta q_1 = \lambda\tilde{\Phi}\Phi$  so that the transversality conditions can be satisfied. Therefore, we obtain:

$$\Delta q_t = \lambda\tilde{\Phi}\Phi^t. \quad (30)$$

From Eqs.(26) and (30), we have  $\Delta x_t = \frac{\Delta x_1}{\lambda\Phi^2}\Delta q_{t+1}$ . From the last equation and Eq.(24), we obtain the following:

$$\hat{x}\Delta q_{t+1} = \frac{R\lambda\tilde{\Phi}\Phi^2\hat{x}}{\lambda\tilde{\Phi}\Phi^2\hat{x} + \hat{q}\Delta x_1}\Delta b_t. \quad (31)$$

Substituting Eq.(31) into Eq.(25), we have:

$$CA_t = \beta RCA_{t-1} + \beta\Delta Z_t - (1-\beta)\lambda^2\Psi\hat{x}\Delta b_{t-1}, \quad (32)$$

where  $\Psi := \frac{R\tilde{\Phi}\Phi^2}{\lambda\tilde{\Phi}\Phi^2\hat{x} + \hat{q}\Delta x_1}$ . Because the increase in loans to borrowers contributes to the increase in the aggregate private credit, we have  $\lambda\Delta b_t := \Delta PC_t$ . By substituting the last into (32), we obtain:

$$CA_t = \beta RCA_{t-1} + \beta\Delta Z_t - (1-\beta)\Psi\lambda\hat{x}\Delta PC_{t-1}. \quad (33)$$

From Eq.(31), we have:

$$\Delta q_{t+1} = \Psi\Delta PC_t. \quad (34)$$

As seen in Eq.(33), if there are no collaterally constrained agents, i.e.,  $\lambda = 0$ , then the effect of  $\Delta PC_{t-1}$  on the current account degenerates. Eq.(33) can be used to examine whether a theoretical model with collateral constraints is applicable to an economy.

## References

- [1] Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. "The Colonial Origins of Comparative Development: An Empirical Investigation." *American Economic Review*, 91(5): 1369-1401.
- [2] Aghion, Philippe, Peter Howitt, and David Mayer-Foulkes. 2005. "The Effect of Financial Development on Convergence: Theory and Evidence" *Quarterly Journal of Economics*, 120(1): 173-222.
- [3] Barro, Robert J. and Jong-Wha Lee. 2010. "New Data Set of Educational Attainment in the World, 1950-2010." National Bureau of Economic Research Working Paper No.15902.
- [4] Bester, Helmut. 1985. "Screening vs. Rationing in Credit Markets with Imperfect Information." *American Economic Review*, 75(4): 850-855.
- [5] Bester, Helmut. 1994. "The Role of Collateral in a Model of Debt Renegotiation." *Journal of Money, Credit and Banking*, 26(1): 72-86.
- [6] Berger, Allen N. and Gregory F. Udell. 1995. "Relationship Lending and Lines of Credit in Small Firm Finance." *Journal of Business*, 68(3): 351-381.
- [7] Bernanke, Ben and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review*, 79(1): 14-31.
- [8] Boot, Arnoud W.A., Anjan V. Thakor, and Gregory F. Udell. 1991. "Secured Lending and Default Risk - Equilibrium-Analysis, Policy Implications and Empirical Results." *Economic Journal*, 101(406): 458-472.
- [9] Boot, Arnoud W.A. 2000. "Relationship Banking: What Do We Know?." *Journal of Financial Intermediation*, 9(3): 7-25.
- [10] Brick, Ivan E. and Darius Palia. 2007. "Evidence of Jointness in the Terms of Relationship Lending." *Journal of Financial Intermediation*, 16(3): 452-476.
- [11] Charumilind, Chutatong, Raja Kali, and Yupana Wiwattanakantang. 2006. "Connected Lending: Thailand before the Financial Crisis." *Journal of Business*, 79(1): 181-218.

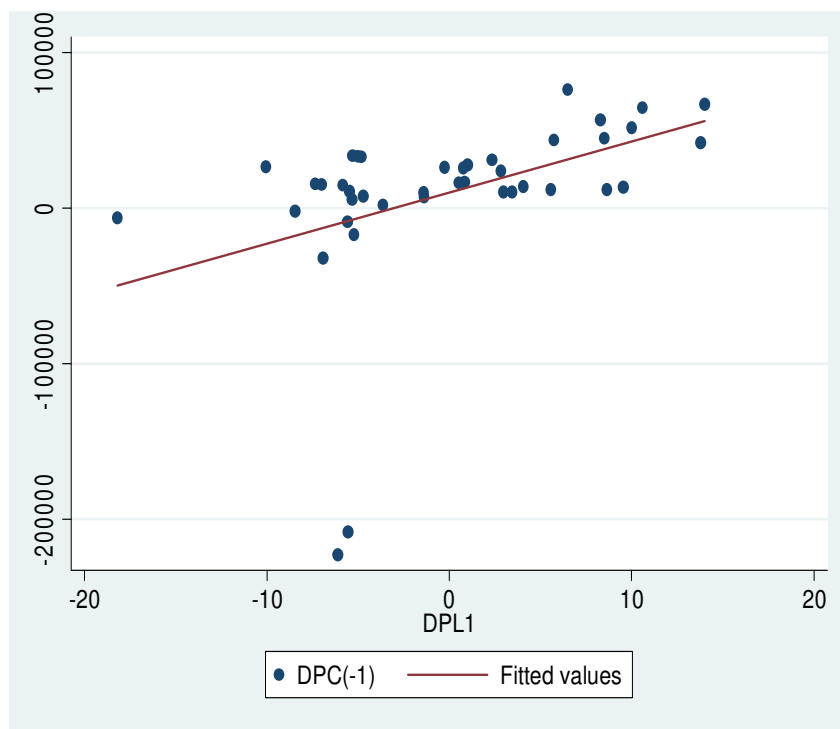
- [12] Chinn, Menzie D. and Hiro Ito. 2008. "A New Measure of Financial Openness." *Journal of Comparative Policy Analysis*, 10(3): 309-322.
- [13] Davis, Morris A. and Jonathan Heathcote. 2007. "The Price and Quantity of Residential Land in the United States." *Journal of Monetary Economics*, 54(8): 2595-2620.
- [14] Degryse, Hans and Patrick Van Cayseele. 2000. "Relationship Lending within a Bank-Based System: Evidence from European Small Business Data," *Journal of Financial Intermediation*, 9(1): 90-109.
- [15] Djankov, Simeon, Rafael La Porta, Florencio López-de-Silanes, and Andrei Shleifer. 2003. "Courts." *Quarterly Journal of Economics*, 118(2): 453-517.
- [16] Elyasiani, Elyas and Lawrence G. Goldberg. 2004. "Relationship lending: a survey of the literature." *Journal of Economics and Business*, 56(4): 315-330.
- [17] Fabbri, Daniela and Mario Padula. 2004. "Does poor legal enforcement make households credi-constrained?" *Journal of Banking and Finance*, 28(10): 2369-2397.
- [18] Finlay, Keith and Leandro M. Magnusson. 2009. "Implementing Weak-Instrument Robust Tests for a General Class of Instrumental-Variables Models." *Stata Journal*, 9(3), 398-421.
- [19] Fukao, Mitsuhiro. 2003. "Japan's Lost Decade and its Financial System." *The World Economy*, 26(3): 365-384.
- [20] Galor, Oded and Joseph Zeira. 1993. "Income Distribution and Macroeconomics." *Review of Economic Studies*, 60(1): 35-52.
- [21] Greenwood, Jeremy and Boyan Jovanovic. 1990. "Financial Development, Growth, and the Distribution of Income." *Journal of Political Economy*, 98(5): 1076-1107.
- [22] Greenwood, Jeremy and Bruce D. Smith. 1997. "Financial Markets in Development, and the Development of Financial Markets." *Journal of Economic Dynamics and Control*, 21(1): 145-181.

- [23] Gwartney, James D., Joshua C. Hall, and Robert Lawson. 2010. "2010 Economic Freedom Dataset," In *Economic Freedom of the World: 2010 Annual Report*. Fraser Institute. Economic Freedom Network.
- [24] Heston, Alan, Roberst Summers, and Bettina Aten. 2009. "Penn World Table Version 6.3." Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania. [http : //pwt.econ.upenn.edu/php\\_site/pwt\\_index.php](http://pwt.econ.upenn.edu/php_site/pwt_index.php) (Accessed July 21, 2010).
- [25] Hall, Robert E. and Frederic S. Mishkin. 1982. "The Sensitivity of Consumption to Transitory Income: Estimates from Panel Data on Households." *Econometrica*, 50(2): 461-481.
- [26] Harhoff, Dietmar and Timm Körting. 1998. "Lending relationships in Germany-Empirical evidence from survey data." *Journal of Banking and Finance*, 22(10-11): 1317-1353.
- [27] Jappelli, Tullio. 1990. "Who Is Credit Constrained in the United-States-Economy." *Quarterly Journal of Economics*, 105(1): 219-234.
- [28] Jappelli, Tullio, Marco Pagano, and Magda Bianco. 2005. "Courts and Banks: Effects of Judicial Enforcement on Credit Markets." *Journal of Money, Credit, and Banking*, 37(2): 223-244.
- [29] Jiménez, Gabriel, Vicente Salas, and Jesus Saurina. 2006. "Determinants of Collateral." *Journal of Financial Economics*, 81(2): 255-281.
- [30] Kasa, Kenneth. 1998. "Borrowing constraints and asset market dynamics: evidence from Pacific Basin." *Federal Reserve Bank of San Francisco Economic Review*, 3: 17-28.
- [31] Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi. 2010. "The Worldwide Governance Indicators : A Summary of Methodology, Data and Analytical Issues." World Bank Policy Research Working Paper Series No.5430.
- [32] King, Robert G. and Ross Levine. 1993. "Finance, Entrepreneurship, and Growth: Theory and Evidence." *Journal of Monetary Economics*, 32(3): 513-542.
- [33] Kiyotaki, Nobuhiro and John Moore. 1997. "Credit Cycles." *Journal of Political Economy*, 105(2): 211-248.

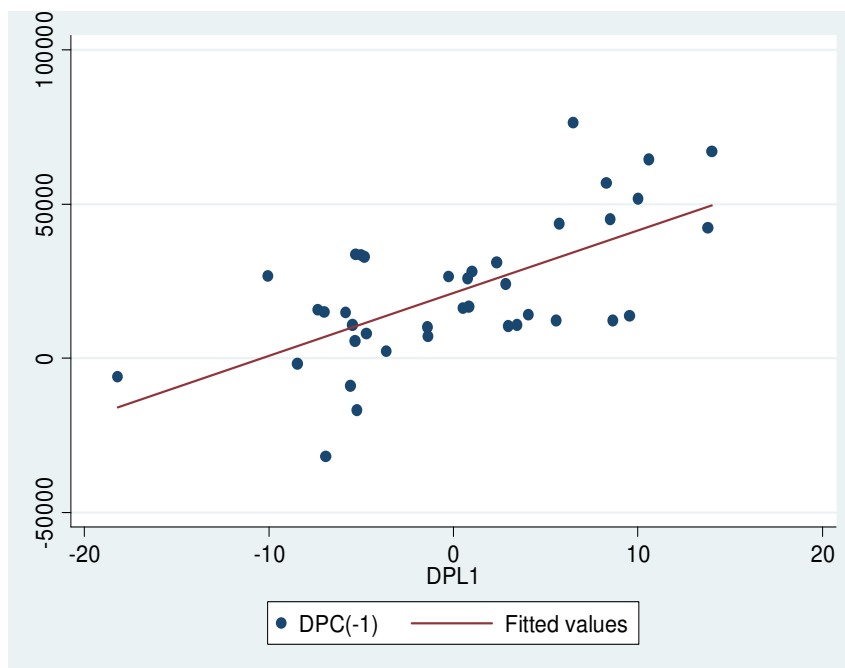
- [34] Kuniieda, Takuma and Akihisa Shibata. 2005. "Credit constraints and the current account: A test for the Japanese economy." *Journal of International Money and Finance*, 24(8): 1261-1277.
- [35] Kwiatkowski, Denis, Peter C.B. Phillips, Peter Schmidt, and Yongcheol Shin. 1992. "Testing the null hypothesis of stationarity against the alternative of a unit root: how sure are we that economic time series have a unit root?" *Journal of Econometrics*, 54(1-3): 159-178.
- [36] La Porta, Rafael, Florencio López-de-Silanes, Andrei Shleifer, and Robert W. Vishny. 1997. "Legal Determinants of External Finance." *Journal of Finance*, 52(3): 1131-1150.
- [37] La Porta, Rafael, Florencio López-de-Silanes, Andrei Shleifer, and Robert W. Vishny. 1998. "Law and Finance." *Journal of Political Economy*, 106(6): 1113-1155.
- [38] La Porta, Rafael, Florencio López-de-Silanes, Andrei Shleifer, and Robert W. Vishny. 1999. "The quality of government." *Journal of Law, Economics and Organization*, 15(1): 222-279.
- [39] La Porta, Rafael, Florencio López-de-Silanes, and Guillermo Zamarripa. 2003. "Related Lending." *Quarterly Journal of Economics*, 118(1): 231-268.
- [40] La Porta, Rafael, Florencio López-de-Silanes, and Andrei Shleifer. 2008. "The Economic Consequences of Legal Origins." *Journal of Economic Literature*, 46(2): 285-332.
- [41] Levine, Ross, Norman Loayza, and Thorsten Beck. 2000. "Financial Intermediation and Growth: Causality and Causes." *Journal of Monetary Economics*, 46(1): 31-77.
- [42] Longhofer, Stanley D. and Joao A.C. Santos. 2000. "The Importance of Bank Seniority for Relationship Lending." *Journal of Financial Intermediation*, 9(1): 57-89.
- [43] Manove, Michael, A Jorge Padilla, and Marco Pagano. 2001. "Collateral versus Project Screening: A Model of Lazy Banks," *Rand Journal of Economics*, 32(4): 726-744.

- [44] Matsuyama, Kiminori, 2004. “Financial Market Globalization, Symmetry-Breaking, and Endogenous Inequality of Nations,” *Econometrica*, 72(3): 853-884.
- [45] Matsuyama, Kiminori, 2007. ”Credit Traps and Credit Cycles,” *American Economic Review* 97(1): 503-516.
- [46] Matsuyama, Kiminori. 2008. “Aggregate Implications of Credit Market Imperfections.” In *NBER Macroeconomics Annual 2007*, ed. Daron Acemoglu, Kenneth Rogoff, and Michael Woodford, 1-60. Cambridge, MA, USA: MIT Press.
- [47] Menkhoff, Lukas, Doris Neuberger,. and Chodechai Suwanaporn. 2006. “Collateral-based lending in emerging markets: Evidence from Thailand.” *Journal of Banking and Finance*, 30(1): 1-21.
- [48] Monge-Naranjo, Alexander, Javier Cascante, and Luis J. Hall. 2001. “Enforcement, Contract Design and Default: Exploring the Financial Markets of Costa Rica.” In *Defusing Default* , ed. Marco Pagano, 225-269. Washington, D.C., USA: Inter-American Development Bank.
- [49] Ono, Arito and Iichiro Uesugi. 2009. “Role of Collateral and Personal Guarantees in Relationship Lending: Evidence from Japan’s SME Loan Market.” *Journal of Money, Credit and Banking*, 41(5): 935-960.
- [50] Staiger, Douglas and James H. Stock. 1997. “Instrumental Variables Regression with Weak Instruments.” *Econometrica*, 65(3): 557-586.
- [51] Trehan, Bharat and Carl E. Walsh. 1988. “Common Trends, the Governments Budget Constraint, and Revenue Smoothing.” *Journal of Economic Dynamics and Control*, 12(2-3): 425-444.
- [52] United Nations. 2010. “World Urbanization Prospects: The 2009 Revision” Department of Economic and Social Affairs, Population Division (accessed July 21, 2010).
- [53] Wooldridge, Jeffrey Marc. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA, USA: MIT Press.





Panel A



Panel B

Figure 1 Land Price versus Private Credit (Japan)

*Notes.* The horizontal axes show the first difference in the land price and the vertical axes show the lagged first difference in private credit. In the Japanese economy, the relationship between the first difference in land price and the lagged first difference in private credit is consistent with Kiyotaki and Moore's (1997) model. In both Panel A and Panel B, we use the land price index of all urban land (DPL1). The outliers of 2002 and 2003 are eliminated from the sample in Panel B.

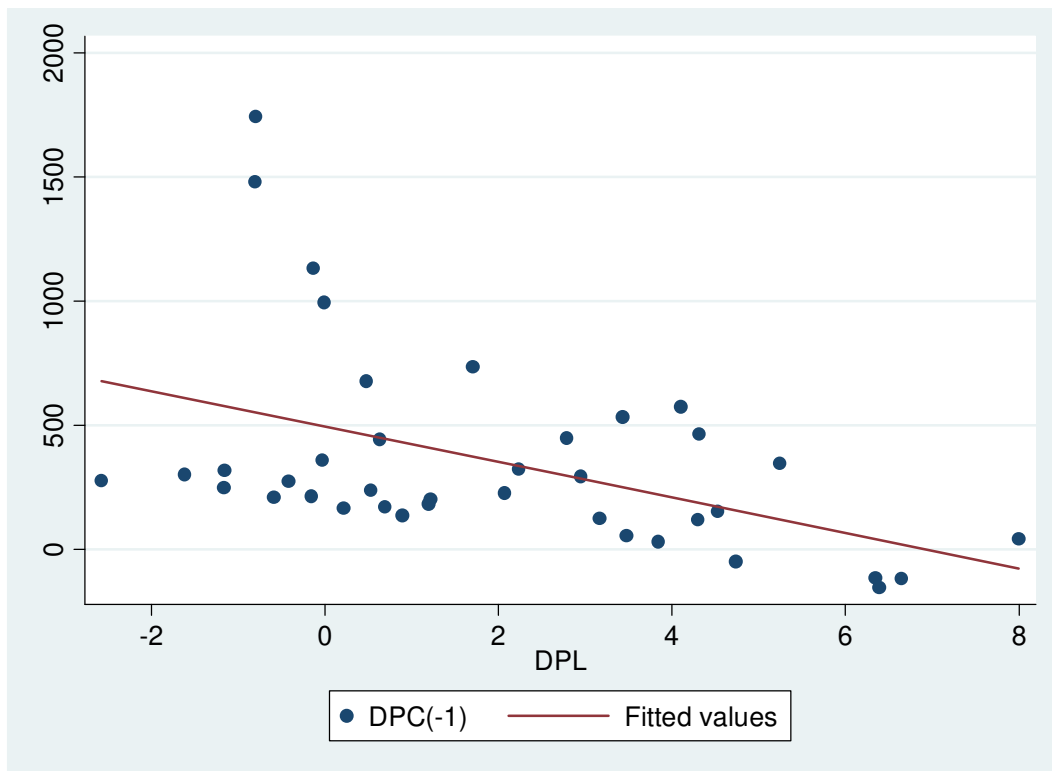


Figure 2 Land Price versus Private Credit (USA)

The horizontal axis shows the first difference in the land price and the vertical axis shows the lagged first difference in private credit. In the US economy, the relationship between the first difference in land price and the lagged first difference in private credit is not consistent with Kiyotaki and Moore's (1997) model.

**Table 1 Estimation Results (Current Account/Land Price)**

|       |     |                           | Dependent Variable: Current Account (CA) |                   |                   |                  |                   |               |             |           |
|-------|-----|---------------------------|--|-------------------|-------------------|------------------|-------------------|---------------|-------------|-----------|
| Japan |     | Estimation Periods (Obs.) | CA(-1)                                   | DZ                | DPL1              | DPL2             | CONS              | First stage F | Hansen test | R-squared |
| (1)   | OLS | 1967-2007 (41)            | 0.982a<br>(0.068)                        | 0.347a<br>(0.107) | -191a<br>(64.1)   |                  | -1118<br>(1152)   |               |             | 0.874     |
| (2)   | OLS | 1967-2007 (41)            | 0.930a<br>(0.046)                        | 0.263a<br>(0.063) | -179a<br>(65.8)   |                  |                   |               |             | 0.951     |
| (3)   | IV  | 1967-2001 (35)            | 0.889a<br>(0.055)                        | 0.311a<br>(0.095) | -119b<br>(71.5)   |                  | -630<br>(941)     | 22.5          |             |           |
| (4)   | IV  | 1969-2001 (33)            | 0.873a<br>(0.060)                        | 0.339a<br>(0.106) | -159b<br>(77.0)   |                  | -550<br>(1038)    | 14.8          | 0.773       |           |
| (5)   | OLS | 1967-2007 (41)            | 1.013a<br>(0.068)                        | 0.294a<br>(0.096) |                   | -52.4a<br>(15.5) | 1080<br>(1124)    |               |             | 0.865     |
| (6)   | OLS | 1967-2007 (41)            | 0.961a<br>(0.044)                        | 0.215a<br>(0.049) |                   | -48.2a<br>(14.3) |                   |               |             | 0.947     |
| (7)   | IV  | 1967-2002 (35)            | 0.899a<br>(0.053)                        | 0.293a<br>(0.092) |                   | -42.7b<br>(23.3) | -659<br>(966)     | 16.9          |             |           |
| (8)   | IV  | 1969-2001 (33)            | 0.882a<br>(0.055)                        | 0.315a<br>(0.100) |                   | -55.5b<br>(25.9) | -540<br>(10.52)   | 5.96          | 0.781       |           |
| USA   |     |                           | CA(-1)                                   | DZ                | DPL               |                  | CONS              |               |             | R-squared |
| (9)   | OLS | 1961-2000 (40)            | 0.856a<br>(0.081)                        | -0.189<br>(0.133) | -1.984<br>(3.270) |                  | 8.711a<br>(16.19) |               |             | 0.802     |
| (10)  | OLS | 1961-2000 (40)            | 0.851a<br>(0.079)                        | -0.142<br>(0.069) | -1.308<br>(2.706) |                  |                   |               |             | 0.872     |
| (11)  | IV  | 1962-2000 (39)            | 0.837a<br>(0.093)                        | -0.176<br>(0.136) | 3.029<br>(5.777)  |                  | -4.122<br>(21.11) | 12.6          |             |           |
| (12)  | IV  | 1965-2000 (36)            | 0.775a<br>(0.116)                        | -0.196<br>(0.136) | 5.074<br>(5.955)  |                  | -13.74<br>(23.15) | 5.45          | 0.236       |           |

*Notes.* The dependent variable is the current account (CA). Robust standard errors are in parentheses. a, b, and c indicate the 1%, 5%, and 10% significance levels for the one-sided test, respectively. In the estimation for Japan, DPL1 shows the first difference in the land price index of all urban land, and DPL2 shows the first difference in the land price index of six major cities. The results of the instrumental variable (IV) estimations are presented in columns (3)-(4), (7)-(8), and (11)-(12). In columns (3), (7), and (11), the one-period-lagged first difference of private credit is used for the instrumental variable, and the IV estimations are just identified. In columns (4), (8), and (12), the one-to-four-period-lagged first differences are used for the instrumental variables. In columns (8) and (12), The F-values for the tests of excluded instruments in the first-stage regressions are less than 10, and the estimations show the symptoms of weak instruments; however, the p-values of the LM tests for the significance of the coefficients of the first difference of the land price, which are robust to weak instruments, are 0.013 and 0.813, respectively. Therefore, the coefficient of the first difference of the land price in Japan is significantly positive, whereas that in the United States is insignificant.

**Table 2 OLS Estimation (The Current Account/Private Credit)**

| country                           | Breaking year    | Estimation periods (Obs.) | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|-----------------------------------|------------------|---------------------------|-------------------|--------------------|-------------------|-------------------|-----------|
| <b>[P-value of the Chow test]</b> |                  |                           |                   |                    |                   |                   |           |
| United Kingdom                    | 1992<br>[0.0372] | 1962–2007 (46)            | 0.623a<br>(0.097) | -0.089a<br>(0.024) | 0.217<br>(0.144)  | -2.054<br>(1.515) | 0.737     |
|                                   |                  | 1962–1991 (30)            | 0.572a<br>(0.093) | -0.143a<br>(0.023) | 0.421a<br>(0.012) | -2.038<br>(1.310) | 0.859     |
|                                   |                  | 1992–2007 (16)            | 0.573a<br>(0.093) | -0.018<br>(0.037)  | 0.167<br>(0.193)  | -7.034<br>(5.427) | 0.443     |
|                                   |                  | 1962–2007 (46)            | 0.633a<br>(0.100) | -0.097a<br>(0.023) | 0.126<br>(0.114)  |                   | 0.811     |
|                                   |                  | 1962–1991 (30)            | 0.577a<br>(0.099) | -0.151a<br>(0.025) | 0.315a<br>(0.105) |                   | 0.868     |
|                                   |                  | 1992–2007 (16)            | 0.691a<br>(0.247) | -0.040<br>(0.035)  | 0.076<br>(0.202)  |                   | 0.815     |
| Japan                             | 1983<br>[0.0016] | 1962–2007 (46)            | 0.997a<br>(0.055) | -0.016a<br>(0.004) | 0.275a<br>(0.088) | -700<br>(876)     | 0.879     |
|                                   |                  | 1962–1982 (21)            | 0.025<br>(0.250)  | 0.040<br>(0.035)   | 0.413a<br>(0.086) | -1958b<br>(853)   | 0.649     |
|                                   |                  | 1983–2007 (35)            | 0.947a<br>(0.183) | -0.015a<br>(0.005) | 0.337b<br>(0.197) | 133<br>(3193)     | 0.709     |
|                                   |                  | 1962–2007 (46)            | 0.965a<br>(0.040) | -0.016a<br>(0.004) | 0.218a<br>(0.046) |                   | 0.946     |
|                                   |                  | 1962–1982 (21)            | 0.195<br>(0.240)  | -0.008<br>(0.027)  | 0.269a<br>(0.051) |                   | 0.629     |
|                                   |                  | 1983–2007 (35)            | 0.954a<br>(0.045) | -0.015a<br>(0.005) | 0.343a<br>(0.087) |                   | 0.974     |
| USA                               |                  | 1962–2007 (46)            | 0.996a<br>(0.077) | 0.023<br>(0.026)   | -0.165<br>(0.158) | -1.482<br>(13.6)  | 0.903     |
|                                   |                  | 1962–2007 (46)            | 0.996a<br>(0.076) | 0.023<br>(0.026)   | -0.174<br>(0.104) |                   | 0.942     |
| Korea                             | 1998<br>[0.0000] | 1973–2007 (35)            | 0.686a<br>(0.096) | 0.042<br>(0.088)   | 0.623b<br>(0.280) | -6026b<br>(2854)  | 0.522     |
|                                   |                  | 1973–1997 (25)            | 0.850a<br>(0.139) | -0.264a<br>(0.042) | 0.923a<br>(0.131) | -3972a<br>(1275)  | 0.823     |
|                                   |                  | 1998–2007 (10)            | -0.149<br>(0.254) | 0.213<br>(0.083)   | 0.385<br>(0.568)  | 16944<br>(10386)  | 0.563     |
|                                   |                  | 1973–2007 (35)            | 0.626a<br>(0.101) | 0.019<br>(0.082)   | 0.307b<br>(0.129) |                   | 0.510     |
|                                   |                  | 1973–1997 (25)            | 0.880a<br>(0.139) | -0.289a<br>(0.044) | 0.739a<br>(0.101) |                   | 0.771     |
|                                   |                  | 1998–2007 (10)            | 0.192<br>(0.187)  | 0.232<br>(0.090)   | 1.030a<br>(0.378) |                   | 0.854     |

*Notes.* The dependent variable is the current account. If the coefficient of DPC(-1) is positive and significant, then a collateral-based lending system is embedded in the country. Robust standard errors are in parentheses. a, b, and c indicate the 1%, 5%, and 10% significance levels for the one-sided test, respectively. The breaking years of the Chow test are under country names (if any), and the values in square brackets are the p-values of the test.

Table 2 (Continued)

| country     | Breaking year    | Estimation periods (Obs.) | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|-------------|------------------|---------------------------|-------------------|--------------------|-------------------|-------------------|-----------|
| Costta Rica | 1987<br>[0.0000] | 1962-2001 (40)            | 0.890a<br>(0.075) | -0.204<br>(0.156)  | 0.085b<br>(0.037) | -26.8b<br>(11.0)  | 0.786     |
|             |                  | 1962-1986 (25)            | 0.963a<br>(0.050) | -0.695a<br>(0.167) | 0.422a<br>(0.097) | -17.5b<br>(8.318) | 0.919     |
|             |                  | 1987-2001 (15)            | -0.082<br>(0.212) | -0.382b<br>(0.182) | 0.038<br>(0.034)  | -248a<br>(39.5)   | 0.414     |
|             |                  | 1962-2001 (40)            | 1.052a<br>(0.058) | -0.099<br>(0.167)  | 0.142a<br>(0.054) |                   | 0.955     |
|             |                  | 1962-1986 (25)            | 1.057a<br>(0.046) | -0.771a<br>(0.180) | 0.378a<br>(0.093) |                   | 0.973     |
|             |                  | 1987-2001 (15)            | 1.100a<br>(0.086) | 0.035<br>(0.222)   | 0.096b<br>(0.053) |                   | 0.950     |
| Kenya       | 1994<br>[0.0000] | 1966-2006 (41)            | 0.655a<br>(0.185) | -0.879<br>(0.561)  | -0.235<br>(0.338) | -22100<br>(12102) | 0.578     |
|             |                  | 1966-1993 (28)            | 0.561a<br>(0.110) | -1.640a<br>(0.525) | 0.305a<br>(0.104) | -12083<br>(5985)  | 0.686     |
|             |                  | 1994-2006 (13)            | 0.355<br>(0.354)  | -1.465b<br>(0.723) | -0.513<br>(0.204) | -87059<br>(39084) | 0.680     |
|             |                  | 1966-2006 (41)            | 0.806a<br>(0.128) | -0.895<br>(0.705)  | -0.271<br>(0.349) |                   | 0.792     |
|             |                  | 1966-1993 (28)            | 0.700a<br>(0.088) | -1.929a<br>(0.542) | 0.303a<br>(0.114) |                   | 0.899     |
|             |                  | 1994-2006 (13)            | 0.837a<br>(0.175) | 0.178<br>(0.511)   | -0.904<br>(0.246) |                   | 0.863     |
| Malaysia    | 1998<br>[0.0000] | 1962-2007 (46)            | 0.862a<br>(0.062) | 0.069<br>(0.115)   | 0.885a<br>(0.218) | -4145a<br>(1255)  | 0.953     |
|             |                  | 1962-1997 (26)            | 0.895a<br>(0.124) | -0.121a<br>(0.029) | 0.717a<br>(0.163) | -2037a<br>(830)   | 0.795     |
|             |                  | 1998-2007 (20)            | 0.789a<br>(0.070) | 0.466<br>(0.151)   | 0.464b<br>(0.193) | 3631<br>(3963)    | 0.953     |
|             |                  | 1962-2007 (46)            | 0.847a<br>(0.072) | 0.006<br>(0.113)   | 0.789a<br>(0.235) |                   | 0.949     |
|             |                  | 1962-1997 (26)            | 0.867a<br>(0.148) | -0.162a<br>(0.030) | 0.589a<br>(0.136) |                   | 0.787     |
|             |                  | 1998-2007 (20)            | 0.823a<br>(0.047) | 0.476<br>(0.130)   | 0.523b<br>(0.209) |                   | 0.993     |
| Thailand    | 1997<br>[0.0029] | 1968-2007 (40)            | 0.828a<br>(0.142) | -0.082<br>(0.071)  | 1.042a<br>(0.185) | -86.5a<br>(15.3)  | 0.842     |
|             |                  | 1968-1996 (29)            | 0.577a<br>(0.152) | -0.237a<br>(0.060) | 0.576a<br>(0.142) | -52.1a<br>(16.7)  | 0.927     |
|             |                  | 1997-2007 (11)            | 0.891a<br>(0.258) | 0.035<br>(0.117)   | 1.101a<br>(0.304) | -86.7<br>(72.5)   | 0.633     |
|             |                  | 1968-2007 (40)            | 0.751a<br>(0.151) | -0.116<br>(0.088)  | 0.672a<br>(0.168) |                   | 0.756     |
|             |                  | 1968-1996 (29)            | 0.841a<br>(0.132) | -0.187a<br>(0.068) | 0.372a<br>(0.129) |                   | 0.935     |
|             |                  | 1997-2007 (11)            | 0.687a<br>(0.189) | 0.001<br>(0.110)   | 0.852a<br>(0.188) |                   | 0.842)    |

**Table 3 Probit Estimation**

|                          | Collateral based lending 80 |                    |                    |                    | Collateral based lending 90 |                    |                    |                    |
|--------------------------|-----------------------------|--------------------|--------------------|--------------------|-----------------------------|--------------------|--------------------|--------------------|
|                          | (1)                         | (2)                | (3)                | (4)                | (5)                         | (6)                | (7)                | (8)                |
| Legal protection 80      | 0.322a<br>(0.091)           | 0.338a<br>(0.098)  | 0.308a<br>(0.091)  | 0.320a<br>(0.095)  |                             |                    |                    |                    |
| Legal protection 90      |                             |                    |                    |                    | 0.207a<br>(0.076)           | 0.243a<br>(0.088)  | 0.159c<br>(0.084)  | 0.195b<br>(0.089)  |
| Urban 50                 | -0.024a<br>(0.008)          | -0.022b<br>(0.009) | -0.026b<br>(0.012) | -0.025c<br>(0.013) | -0.011c<br>(0.007)          | -0.008<br>(0.007)  | -0.021b<br>(0.009) | -0.019b<br>(0.009) |
| Financial openness 80    |                             | -0.055<br>(0.145)  |                    | -0.051<br>(0.147)  |                             |                    |                    |                    |
| Financial openness 90    |                             |                    |                    |                    |                             | -0.127<br>(0.153)  |                    | -1.172<br>(0.175)  |
| Log of GDP per capita 70 |                             |                    | 0.096<br>(0.329)   | 0.137<br>(0.347)   |                             |                    | 0.372<br>(0.280)   | 0.470<br>(0.311)   |
| Constant                 | -0.742c<br>(0.444)          | -0.896c<br>(0.517) | -1.275<br>(1.951)  | -1.654<br>(2.095)  | -0.826b<br>(0.390)          | -1.106b<br>(0.492) | -2.825c<br>(1.610) | -3.725c<br>(1.938) |
| P-value of the Wald test | 0.001                       | 0.006              | 0.004              | 0.012              | 0.024                       | 0.079              | 0.033              | 0.056              |
| Observations             | 65                          | 62                 | 65                 | 62                 | 80                          | 78                 | 80                 | 78                 |

*Notes.* The dependent variable is an index for collateral-based lending. Robust standard errors are in parentheses. a, b, and c indicate the 1%, 5%, and 10% significance levels for the two-sided test, respectively. The null hypothesis of the Wald test is that all the coefficients are zero.

**Table 4 Probit Estimation with Instruments**

|                          | Collateral based lending 80 |                    |                    |                    | Collateral based lending 90 |                    |                    |                    |
|--------------------------|-----------------------------|--------------------|--------------------|--------------------|-----------------------------|--------------------|--------------------|--------------------|
|                          | (1)                         | (2)                | (3)                | (4)                | (5)                         | (6)                | (7)                | (8)                |
| Legal protection 80      | 0.463a<br>(0.138)           | 0.487a<br>(0.149)  | 0.513a<br>(0.147)  | 0.519a<br>(0.192)  |                             |                    |                    |                    |
| Legal protection 90      |                             |                    |                    |                    | 0.314a<br>(0.109)           | 0.348b<br>(0.148)  | 0.289c<br>(0.157)  | 0.275<br>(0.186)   |
| Urban 50                 | -0.034a<br>(0.010)          | -0.031a<br>(0.010) | -0.030b<br>(0.012) | -0.028b<br>(0.013) | -0.019b<br>(0.008)          | -0.012<br>(0.008)  | -0.022b<br>(0.009) | -0.020b<br>(0.009) |
| Financial openness 80    |                             | -0.108<br>(0.149)  |                    | -0.116<br>(0.148)  |                             |                    |                    |                    |
| Financial openness 90    |                             |                    |                    |                    |                             | -0.220<br>(0.183)  |                    | -0.224<br>(0.193)  |
| Log of GDP per capita 70 |                             |                    | -0.216<br>(0.409)  | -0.136<br>(0.416)  |                             |                    | 0.126<br>(0.381)   | 0.357<br>(0.370)   |
| Constant                 | -1.152b<br>(0.580)          | -1.405b<br>(0.690) | -0.034<br>(2.227)  | -0.708<br>(2.288)  | -1.163b<br>(0.519)          | -1.512b<br>(0.756) | -1.804<br>(1.901)  | -3.335c<br>(1.992) |
| First stage F statistic  | 27.5                        | 8.05               | 10.2               | 4.05               | 21.14                       | 16.18              | 8.17               | 7.83               |
| LM test                  | p=0.012                     | p=0.020            | p=0.026            | p=0.042            | p=0.017                     | p=0.036            | p=0.113            | p=0.171            |
| J test                   | p=0.695                     | p=0.490            | p=0.766            | p=0.529            | p=0.652                     | p=0.579            | p=0.665            | p=0.660            |
| Observations             | 64                          | 61                 | 64                 | 61                 | 78                          | 76                 | 78                 | 78                 |

*Notes.* The dependent variable is an index for collateral-based lending. The conditional maximum-likelihood estimators are used. Instrumental variables are legal origin (France, Germany, and Scandinavians) and School 60. Robust standard errors are in parentheses. a, b, and c indicate the 1%, 5%, and 10% significance levels for the two-sided test, respectively. The first-stage F statistic is for a test of excluded instrumental variables in the first-stage regressions. The LM test for the significance of an endogenous variable is robust to weak instruments. The J test is a test of the overidentifying restrictions. ``p=" is the p-value for a test.

**Table 5 Probit Estimation with Instruments**

|                          | Collateral based lending 80 |                    |                    |                    | Collateral based lending 90 |                    |                    |                    |
|--------------------------|-----------------------------|--------------------|--------------------|--------------------|-----------------------------|--------------------|--------------------|--------------------|
|                          |                             |                    |                    |                    |                             |                    |                    |                    |
| Legal protection 80      | 0.745a<br>(0.070)           | 0.781a<br>(0.073)  | 0.747a<br>(0.067)  | 0.785a<br>(0.069)  |                             |                    |                    |                    |
| Legal protection 90      |                             |                    |                    |                    | 0.660a<br>(0.066)           | 0.696a<br>(0.065)  | 0.676a<br>(0.060)  | 0.705a<br>(0.068)  |
| Urban 50                 | -0.051a<br>(0.006)          | -0.044a<br>(0.007) | -0.046a<br>(0.013) | -0.036b<br>(0.014) | -0.032a<br>(0.007)          | -0.022a<br>(0.007) | -0.017c<br>(0.010) | -0.007<br>(0.009)  |
| Financial openness 80    |                             | -0.263<br>(0.188)  |                    | -0.277<br>(0.179)  |                             |                    |                    |                    |
| Financial openness 90    |                             |                    |                    |                    |                             | -0.411b<br>(0.182) |                    | -0.374b<br>(0.169) |
| Log of GDP per capita 70 |                             |                    | -0.181<br>(0.422)  | -0.274<br>(0.424)  |                             |                    | -0.626b<br>(0.288) | -0.630b<br>(0.264) |
| Constant                 | -2.190a<br>(0.367)          | -2.651a<br>(0.530) | -1.126<br>(2.518)  | -1.065<br>(2.522)  | -2.436a<br>(0.335)          | -2.902a<br>(0.430) | 1.230<br>(1.812)   | 0.849<br>(1.623)   |
| First stage F statistic  | 6.87                        | 6.19               | 4.35               | 3.56               | 3.52                        | 1.19               | 0.87               | 0.10               |
| AR test                  | p=0.005                     | p=0.006            | p=0.007            | p=0.008            | p=0.001                     | p=0.001            | p=0.003            | p=0.003            |
| Observations             | 42                          | 42                 | 42                 | 42                 | 52                          | 52                 | 52                 | 52                 |

*Notes.* The dependent variable is an index for collateral-based lending. The conditional maximum-likelihood estimators are used. The mortality rate of settlers is used as an instrumental variable. Robust standard errors are in parentheses. a, b, and c indicate the 1%, 5%, and 10% significance levels for the two-sided test, respectively. The first stage F statistic is for a test of excluded instrumental variables in the first-stage regressions. The Anderson-Rubin (AR) test for the significance of an endogenous variable is robust to weak instruments. "p=" is the p-value for a test.

**Table 6 Probit Estimation with Instruments**

|                          | Collateral based lending 90 |                    |                    |                    | Collateral based lending 90 |                   |                    |                    |
|--------------------------|-----------------------------|--------------------|--------------------|--------------------|-----------------------------|-------------------|--------------------|--------------------|
|                          |                             |                    |                    |                    |                             |                   |                    |                    |
| Legal protection 96      | 0.778a<br>(0.274)           | 0.677b<br>(0.307)  | 0.711b<br>(0.350)  | 0.537<br>(0.373)   |                             |                   |                    |                    |
| Legal protection 98      |                             |                    |                    |                    | 0.784a<br>(0.279)           | 0.836b<br>(0.339) | 0.758b<br>(0.387)  | 0.718c<br>(0.413)  |
| Urban 50                 | -0.020b<br>(0.009)          | -0.016c<br>(0.009) | -0.029b<br>(0.009) | -0.021b<br>(0.010) | -0.021b<br>(0.009)          | -0.016<br>(0.010) | -0.022b<br>(0.009) | -0.020b<br>(0.010) |
| Financial openness 80    |                             | -0.027<br>(0.116)  |                    | -0.038<br>(0.125)  |                             |                   |                    |                    |
| Financial openness 90    |                             |                    |                    |                    |                             | -0.157<br>(0.145) |                    | -0.191<br>(0.163)  |
| Log of GDP per capita 70 |                             |                    | 0.140<br>(0.307)   | 0.286<br>(0.309)   |                             |                   | 0.043<br>(0.340)   | 0.262<br>(0.351)   |
| Constant                 | 0.429<br>(0.285)            | 0.308<br>(0.299)   | -0.446<br>(1.989)  | -1.493<br>(2.000)  | 0.497<br>(0.314)            | 0.387<br>(0.332)  | 0.222<br>(2.280)   | -1.282<br>(2.357)  |
| First stage F statistic  | 21.84                       | 20.32              | 11.32              | 10.59              | 24.10                       | 16.25             | 10.26              | 10.15              |
| LM test                  | p=0.013                     | p=0.041            | p=0.062            | p=0.161            | p=0.015                     | p=0.027           | p=0.073            | p=0.106            |
| J test                   | p=0.820                     | p=0.918            | p=0.822            | p=0.930            | p=0.757                     | p=0.687           | p=0.757            | p=0.744            |
| Observations             | 85                          | 80                 | 85                 | 80                 | 85                          | 83                | 85                 | 83                 |

*Notes.* The dependent variable is an index for collateral-based lending. The conditional maximum-likelihood estimators are used. Instrumental variables are legal origin (France, Germany, and Scandinavians) and School 60. Robust standard errors are in parentheses. a, b, and c indicate the 1%, 5%, and 10% significance levels for the two-sided test, respectively. The first stage F statistic is for a test of excluded instrumental variables in the first-stage regressions. The LM test for the significance of an endogenous variable is robust to weak instruments. The J test is a test of the overidentifying restrictions. "p=" is the p-value for a test.

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## Binding Credit Constraint

The claim that there exists  $T$  such that from time  $T$  onwards, Eq.(7) is always binding is proven taking two steps. Step 1 claims that each borrower faces credit constraints at least once over his lifetime. Step 2 claims that if a borrower faces a credit constraint at time  $T$ , then the credit constraints are binding from  $T$  onward.

First, step 1 is proven by contradiction. Suppose that Eq.(7) is never binding. Then  $\phi_t = 0$  for all  $t$ , and thus the Euler equation for a borrower becomes:

$$c_{t+1} = \beta R c_t, \quad (35)$$

and the dynamic equation for the land price is given by:

$$q_{t+1} = R q_t - a(1 - \tau). \quad (36)$$

From Eq.(36) and the transversality condition,  $q_t$  must be constant for all  $t \geq 0$  and is given by:

$$q_t = \frac{a(1 - \tau)}{R - 1}.$$

From this, Eq.(13) is reduced to:

$$G'_1(x_t^*) = a,$$

which implies that  $x_t$  and  $x_t^*$  become constant as well. Then the budget constraint (6) becomes:

$$c_t + R b_{t-1} = a(1 - \tau)\tilde{x} + b_t, \quad (37)$$

where  $\tilde{x} := \bar{X}/\lambda - (1 - \lambda)G_1'^{-1}(a)/\lambda$ . From Eqs.(27), (29) and the transversality condition, we can obtain the dynamics of  $b_t$  as follows:

$$b_t = \frac{\beta c_0}{\beta - 1}(\beta R)^t + \frac{a(1 - \tau)\tilde{x}}{R - 1},$$

where  $c_0$  is the initial value of consumption. Because  $\beta < 1$  and  $R\beta < 1$ ,  $b_t$  is increasing and converges to  $a(1 - \tau)\tilde{x}/(R - 1)$ . However, this is a contradiction



because the right-hand side of Eq.(7) is equal to  $a(1 - \tau)\tilde{x}/R(R - 1) < a(1 - \tau)\tilde{x}/(R - 1)$ .

Next, we will show step 2. Suppose that the claim of step 2 does not hold. More concretely, suppose that Eq.(7) is not binding at time  $t$  when it is binding at time  $t - 1$ . In this case, we have the Euler equations at time  $t - 1$  and  $t$ , respectively, as follows:

$$c_t = \frac{(1 - \tau)a\beta}{u_{t-1}}c_{t-1} \quad (38)$$

$$c_{t+1} = \beta R c_t, \quad (39)$$

which implies that  $u_t$  becomes constant and is given by  $\tilde{u} := (1 - \tau)a/R$ . From Eq.(13),  $x_t^*$  and  $x_t$  become constant as well and are given by  $\tilde{x}^* := G_1^{\prime-1}(a)$  and  $\tilde{x} := \bar{X}/\lambda - (1 - \lambda)G_1^{\prime-1}(a)/\lambda$ , respectively.

Because the first equality of Eq.(17) holds whether Eq.(7) is binding or not, it follows from Eq.(17), Eq.(39) and  $q_{t+1} = Rq_t - (1 - \tau)a$  that  $b_t = q_t\tilde{x} - \beta a(1 - \tau)x_{t-1}$ . From the last, however, we have:

$$\begin{aligned} Rb_t - q_{t+1}\tilde{x} &= (1 - \tau)a/\lambda(\lambda\tilde{x} - \beta R\lambda x_{t-1}) \\ &> (1 - \tau)a/\lambda(\lambda\tilde{x} - \beta R\bar{X}) \\ &= (1 - \tau)(1 - \lambda)a/\lambda((1 - \beta R)\bar{X}/(1 - \lambda) - G_1^{\prime-1}(a)) > 0, \end{aligned}$$

where the last inequality comes from Eq.(4). This is a contradiction. From mathematical induction, we have a desired conclusion.  $\square$

## Tests for the Stationarity

In the diagnosis for the stationarity tests in table A1 in the unpublished appendix, “pass” means that the hypothesis of no unit root is accepted both by the DF test without trend and by the KPSS test without trend, or both by the DF test with trend and by the KPSS test with trend. “Mixed” means that the hypothesis of no unit root is accepted either by the DF test without trend or by the KPSS test without trend, or either by the DF test with trend or by the KPSS test with trend. “Caution” means that none of the tests accepts the hypothesis of no unit root.

Because we cannot discuss the results for the stationarity tests country by country due to space constraints, we briefly comment on the results in order. First, for the first difference in the net output, 91 cases out of 98 cases are labeled “pass,” while seven cases are labeled “mixed.” However, for six

out of these seven “mixed” cases, the DF test with trend or without trend rejects the null hypothesis of a unit root at the 0.1% significance level. Then we judge that the first differences in the net output of these countries follow stationary processes with or without trend. For Central Africa, which is the last case, the  $p$ -value for the DF test without trend is 8%, and neither the KPSS test with trend nor the one without trend rejects the null hypothesis of no unit root. Then, we also judge that the first difference in the net output of Central Africa follows a stationary process.

For the first difference in private credit, 24 cases out of 98 cases are labeled “pass,” 73 cases are labeled “mixed,” and one case is labeled “caution.” The one “caution” case is that of India. Due to industrialization, the private credit of India has increases since the late 1990s. The non-stationarity of the first difference in private credit is caused by this boost. India might have experienced a structural change for the process of its private credit in the late 1990s. If a time series includes a structural change, the DF test hardly rejects the null hypothesis.

The stationarity of the first differences in private credit for the 73 “mixed” cases cannot be determined. However, if the first difference in private credit follows a unit root process and the first difference in the net output is stationary in a country, then the inter-temporal budget constraints of agents in the country do not hold. Therefore, we reasonably assume that the first difference in private credit follows a stationary process.

For the current account, 16 cases out of 98 cases are labeled “pass,” 75 cases are labeled “mixed,” and six cases are labeled “caution.” These six “caution” cases are those of Algeria, Grenada, Honduras, Jamaica, Madagascar, and Malaysia. These six countries are categorized into two groups. One is a group for which the current account suddenly started to increase in the mid 1990s, and the other is a group for which the current account suddenly started to decrease in the mid 1990s. The first group includes Algeria and Malaysia and the second group consists of Grenada, Honduras, Jamaica, and Madagascar. Due to the structural change for the current account, the null hypothesis of stationarity cannot be accepted. The phenomena appearing in these six countries have likely been the result of financial globalization since the mid 1990s.

The stationarity (with or without trend) of the current account cannot be accepted in the “caution” countries and cannot be determined in the “mixed” countries. However, for the inter-temporal budget constraint of a country to be satisfied, the country’s current account must follow a stationary process

with or without trend. The current account should be adjusted in the future so that the feasibility condition in a country holds.

In sum, from a theoretical viewpoint, if  $DZ$  follows a stationary process (with or without trend), then the variables,  $CA$  and  $DPC$ , must follow stationary processes.

## Tables

[Table A1 around here]

[Table A2 around here]

**Table A1.** Tests for stationarity. The null hypothesis of the DF test is that the time series has a unit root, for which the Mackinnon approximate p-values are entered. The null hypothesis of the KPSS test is that the time series does not have a unit root, for which the test statistics are entered. a and b indicate significance at the 1% and 5% level for the KPSS test, respectively. In the column of diagnosis, "pass" means that the hypothesis of no unit root is accepted both by the DF test without trend and by the KPSS test without trend, or both by the DF test with trend and by the KPSS test with trend. "Mixed" means that the hypothesis of no unit root is accepted either by the DF test without trend or by the KPSS test without trend, or either by the ADF test with trend or by the KPSS test with trend. "Caution" means that none of the tests accepts the hypothesis of no unit root.

| Country        | variable (Obs.) | DF test without trend | DF test with trend | The KPSS test without trend<br>5% significance level: 0.463 | The KPSS test with trend<br>5% significance level: 0.146 | diagnosis |
|----------------|-----------------|-----------------------|--------------------|---|--|-----------|
| United Kingdom | CA (47)         | 0.2539                | 0.2093             | 0.525b  | 0.0416   | mixed     |
|                | DPC (45)        | 0.5146                | 0.2817             | 0.578b  | 0.0572   | mixed     |
|                | DZ (46)         | 0.0000                | 0.000              | 0.486b  | 0.0839   | pass      |
| Greece         | CA (41)         | 0.1167                | 0.3428             | 0.213   | 0.161b   | mixed     |
|                | DPC (39)        | 0.3219                | 0.5756             | 0.147   | 0.103  | mixed     |
|                | DZ (40)         | 0.0000                | 0.0000             | 0.111   | 0.095  | pass      |
| Japan          | CA (47)         | 0.9244                | 0.3286             | 0.842b  | 0.0854   | mixed     |
|                | DPC (45)        | 0.0450                | 0.1156             | 0.256   | 0.130  | pass      |
|                | DZ (46)         | 0.0005                | 0.0003             | 0.413   | 0.0935   | pass      |
|                | DLP1(41)        | 0.1219                | 0.2123             | 0.340   | 0.0656   | mixed     |
| United States  | DLP2 (41)       | 0.1272                | 0.3520             | 0.133   | 0.0651   | mixed     |
|                | CA (47)         | 0.9123                | 0.3916             | 0.813a  | 0.123  | mixed     |
|                | DPC (45)        | 0.3061                | 0.1282             | 0.650b  | 0.138  | mixed     |
|                | DZ (46)         | 0.0005                | 0.0004             | 0.509b  | 0.0749   | pass      |
| Korea          | DLP             | 0.1949                | 0.5140             | 0.189   | 0.186b   | mixed     |
|                | CA (36)         | 0.0628                | 0.0286             | 0.547b  | 0.072  | pass      |
|                | DPC (34)        | 0.5800                | 0.9692             | 0.248   | 0.162b   | mixed     |
| Australia      | DZ (35)         | 0.0031                | 0.0044             | 0.402   | 0.125  | pass      |
|                | CA (37)         | 0.7718                | 0.0842             | 0.750a  | 0.0981   | mixed     |
|                | DPC (37)        | 0.9307                | 0.4884             | 0.757a  | 0.136  | mixed     |
| Canada         | DZ (37)         | 0.0000                | 0.0000             | 0.640b  | 0.112  | pass      |
|                | CA (47)         | 0.4022                | 0.6293             | 0.234   | 0.148b   | mixed     |
|                | DPC (45)        | 0.0028                | 0.0015             | 0.592b  | 0.142  | pass      |
| Botswana       | DZ (46)         | 0.0000                | 0.0001             | 0.201   | 0.0676   | pass      |
|                | CA (32)         | 0.5587                | 0.0776             | 0.691b  | 0.0715   | mixed     |
|                | DPC (30)        | 0.4644                | 0.5172             | 0.425   | 0.0615   | mixed     |
| India          | DZ (31)         | 0.0000                | 0.0000             | 0.258   | 0.0939   | pass      |
|                | CA (36)         | 0.0070                | 0.0362             | 0.115   | 0.0923   | pass      |
|                | DPC (36)        | 0.9991                | 1.000              | 0.560b  | 0.177b   | caution   |
| Austria        | DZ (36)         | 0.7383                | 0.0000             | 0.708b  | 0.165b   | mixed     |
|                | CA (37)         | 0.0320                | 0.0669             | 0.218   | 0.0756   | pass      |
|                | DPC (35)        | 0.1114                | 0.1627             | 0.416   | 0.0596   | mixed     |
|                | DZ (36)         | 0.0000                | 0.0000             | 0.121   | 0.096  | pass      |

**Table A1 (Continued)**

| Country        | variable (Obs.) | DF test without trend | DF test with trend | The KPSS test without trend<br>The 5% significance level: 0.463 | The KPSS test with trend<br>The 5% significance level: 0.146 | diagnosis |
|----------------|-----------------|-----------------------|--------------------|---|--|-----------|
| Burundi        | CA (36)         | 0.2108                | 0.3006             | 0.504b  | 0.0768   | mixed     |
|                | DPC (34)        | 0.0198                | 0.0941             | 0.0383  | 0.0379   | pass      |
|                | DZ (35)         | 0.0000                | 0.0000             | 0.123   | 0.0775   | pass      |
| Belgium        | CA (37)         | 0.9819                | 0.9713             | 0.423   | 0.199b   | mixed     |
|                | DPC (35)        | 0.0091                | 0.0203             | 0.351   | 0.127  | pass      |
|                | DZ (36)         | 0.0000                | 0.0000             | 0.12  | 0.104  | pass      |
| BurkinaFaso    | CA (36)         | 0.7606                | 0.7384             | 0.395   | 0.119  | mixed     |
|                | DPC (34)        | 0.396                 | 0.6410             | 0.191   | 0.124  | mixed     |
|                | DZ (35)         | 0.0000                | 0.0000             | 0.458   | 0.0615   | pass      |
| Bahrain        | CA (20)         | 0.7698                | 0.9023             | 0.298   | 0.164b   | mixed     |
|                | DPC (18)        | 0.2490                | 0.5075             | 0.174   | 0.0655   | mixed     |
|                | DZ (19)         | 0.0034                | 0.0024             | 0.311   | 0.0872   | pass      |
| Belize         | CA (22)         | 0.6588                | 0.9795             | 0.463b  | 0.0825   | mixed     |
|                | DPC (20)        | 0.5109                | 0.9733             | 0.177   | 0.0909   | mixed     |
|                | DZ (21)         | 0.0000                | 0.0000             | 0.191   | 0.0729   | pass      |
| Bolivia        | CA (23)         | 0.6697                | 0.9033             | 0.165   | 0.158b   | mixed     |
|                | DPC (21)        | 0.4244                | 0.6529             | 0.192   | 0.122  | mixed     |
|                | DZ (22)         | 0.0000                | 0.0000             | 0.435   | 0.0959   | pass      |
| Barbados       | CA (23)         | 0.1773                | 0.1920             | 0.442   | 0.108  | mixed     |
|                | DPC (21)        | 0.0011                | 0.0166             | 0.217   | 0.0829   | pass      |
|                | DZ (22)         | 0.0007                | 0.0064             | 0.147   | 0.114  | pass      |
| Bhutan         | CA (22)         | 0.2104                | 0.2825             | 0.397   | 0.128  | mixed     |
|                | DPC (20)        | 0.9041                | 0.7728             | 0.467b  | 0.138  | mixed     |
|                | DZ (21)         | 0.0137                | 0.0986             | 0.081   | 0.0677   | pass      |
| Central Africa | CA (20)         | 0.0626                | 0.0560             | 0.445   | 0.109  | mixed     |
|                | DPC (18)        | 0.5659                | 0.5059             | 0.351   | 0.108  | mixed     |
|                | DZ (19)         | 0.0779                | 0.1819             | 0.226   | 0.115  | mixed     |
| Switzerland    | CA (27)         | 0.9458                | 0.5011             | 0.687b  | 0.0724   | mixed     |
|                | DPC (27)        | 0.5383                | 0.9088             | 0.195   | 0.102  | mixed     |
|                | DZ (27)         | 0.0297                | 0.1481             | 0.153   | 0.142  | pass      |
| Chile          | CA (33)         | 0.6015                | 0.8536             | 0.162   | 0.15   | mixed     |
|                | DPC (31)        | 0.9899                | 0.9875             | 0.529b  | 0.115  | mixed     |
|                | DZ (32)         | 0.0020                | 0.0004             | 0.469b  | 0.11   | pass      |
| Côte d'Ivoire  | CA (46)         | 0.0965                | 0.0740             | 0.556b  | 0.0806   | mixed     |
|                | DPC (44)        | 0.2168                | 0.3183             | 0.365   | 0.111  | mixed     |
|                | DZ (45)         | 0.0000                | 0.0001             | 0.0432  | 0.0413   | pass      |

**Table A1 (Continued)**

| Country            | variable (Obs.) | DF test without trend | DF test with trend | The KPSS test without trend<br>The 5% significance level: 0.463 | The KPSS test with trend<br>The 5% significance level: 0.146 | diagnosis |
|--------------------|-----------------|-----------------------|--------------------|---|--|-----------|
| Cameroon           | CA (37)         | 0.0166                | 0.0134             | 0.419   | 0.0997   | pass      |
|                    | DPC (35)        | 0.2033                | 0.4671             | 0.226   | 0.111  | mixed     |
|                    | DZ (36)         | 0.0000                | 0.0003             | 0.138   | 0.138  | pass      |
| Colombia           | CA (20)         | 0.3559                | 0.6997             | 0.132   | 0.112  | mixed     |
|                    | DPC (20)        | 0.0829                | 0.0812             | 0.39  | 0.0532   | mixed     |
|                    | DZ (20)         | 0.0036                | 0.0254             | 0.0836  | 0.0843   | pass      |
| Costta Rica        | CA (41)         | 0.6383                | 0.0413             | 0.751a  | 0.0988   | pass      |
|                    | DPC (39)        | 0.5329                | 0.6445             | 0.322   | 0.149b   | mixed     |
|                    | DZ (40)         | 0.0000                | 0.0000             | 0.292   | 0.0823   | pass      |
| Cyprus             | CA (47)         | 0.6169                | 0.4876             | 0.496b  | 0.114  | mixed     |
|                    | DPC (45)        | 0.7547                | 0.1820             | 0.754a  | 0.112  | mixed     |
|                    | DZ (46)         | 0.0000                | 0.0000             | 0.556b  | 0.077  | pass      |
| Germany            | CA (29)         | 0.6618                | 0.8560             | 0.124   | 0.0779   | mixed     |
|                    | DPC (27)        | 0.0889                | 0.2988             | 0.0356  | 0.0356   | mixed     |
|                    | DZ (28)         | 0.0413                | 0.1742             | 0.0921  | 0.095  | pass      |
| Dominica           | CA (25)         | 0.1823                | 0.0125             | 0.436   | 0.183  | pass      |
|                    | DPC (23)        | 0.5132                | 0.7765             | 0.18  | 0.176  | mixed     |
|                    | DZ (24)         | 0.0000                | 0.0001             | 0.407   | 0.16   | pass      |
| Denmark            | CA (37)         | 0.5635                | 0.2247             | 0.742a  | 0.126  | mixed     |
|                    | DPC (37)        | 0.0353                | 0.0341             | 0.417   | 0.109  | pass      |
|                    | DZ (37)         | 0.0000                | 0.0000             | 0.0995  | 0.0857   | pass      |
| Dominican Republic | CA (27)         | 0.9704                | 0.6397             | 0.651b  | 0.131  | mixed     |
|                    | DPC (27)        | 0.1084                | 0.3393             | 0.0909  | 0.091  | mixed     |
|                    | DZ (27)         | 0.0000                | 0.0001             | 0.327   | 0.078  | pass      |
| Algeria            | CA (27)         | 0.9666                | 0.8649             | 0.509b  | 0.179b   | caution   |
|                    | DPC (25)        | 0.1652                | 0.4298             | 0.161   | 0.153b   | mixed     |
|                    | DZ (26)         | 0.0012                | 0.0018             | 0.346   | 0.13   | pass      |
| Ecuador            | CA (39)         | 0.0006                | 0.0016             | 0.267   | 0.0795   | pass      |
|                    | DPC (37)        | 0.0620                | 0.1729             | 0.16  | 0.0802   | mixed     |
|                    | DZ (38)         | 0.0003                | 0.0015             | 0.195   | 0.0879   | pass      |
| Egypt              | CA (47)         | 0.1786                | 0.4615             | 0.421   | 0.191b   | mixed     |
|                    | DPC (45)        | 0.4125                | 0.7678             | 0.396   | 0.0617   | mixed     |
|                    | DZ (46)         | 0.0000                | 0.0000             | 0.67b   | 0.0955   | pass      |
| Spain              | CA (25)         | 0.3468                | 0.8224             | 0.188   | 0.0969   | mixed     |
|                    | DPC (23)        | 0.5010                | 0.7778             | 0.0999  | 0.0649   | mixed     |
|                    | DZ (24)         | 0.0278                | 0.0812             | 0.387   | 0.0708   | pass      |

**Table A1 (Continued)**

| Country   | variable (Obs.) | DF test without trend | DF test with trend | The KPSS test without trend<br>The 5% significance level: 0.463 | The KPSS test with trend<br>The 5% significance level: 0.146 | diagnosis |
|-----------|-----------------|-----------------------|--------------------|---|--|-----------|
| Ethiopia  | CA (34)         | 0.9936                | 0.9430             | 0.678b  | 0.138  | mixed     |
|           | DPC (32)        | 0.6470                | 0.7445             | 0.278   | 0.124  | mixed     |
|           | DZ (33)         | 0.0000                | 0.0000             | 0.276   | 0.115  | pass      |
| Finland   | CA (39)         | 0.9062                | 0.9478             | 0.273   | 0.146b   | mixed     |
|           | DPC (37)        | 0.4888                | 0.7957             | 0.104   | 0.101  | mixed     |
|           | DZ (38)         | 0.0000                | 0.0000             | 0.32  | 0.11   | pass      |
| Fiji      | CA (35)         | 0.8395                | 0.9530             | 0.206   | 0.143  | mixed     |
|           | DPC (33)        | 0.0931                | 0.3233             | 0.0569  | 0.0574   | mixed     |
|           | DZ (34)         | 0.0000                | 0.0000             | 0.135   | 0.0648   | pass      |
| France    | CA (37)         | 0.8512                | 0.9952             | 0.241   | 0.14   | mixed     |
|           | DPC (35)        | 0.1119                | 0.3651             | 0.12  | 0.112  | mixed     |
|           | DZ (36)         | 0.0000                | 0.0000             | 0.125   | 0.0513   | pass      |
| Gabon     | CA (37)         | 0.4430                | 0.1262             | 0.613b  | 0.132  | mixed     |
|           | DPC (35)        | 0.0873                | 0.2206             | 0.194   | 0.0963   | mixed     |
|           | DZ (36)         | 0.0000                | 0.0000             | 0.27  | 0.0952   | pass      |
| Ghana     | CA (33)         | 0.5349                | 0.3349             | 0.448   | 0.195b   | mixed     |
|           | DPC (31)        | 0.0911                | 0.2961             | 0.0975  | 0.0965   | mixed     |
|           | DZ (32)         | 0.0000                | 0.0000             | 0.117   | 0.0851   | pass      |
| Grenada   | CA (20)         | 0.8719                | 0.4105             | 0.552b  | 0.156b   | caution   |
|           | DPC (20)        | 0.2240                | 0.5398             | 0.0854  | 0.0735   | mixed     |
|           | DZ (20)         | 0.0249                | 0.1407             | 0.0566  | 0.0572   | pass      |
| Guatemala | CA (26)         | 0.9826                | 0.8004             | 0.587b  | 0.142  | mixed     |
|           | DPC (26)        | 0.0002                | 0.0002             | 0.319   | 0.116  | pass      |
|           | DZ (26)         | 0.0000                | 0.0003             | 0.149   | 0.107  | pass      |
| Honduras  | CA (47)         | 0.9991                | 1.0000             | 0.800a  | 0.162b   | caution   |
|           | DPC (45)        | 0.0106                | 0.0330             | 0.316   | 0.107  | pass      |
|           | DZ (46)         | 0.0000                | 0.0000             | 0.108   | 0.0748   | pass      |
| Hungary   | CA (24)         | 0.1684                | 0.5573             | 0.288   | 0.097  | mixed     |
|           | DPC (22)        | 0.3319                | 0.6109             | 0.179   | 0.126  | mixed     |
|           | DZ (23)         | 0.0282                | 0.0130             | 0.331   | 0.107  | pass      |
| Indonesia | CA (26)         | 0.0198                | 0.0997             | 0.0631  | 0.0648   | pass      |
|           | DPC (24)        | 0.1362                | 0.3827             | 0.111   | 0.0738   | mixed     |
|           | DZ (25)         | 0.0077                | 0.0033             | 0.397   | 0.0652   | pass      |
| Ireland   | CA (38)         | 0.5132                | 0.8893             | 0.223   | 0.188b   | mixed     |
|           | DPC (36)        | 0.9968                | 0.9962             | 0.566b  | 0.144  | mixed     |
|           | DZ (37)         | 0.1613                | 0.0020             | 0.71b   | 0.175b   | mixed     |

**Table A1 (Continued)**

| Country             | variable (Obs.) | DF test without trend | DF test with trend | The KPSS test without trend<br>The 5% significance level: 0.463 | The KPSS test with trend<br>The 5% significance level: 0.146 | diagnosis |
|---------------------|-----------------|-----------------------|--------------------|---|--|-----------|
| Iceland             | CA (36)         | 0.9984                | 1.0000             | 0.455   | 0.174b   | mixed     |
|                     | DPC (33)        | 1.0000                | 1.0000             | 0.455   | 0.176b   | mixed     |
|                     | DZ (36)         | 0.0000                | 0.0000             | 0.121   | 0.062  | pass      |
| Israel              | CA (33)         | 0.3074                | 0.2403             | 0.353   | 0.179b   | mixed     |
|                     | DPC (31)        | 0.2546                | 0.2820             | 0.466b  | 0.0894   | mixed     |
|                     | DZ (32)         | 0.0000                | 0.0000             | 0.263   | 0.113  | pass      |
| Italy               | CA (34)         | 0.5385                | 0.4715             | 0.443   | 0.165b   | mixed     |
|                     | DPC (32)        | 0.3467                | 0.6646             | 0.0979  | 0.0918   | mixed     |
|                     | DZ (33)         | 0.0000                | 0.0000             | 0.334   | 0.0689   | pass      |
| Jamaica             | CA (37)         | 0.9917                | 0.9488             | 0.704a  | 0.188b   | caution   |
|                     | DPC (37)        | 0.0073                | 0.0428             | 0.0704  | 0.0694   | pass      |
|                     | DZ (37)         | 0.0000                | 0.0000             | 0.152   | 0.0782   | pass      |
| Jordan              | CA (27)         | 0.0837                | 0.2897             | 0.144   | 0.0761   | mixed     |
|                     | DPC (25)        | 0.2172                | 0.4990             | 0.102   | 0.0779   | mixed     |
|                     | DZ (26)         | 0.0074                | 0.0434             | 0.0814  | 0.0763   | pass      |
| Kenya               | CA (42)         | 0.0738                | 0.0864             | 0.571b  | 0.0505   | mixed     |
|                     | DPC (40)        | 0.0051                | 0.0195             | 0.197   | 0.0491   | pass      |
|                     | DZ (41)         | 0.0000                | 0.0000             | 0.0795  | 0.075  | pass      |
| St. Kitts and Nevis | CA (27)         | 0.2211                | 0.0947             | 0.61b   | 0.0993   | mixed     |
|                     | DPC (25)        | 0.1080                | 0.3291             | 0.145   | 0.14   | mixed     |
|                     | DZ (26)         | 0.0000                | 0.0002             | 0.143   | 0.105  | pass      |
| Kuwait              | CA (33)         | 0.0847                | 0.2872             | 0.171   | 0.172b   | mixed     |
|                     | DPC (28)        | 0.3431                | 0.5240             | 0.231   | 0.115  | mixed     |
|                     | DZ (32)         | 0.0000                | 0.0000             | 0.335   | 0.0933   | pass      |
| St. Lucia           | CA (23)         | 0.8343                | 0.6592             | 0.531b  | 0.143  | mixed     |
|                     | DPC (21)        | 0.7785                | 0.9615             | 0.134   | 0.0823   | mixed     |
|                     | DZ (22)         | 0.0000                | 0.0001             | 0.185   | 0.145  | pass      |
| Sri Lanka           | CA (47)         | 0.8063                | 0.0801             | 0.857a  | 0.101  | mixed     |
|                     | DPC (45)        | 0.0241                | 0.0346             | 0.381   | 0.0641   | mixed     |
|                     | DZ (46)         | 0.0000                | 0.0000             | 0.511b  | 0.0745   | pass      |
| Lesotho             | CA (23)         | 0.8538                | 0.9949             | 0.622b  | 0.135  | mixed     |
|                     | DPC (22)        | 0.0380                | 0.0820             | 0.101   | 0.0898   | pass      |
|                     | DZ (22)         | 0.0000                | 0.0001             | 0.367   | 0.0955   | pass      |
| Luxembourg          | CA (28)         | 0.1591                | 0.3152             | 0.374   | 0.0692   | mixed     |
|                     | DPC (24)        | 0.2373                | 0.2023             | 0.367   | 0.0955   | mixed     |
|                     | DZ (28)         | 0.0001                | 0.0000             | 0.359   | 0.106  | pass      |



**Table A1 (Continued)**

| Country     | variable (Obs.) | DF test without trend | DF test with trend | The KPSS test without trend<br>The 5% significance level: 0.463 | The KPSS test with trend<br>The 5% significance level: 0.146 | diagnosis |
|-------------|-----------------|-----------------------|--------------------|---|--|-----------|
| Morocco     | CA (47)         | 0.2168                | 0.4870             | 0.194   | 0.198b   | mixed     |
|             | DPC (45)        | 0.2038                | 0.1430             | 0.564b  | 0.0807   | mixed     |
|             | DZ (46)         | 0.0000                | 0.0000             | 0.12  | 0.0432   | pass      |
| Madagascar  | CA (42)         | 0.9237                | 0.7297             | 0.621b  | 0.151b   | caution   |
|             | DPC (40)        | 0.0092                | 0.0495             | 0.124   | 0.0868   | pass      |
|             | DZ (38)         | 0.0000                | 0.0000             | 0.258   | 0.032  | pass      |
| Mexico      | CA (29)         | 0.3186                | 0.3370             | 0.332   | 0.0659   | mixed     |
|             | DPC (27)        | 0.0252                | 0.1113             | 0.0781  | 0.0711   | pass      |
|             | DZ (28)         | 0.0012                | 0.0010             | 0.342   | 0.12   | pass      |
| Mali        | CA (19)         | 0.0205                | 0.0420             | 0.299   | 0.0855   | pass      |
|             | DPC (17)        | 0.2475                | 0.7739             | 0.308   | 0.10   | mixed     |
|             | DZ (18)         | 0.0186                | 0.0670             | 0.244   | 0.0671   | pass      |
| Malta       | CA (46)         | 0.0162                | 0.0054             | 0.667b  | 0.0963   | pass      |
|             | DPC (44)        | 0.4794                | 0.3464             | 0.657b  | 0.094  | mixed     |
|             | DZ (45)         | 0.0000                | 0.0000             | 0.364   | 0.0774   | pass      |
| Mauritius   | CA (44)         | 0.0788                | 0.1470             | 0.321   | 0.0568   | mixed     |
|             | DPC (42)        | 0.0591                | 0.0133             | 0.77a   | 0.488a   | mixed     |
|             | DZ (43)         | 0.0000                | 0.0000             | 0.659b  | 0.0685   | pass      |
| Malawi      | CA (24)         | 0.9974                | 0.9956             | 0.475b  | 0.12   | mixed     |
|             | DPC (22)        | 0.2841                | 0.4176             | 0.202   | 0.0503   | mixed     |
|             | DZ (23)         | 0.0000                | 0.0000             | 0.085   | 0.0463   | pass      |
| Malaysia    | CA (47)         | 0.9865                | 0.9812             | 0.463b  | 0.188b   | caution   |
|             | DPC (45)        | 0.0345                | 0.0446             | 0.465   | 0.0562   | pass      |
|             | DZ (46)         | 0.0024                | 0.0000             | 0.714b  | 0.189b   | mixed     |
| Netherlands | CA (38)         | 0.8370                | 0.1812             | 0.749a  | 0.141  | mixed     |
|             | DPC (36)        | 0.3764                | 0.3905             | 0.419   | 0.0733   | mixed     |
|             | DZ (37)         | 0.0002                | 0.0015             | 0.146   | 0.134  | pass      |
| Niger       | CA (34)         | 0.7705                | 0.7062             | 0.44  | 0.123  | mixed     |
|             | DPC (33)        | 0.0511                | 0.1513             | 0.245   | 0.108  | mixed     |
|             | DZ (34)         | 0.0000                | 0.0000             | 0.144   | 0.0604   | pass      |
| Nigeria     | CA (43)         | 0.0001                | 0.0003             | 0.329   | 0.357  | pass      |
|             | DPC (41)        | 0.0002                | 0.0016             | 0.0824  | 0.0799   | pass      |
|             | DZ (42)         | 0.0000                | 0.0000             | 0.0567  | 0.0565   | pass      |
| Norway      | CA (46)         | 0.0108                | 0.0001             | 0.654   | 0.177  | pass      |
|             | DPC (44)        | 0.1750                | 0.2271             | 0.311   | 0.0973   | mixed     |
|             | DZ (45)         | 0.0000                | 0.0000             | 0.389   | 0.11   | pass      |

**Table A1 (Continued)**

| Country          | variable (Obs.) | ADF test without trend | ADF test with trend | The KPSS test without trend<br>The 5% significance level: 0.463 | The KPSS test with trend<br>The 5% significance level: 0.146 | diagnosis |
|------------------|-----------------|------------------------|---------------------|---|--|-----------|
| Nepal            | CA (32)         | 0.7860                 | 0.0052              | 0.755a  | 0.166b   | mixed     |
|                  | DPC (30)        | 0.2111                 | 0.1253              | 0.594b  | 0.0589   | mixed     |
|                  | DZ (31)         | 0.0000                 | 0.0000              | 0.13  | 0.129  | pass      |
| New Zealand      | CA (47)         | 0.5008                 | 0.1028              | 0.734a  | 0.0819   | mixed     |
|                  | DPC (45)        | 0.1469                 | 0.0062              | 0.834a  | 0.111  | pass      |
|                  | DZ (46)         | 0.0000                 | 0.0000              | 0.30  | 0.115  | pass      |
| Pakistan         | CA (37)         | 0.5504                 | 0.7322              | 0.237   | 0.048  | mixed     |
|                  | DPC (37)        | 0.2557                 | 0.1415              | 0.548b  | 0.135  | mixed     |
|                  | DZ (37)         | 0.0027                 | 0.0003              | 0.591b  | 0.102  | pass      |
| Panama           | CA (47)         | 0.0255                 | 0.0778              | 0.146   | 0.0751   | pass      |
|                  | DPC (45)        | 0.1926                 | 0.2682              | 0.39  | 0.0684   | mixed     |
|                  | DZ (46)         | 0.0004                 | 0.0000              | 0.674b  | 0.153b   | mixed     |
| Philippines      | CA (37)         | 0.9986                 | 0.9969              | 0.409   | 0.172b   | mixed     |
|                  | DPC (37)        | 0.1342                 | 0.3846              | 0.0662  | 0.0663   | mixed     |
|                  | DZ (37)         | 0.0343                 | 0.0010              | 0.582b  | 0.178b   | mixed     |
| Papua New Guinea | CA (30)         | 0.0462                 | 0.0385              | 0.283   | 0.0835   | pass      |
|                  | DPC (28)        | 0.1771                 | 0.2212              | 0.264   | 0.0968   | mixed     |
|                  | DZ (29)         | 0.0000                 | 0.0005              | 0.292   | 0.517a   | pass      |
| Poland           | CA (26)         | 0.4920                 | 0.2001              | 0.409   | 0.0949   | mixed     |
|                  | DPC (24)        | 0.0000                 | 0.0000              | 0.276   | 0.102  | pass      |
|                  | DZ (25)         | 0.0000                 | 0.0000              | 0.402   | 0.109  | pass      |
| Portugal         | CA (37)         | 0.5800                 | 0.1825              | 0.764a  | 0.129  | mixed     |
|                  | DPC (35)        | 0.3827                 | 0.5908              | 0.204   | 0.126  | mixed     |
|                  | DZ (36)         | 0.0000                 | 0.0000              | 0.279   | 0.0858   | pass      |
| Paraguay         | CA (45)         | 0.2033                 | 0.3905              | 0.348   | 0.0565   | mixed     |
|                  | DPC (43)        | 0.0161                 | 0.0709              | 0.104   | 0.978  | pass      |
|                  | DZ (44)         | 0.0000                 | 0.0000              | 0.357   | 0.0799   | pass      |
| Rwanda           | CA (35)         | 0.8814                 | 0.0005              | 0.618b  | 0.116  | mixed     |
|                  | DPC (31)        | 0.0217                 | 0.0937              | 0.264   | 0.115  | pass      |
|                  | DZ (33)         | 0.0005                 | 0.0039              | 0.284   | 0.148b   | pass      |
| Saudi Arabia     | CA (35)         | 0.9115                 | 0.9604              | 0.327   | 0.191b   | mixed     |
|                  | DPC (33)        | 0.6531                 | 0.8335              | 0.235   | 0.140  | mixed     |
|                  | DZ (34)         | 0.0000                 | 0.0000              | 0.222   | 0.141  | pass      |
| Senegal          | CA (32)         | 0.0753                 | 0.1457              | 0.219   | 0.114  | mixed     |
|                  | DPC (30)        | 0.0818                 | 0.2568              | 0.229   | 0.0723   | mixed     |
|                  | DZ (31)         | 0.0004                 | 0.0011              | 0.204   | 0.185b   | pass      |

**Table A1 (Continued)**

| Country              | variable (Obs.) | ADF test without trend | ADF test with trend | The KPSS test without trend<br>The 5% significance level: 0.463 | The KPSS test with trend<br>The 5% significance level: 0.146 | diagnosis |
|----------------------|-----------------|------------------------|---------------------|---|--|-----------|
| Singapore            | CA (27)         | 0.9892                 | 0.4803              | 0.675b  | 0.104  | mixed     |
|                      | DPC (27)        | 0.2910                 | 0.6658              | 0.14  | 0.143  | mixed     |
|                      | DZ (27)         | 0.0055                 | 0.0000              | 0.526b  | 0.132  | pass      |
| Sierra Leone         | CA (39)         | 0.5180                 | 0.8400              | 0.09  | 0.093  | mixed     |
|                      | DPC (37)        | 0.0068                 | 0.0407              | 0.148   | 0.114  | pass      |
|                      | DZ (38)         | 0.0000                 | 0.0000              | 0.149   | 0.124  | pass      |
| Suriname             | CA (29)         | 0.3431                 | 0.8033              | 0.102   | 0.091  | mixed     |
|                      | DPC (27)        | 0.1524                 | 0.4605              | 0.342   | 0.0547   | mixed     |
|                      | DZ (28)         | 0.0000                 | 0.0000              | 0.132   | 0.0814   | pass      |
| Sweden               | CA (41)         | 0.8346                 | 0.7200              | 0.446   | 0.153  | mixed     |
|                      | DPC (39)        | 0.2454                 | 0.4703              | 0.218   | 0.132  | mixed     |
|                      | DZ (40)         | 0.0000                 | 0.0000              | 0.333   | 0.106  | pass      |
| Swaziland            | CA (35)         | 0.3351                 | 0.7826              | 0.279   | 0.0939   | mixed     |
|                      | DPC (33)        | 0.4341                 | 0.6408              | 0.197   | 0.0792   | mixed     |
|                      | DZ (34)         | 0.0000                 | 0.0000              | 0.303   | 0.0707   | pass      |
| Seychelles           | CA (22)         | 0.7818                 | 0.8722              | 0.26  | 0.0878   | mixed     |
|                      | DPC (20)        | 0.9219                 | 0.0828              | 0.359   | 0.165b   | mixed     |
|                      | DZ (21)         | 0.0000                 | 0.0000              | 0.0965  | 0.0955   | pass      |
| Syrian Arab Republic | CA (43)         | 0.7063                 | 0.8054              | 0.265   | 0.183b   | mixed     |
|                      | DPC (41)        | 0.9934                 | 0.9943              | 0.514b  | 0.102  | mixed     |
|                      | DZ (42)         | 0.0000                 | 0.0000              | 0.405   | 0.118  | pass      |
| Togo                 | CA (36)         | 0.2302                 | 0.0549              | 0.558b  | 0.132  | mixed     |
|                      | DPC (34)        | 0.0245                 | 0.0791              | 0.201   | 0.0679   | pass      |
|                      | DZ (35)         | 0.0000                 | 0.0000              | 0.136   | 0.0624   | pass      |
| Thailand             | CA (41)         | 0.2663                 | 0.4074              | 0.248   | 0.13   | mixed     |
|                      | DPC (39)        | 0.3416                 | 0.6841              | 0.0977  | 0.0886   | mixed     |
|                      | DZ (40)         | 0.0000                 | 0.0000              | 0.479b  | 0.062  | pass      |
| Trinidad and Tobago  | CA (41)         | 0.0015                 | 0.0084              | 0.154   | 0.0694   | pass      |
|                      | DPC (39)        | 0.4208                 | 0.7542              | 0.161   | 0.119  | mixed     |
|                      | DZ (40)         | 0.0002                 | 0.0020              | 0.0995  | 0.0915   | pass      |
| Turkey               | CA (20)         | 0.0901                 | 0.2467              | 0.13  | 0.0952   | mixed     |
|                      | DPC (18)        | 0.8485                 | 0.9142              | 0.302   | 0.103  | mixed     |
|                      | DZ (19)         | 0.0000                 | 0.0001              | 0.0851  | 0.0693   | pass      |
| Uganda               | CA (24)         | 0.9977                 | 0.9425              | 0.602b  | 0.141  | mixed     |
|                      | DPC (22)        | 0.1128                 | 0.0196              | 0.539   | 0.125  | pass      |
|                      | DZ (23)         | 0.0000                 | 0.0000              | 0.284   | 0.072  | pass      |

**Table A1 (Continued)**

| Country                           | variable (Obs.) | ADF test without trend | ADF test with trend | The KPSS test without trend<br>The 5% significance level: 0.463 | The KPSS test with trend<br>The 5% significance level: 0.146 | diagnosis |
|-----------------------------------|-----------------|------------------------|---------------------|---|--|-----------|
| Uruguay                           | CA (31)         | 0.0491                 | 0.1783              | 0.141   | 0.126  | pass      |
|                                   | DPC (29)        | 0.0356                 | 0.1498              | 0.132   | 0.085  | pass      |
|                                   | DZ (30)         | 0.0000                 | 0.0000              | 0.241   | 0.273a   | pass      |
| St. Vincent<br>and the Grenadines | CA (28)         | 0.2317                 | 0.1812              | 0.437   | 0.0912   | mixed     |
|                                   | DPC (26)        | 0.3325                 | 0.7529              | 0.221   | 0.114  | mixed     |
|                                   | DZ (27)         | 0.0000                 | 0.0000              | 0.0978  | 0.0939   | pass      |
| Venezuela                         | CA (34)         | 0.0067                 | 0.0083              | 0.379   | 0.167  | pass      |
|                                   | DPC (34)        | 0.3280                 | 0.7343              | 0.238   | 0.193  | mixed     |
|                                   | DZ (34)         | 0.0000                 | 0.0000              | 0.174   | 0.111  | pass      |
| South Africa                      | CA (45)         | 0.5225                 | 0.7328              | 0.233   | 0.116  | mixed     |
|                                   | DPC (43)        | 0.0987                 | 0.0633              | 0.664b  | 0.129  | mixed     |
|                                   | DZ (44)         | 0.0000                 | 0.0000              | 0.612b  | 0.151b   | mixed     |

**Table A2.** OLS Estimations (The Current Account/Private Credit). Robust standard errors are in parentheses. a, b, and c indicate the 1%, 5%, and 10% significance levels for the one-sided test, respectively. The breaking years of the Chow test are under country names (if any), and the values in square brackets are the p-values of the test. Years under estimation periods (if any) are missing years for the estimation.

| country                    | Breaking year    | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|----------------------------|------------------|----------------|-------------------|--------------------|-------------------|-------------------|-----------|
| [P-value of the Chow test] |                  |                |                   |                    |                   |                   |           |
| United Kingdom             | 1992<br>[0.0372] | 1962–2007 (46) | 0.623a<br>(0.097) | -0.089a<br>(0.024) | 0.217<br>(0.144)  | -2.054<br>(1.515) | 0.737     |
|                            |                  | 1962–1991 (30) | 0.572a<br>(0.093) | -0.143a<br>(0.023) | 0.421a<br>(0.012) | -2.038<br>(1.310) | 0.859     |
|                            |                  | 1992–2007 (16) | 0.573a<br>(0.093) | -0.018<br>(0.037)  | 0.167<br>(0.193)  | -7.034<br>(5.427) | 0.443     |
|                            |                  | 1962–2007 (46) | 0.633a<br>(0.100) | -0.097a<br>(0.023) | 0.126<br>(0.114)  |                   | 0.811     |
|                            |                  | 1962–1991 (30) | 0.577a<br>(0.099) | -0.151a<br>(0.025) | 0.315a<br>(0.105) |                   | 0.868     |
|                            |                  | 1992–2007 (16) | 0.691a<br>(0.247) | -0.040<br>(0.035)  | 0.076<br>(0.202)  |                   | 0.815     |
| Greece                     | 1995<br>[0.0001] | 1962–2001 (40) | 0.749a<br>(0.009) | -0.356<br>(0.226)  | 0.731<br>(0.195)  | -950a<br>(270)    | 0.762     |
|                            |                  | 1962–1994 (33) | 0.843a<br>(0.092) | -0.328b<br>(0.160) | 0.039<br>(0.135)  | -384b<br>(154)    | 0.820     |
|                            |                  | 1995–2001 (7)  | 2.820a<br>(0.375) | 2.136<br>(0.496)   | 2.883a<br>(0.339) | -5125a<br>(838)   | 0.972     |
|                            |                  | 1962–2001 (40) | 0.952a<br>(0.076) | -0.490<br>(0.331)  | 0.592<br>(0.235)  |                   | 0.875     |
|                            |                  | 1962–1994 (33) | 0.932a<br>(0.080) | -0.349b<br>(0.167) | -0.094<br>(0.139) |                   | 0.951     |
|                            |                  | 1995–2001 (7)  | 0.610b<br>(0.238) | -0.977b<br>(0.411) | 0.857<br>(0.462)  |                   | 0.822     |
| Japan                      | 1983<br>[0.0016] | 1962–2007 (46) | 0.997a<br>(0.055) | -0.016a<br>(0.004) | 0.275a<br>(0.088) | -700<br>(876)     | 0.879     |
|                            |                  | 1962–1982 (21) | 0.025<br>(0.250)  | 0.040<br>(0.035)   | 0.413a<br>(0.086) | -1958b<br>(853)   | 0.649     |
|                            |                  | 1983–2007 (35) | 0.947a<br>(0.183) | -0.015a<br>(0.005) | 0.337b<br>(0.197) | 133<br>(3193)     | 0.709     |
|                            |                  | 1962–2007 (46) | 0.965a<br>(0.040) | -0.016a<br>(0.004) | 0.218a<br>(0.046) |                   | 0.946     |
|                            |                  | 1962–1982 (21) | 0.195<br>(0.240)  | -0.008<br>(0.027)  | 0.269a<br>(0.051) |                   | 0.629     |
|                            |                  | 1983–2007 (35) | 0.954a<br>(0.045) | -0.015a<br>(0.005) | 0.343a<br>(0.087) |                   | 0.974     |
| USA                        |                  | 1962–2007 (46) | 0.996a<br>(0.077) | 0.023<br>(0.026)   | -0.165<br>(0.158) | -1.482<br>(13.6)  | 0.903     |
|                            |                  | 1962–2007 (46) | 0.996a<br>(0.076) | 0.023<br>(0.026)   | -0.174<br>(0.104) |                   | 0.942     |
| Korea                      | 1998<br>[0.0000] | 1973–2007 (35) | 0.686a<br>(0.096) | 0.042<br>(0.088)   | 0.623b<br>(0.280) | -6026b<br>(2854)  | 0.522     |
|                            |                  | 1973–1997 (25) | 0.850a<br>(0.139) | -0.264a<br>(0.042) | 0.923a<br>(0.131) | -3972a<br>(1275)  | 0.823     |
|                            |                  | 1998–2007 (10) | -0.149<br>(0.254) | 0.213<br>(0.083)   | 0.385<br>(0.568)  | 16944<br>(10386)  | 0.563     |
|                            |                  | 1973–2007 (35) | 0.626a<br>(0.101) | 0.019<br>(0.082)   | 0.307b<br>(0.129) |                   | 0.510     |
|                            |                  | 1973–1997 (25) | 0.880a<br>(0.139) | -0.289a<br>(0.044) | 0.739a<br>(0.101) |                   | 0.771     |
|                            |                  | 1998–2007 (10) | 0.192<br>(0.187)  | 0.232<br>(0.090)   | 1.030a<br>(0.378) |                   | 0.854     |

Table A2 (Continued)

| country                     | Breaking year | stimation periods (Obs | CA(-1)            | DPC(-1)            | DZ                | CONS               | R-squared |
|-----------------------------|---------------|------------------------|-------------------|--------------------|-------------------|--------------------|-----------|
| [P-value of the Chow test]  |               |                        |                   |                    |                   |                    |           |
| Australia                   |               | 1970-2007 (37)         | 0.802a<br>(0.072) | -0.252a<br>(0.048) | 0.937a<br>(0.162) | -7.636a<br>(1.327) | 0.900     |
|                             |               | 1970-2007 (37)         | 1.057a<br>(0.089) | -0.177a<br>(0.058) | 0.660a<br>(0.148) |                    | 0.9481    |
| Canada                      |               | 1962-2007 (46)         | 0.848a<br>(0.065) | -0.002<br>(0.009)  | 0.426a<br>(0.159) | -5.736a<br>(2.393) | 0.835     |
|                             |               | 1962-2007 (46)         | 0.944a<br>(0.060) | -0.022b<br>(0.010) | 0.237a<br>(0.091) |                    | 0.808     |
| Botswana                    |               | 1977-2007 (31)         | 0.780a<br>(0.079) | 0.561<br>(0.598)   | 0.911a<br>(0.103) | -27.7<br>(137)     | 0.882     |
|                             |               | 1977-2007 (31)         | 0.775a<br>(0.079) | 0.533<br>(0.560)   | 0.908a<br>(0.091) |                    | 0.932     |
| India<br>1989<br>[0.0031]   |               | 1971-2006 (36)         | 0.431a<br>(0.138) | -0.354b<br>(0.175) | 0.205b<br>(0.103) | -185a<br>(58.0)    | 0.316     |
|                             |               | 1971-1988 (18)         | 0.082<br>(0.164)  | 0.390<br>(0.445)   | -0.926<br>(0.195) | -183b<br>(82.5)    | 0.429     |
|                             |               | 1989-2006 (18)         | 0.403b<br>(0.159) | -0.600a<br>(0.128) | 0.535a<br>(0.104) | -493a<br>(154)     | 0.650     |
|                             |               | 1971-2006 (36)         | 0.670a<br>(0.111) | -0.331<br>(0.215)  | 0.104<br>(0.124)  |                    | 0.574     |
|                             |               | 1971-1988 (18)         | 0.229<br>(0.256)  | -0.322<br>(0.427)  | -0.965<br>(0.233) |                    | 0.748     |
|                             |               | 1989-2006 (18)         | 0.641a<br>(0.153) | -0.354<br>(0.225)  | 0.123<br>(0.131)  |                    | 0.604     |
| Austria                     |               | 1962-1997 (36)         | 0.543a<br>(0.201) | -0.055<br>(0.077)  | 0.329b<br>(0.187) | -13.3a<br>(5.02)   | 0.417     |
|                             |               | 1962-1997 (36)         | 0.596a<br>(0.225) | -0.165b<br>(0.084) | 0.235<br>(0.207)  |                    | 0.551     |
| Burundi<br>1998<br>[0.0001] |               | 1973-2007 (35)         | 0.860a<br>(0.138) | -0.650<br>(0.539)  | 0.098<br>(0.109)  | -14125<br>(10176)  | 0.742     |
|                             |               | 1973-1997 (25)         | 0.766a<br>(0.084) | -1.871a<br>(0.374) | -0.018<br>(0.070) | -14215<br>(8662)   | 0.839     |
|                             |               | 1998-2007 (10)         | 0.822a<br>(0.095) | 0.941<br>(0.422)   | 0.638a<br>(0.168) | -36843a<br>(9659)  | 0.930     |
|                             |               | 1973-2007 (35)         | 0.979a<br>(0.073) | -0.708<br>(0.524)  | 0.107<br>(0.111)  |                    | 0.939     |
|                             |               | 1973-1997 (25)         | 0.903a<br>(0.036) | -1.834a<br>(0.401) | 0.009<br>(0.081)  |                    | 0.962     |
|                             |               | 1998-2007 (10)         | 1.067a<br>(0.080) | 0.451<br>(0.664)   | 0.725a<br>(0.236) |                    | 0.973     |
| Belgium<br>1980<br>[0.0000] |               | 1962-1997 (36)         | 0.975a<br>(0.065) | 0.071<br>(0.015)   | 0.064<br>(0.257)  | -1.145<br>(31.7)   | 0.920     |
|                             |               | 1962-1979 (18)         | 1.012a<br>(0.079) | -0.944a<br>(0.337) | 0.492a<br>(0.087) | -0.279<br>(24.4)   | 0.959     |
|                             |               | 1980-1997 (18)         | 0.846a<br>(0.061) | 0.065<br>(0.012)   | -0.039<br>(0.182) | 66.9b<br>(28.3)    | 0.953     |
|                             |               | 1962-1997 (36)         | 0.976a<br>(0.082) | 0.070<br>(0.026)   | 0.057<br>(0.110)  |                    | 0.923     |
|                             |               | 1962-1979 (18)         | 1.012a<br>(0.076) | -0.947a<br>(0.159) | 0.491a<br>(0.087) |                    | 0.970     |
|                             |               | 1980-1997 (18)         | 0.822a<br>(0.109) | 0.096<br>(0.026)   | 0.330b<br>(0.147) |                    | 0.954     |

Table A2 (Continued)

| country                                     | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS               | R-squared |
|---|----------------|-------------------|--------------------|-------------------|--------------------|-----------|
| Breaking year<br>[P-value of the Chow test] |                |                   |                    |                   |                    |           |
| BurkinaFaso                                 | 1972-2006 (35) | 0.677a<br>(0.172) | -2.058b<br>(0.904) | 0.057<br>(0.109)  | -49002b<br>(24419) | 0.763     |
|   | 1972-2006 (35) | 0.904a<br>(0.098) | -1.667b<br>(0.942) | 0.014<br>(0.096)  |                    | 0.931     |
| Bahrain                                     | 1982-2000 (19) | 1.091a<br>(0.106) | 0.111<br>(0.168)   | 0.887a<br>(0.056) | -54.6a<br>(20.8)   | 0.922     |
|   | 1982-2000 (19) | 0.859a<br>(0.118) | -0.173<br>(0.167)  | 0.841a<br>(0.105) |                    | 0.908     |
| Belize                                      | 1986-2006 (21) | 0.806a<br>(0.058) | -0.994a<br>(0.156) | 0.606a<br>(0.203) | -29.4b<br>(13.2)   | 0.936     |
|   | 1986-2006 (21) | 0.869a<br>(0.053) | -1.058a<br>(0.189) | 0.505b<br>(0.221) |                    | 0.977     |
| Bolivia                                     | 1986-2007 (22) | 0.906a<br>(0.036) | -0.199b<br>(0.102) | 0.705a<br>(0.048) | -539a<br>(189)     | 0.967     |
|   | 1986-2007 (22) | 0.911a<br>(0.059) | -0.351a<br>(0.109) | 0.670a<br>(0.031) |                    | 0.958     |
| Barbados<br>1983<br>[0.0056]                | 1976-1997 (22) | 0.672a<br>(0.126) | 0.241<br>(0.744)   | 0.283<br>(0.259)  | -29.6<br>(65.3)    | 0.510     |
|   | 1976-1982 (7)  | 0.021b<br>(0.354) | 1.265<br>(0.444)   | 0.156<br>(0.269)  | -329<br>(127)      | 0.616     |
|   | 1983-1997 (15) | 0.169<br>(0.203)  | -1.263b<br>(0.568) | 0.273<br>(0.227)  | 141b<br>(52.8)     | 0.467     |
|   | 1976-1997 (22) | 0.687a<br>(0.133) | 0.084<br>(0.534)   | 0.265<br>(0.259)  |                    | 0.506     |
|   | 1976-1982 (7)  | 0.938a<br>(0.147) | 1.542<br>(0.740)   | 0.332<br>(0.417)  |                    | 0.794     |
|   | 1983-1997 (15) | 0.500b<br>(0.205) | -0.414<br>(0.364)  | 0.306<br>(0.255)  |                    | 0.369     |
| Bhutan                                      | 1986-2006 (21) | 0.477a<br>(0.169) | -2.592b<br>(1.093) | 0.698a<br>(0.178) | -1695a<br>(582)    | 0.715     |
|   | 1986-2006 (21) | 0.872a<br>(0.135) | -1.808<br>(1.491)  | 0.726a<br>(0.244) |                    | 0.924     |
| Central Africa                              | 1987-2005 (19) | 0.396<br>(0.229)  | -0.710<br>(1.089)  | -0.090<br>(0.143) | -18.5b<br>(8.66)   | 0.196     |
|   | 1987-2005 (19) | 0.868a<br>(0.103) | -1.344<br>(0.920)  | -0.084<br>(0.154) |                    | 0.827     |
| Switzerland                                 | 1981-2007 (27) | 0.926a<br>(0.026) | -0.082a<br>(0.020) | 0.926a<br>(0.084) | -0.268<br>(0.722)  | 0.980     |
|   | 1981-2007 (27) | 0.918a<br>(0.022) | -0.085a<br>(0.014) | 0.916a<br>(0.083) |                    | 0.994     |
| Chile<br>1996<br>[0.0000]                   | 1976-2007 (32) | 0.761a<br>(0.160) | -0.007<br>(0.120)  | 0.270a<br>(0.097) | -562a<br>(224)     | 0.678     |
|   | 1976-1995 (20) | 0.707a<br>(0.125) | -0.352b<br>(0.152) | 0.091<br>(0.158)  | -315<br>(173)      | 0.730     |
|   | 1996-2007 (12) | 0.351b<br>(0.140) | 0.204<br>(0.184)   | 0.276a<br>(0.084) | -1287b<br>(408)    | 0.760     |
|   | 1976-2007 (32) | 0.930a<br>(0.118) | -0.102<br>(0.104)  | 0.214b<br>(0.117) |                    | 0.802     |
|   | 1976-1995 (20) | 0.809a<br>(0.135) | -0.375b<br>(0.170) | 0.016<br>(0.163)  |                    | 0.901     |
|   | 1996-2007 (12) | 0.684a<br>(0.177) | -0.092<br>(0.151)  | 0.245b<br>(0.116) |                    | 0.708     |

Table A2 (Continued)

| country                                     | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|---|----------------|-------------------|--------------------|-------------------|-------------------|-----------|
| Breaking year<br>[P-value of the Chow test] |                |                   |                    |                   |                   |           |
| Côte d'Ivoire<br>1994<br>[0.0003]           | 1963–2007 (45) | 0.814a<br>(0.074) | -0.368b<br>(0.169) | 0.538a<br>(0.108) | 21.2<br>(32.2)    | 0.820     |
|   | 1963–1993 (31) | 0.870a<br>(0.074) | -0.407a<br>(0.160) | 0.631a<br>(0.096) | 1.257<br>(31.5)   | 0.845     |
|   | 1994–2007 (14) | -0.309<br>(0.151) | 1.214<br>(0.292)   | -0.023<br>(0.044) | 867a<br>(114)     | 0.634     |
|   | 1963–2007 (45) | 0.846a<br>(0.049) | -0.343b<br>(0.153) | 0.554a<br>(0.102) |                   | 0.905     |
|   | 1963–1993 (31) | 0.872a<br>(0.058) | -0.405a<br>(0.140) | 0.631a<br>(0.090) |                   | 0.886     |
|   | 1994–2007 (14) | 0.881a<br>(0.074) | -0.362<br>(0.715)  | 0.363b<br>(0.198) |                   | 0.930     |
| Cameroon                                    | 1971–2006 (36) | 0.374a<br>(0.150) | -0.490b<br>(0.255) | 0.098<br>(0.085)  | 8.27<br>(22.5)    | 0.421     |
|   | 1971–2006 (36) | 0.382a<br>(0.148) | -0.484b<br>(0.248) | 0.107<br>(0.080)  |                   | 0.429     |
| Colombia                                    | 1966–1985 (20) | 0.797a<br>(0.124) | -0.176<br>(0.161)  | 0.569a<br>(0.129) | -1233a<br>(395)   | 0.905     |
|   | 1966–1985 (20) | 0.820a<br>(0.128) | -0.449<br>(0.273)  | 0.353b<br>(0.151) |                   | 0.707     |
| Costta Rica<br>1987<br>[0.0000]             | 1962–2001 (40) | 0.890a<br>(0.075) | -0.204<br>(0.156)  | 0.085b<br>(0.037) | -26.8b<br>(11.0)  | 0.786     |
|   | 1962–1986 (25) | 0.963a<br>(0.050) | -0.695a<br>(0.167) | 0.422a<br>(0.097) | -17.5b<br>(8.318) | 0.919     |
|   | 1987–2001 (15) | -0.082<br>(0.212) | -0.382b<br>(0.182) | 0.038<br>(0.034)  | -248a<br>(39.5)   | 0.414     |
|   | 1962–2001 (40) | 1.052a<br>(0.058) | -0.099<br>(0.167)  | 0.142a<br>(0.054) |                   | 0.955     |
|   | 1962–1986 (25) | 1.057a<br>(0.046) | -0.771a<br>(0.180) | 0.378a<br>(0.093) |                   | 0.973     |
|   | 1987–2001 (15) | 1.100a<br>(0.086) | 0.035<br>(0.222)   | 0.096b<br>(0.053) |                   | 0.950     |
| Cyprus                                      | 1962–2007 (46) | 0.724a<br>(0.190) | -0.184b<br>(0.087) | 0.239<br>(0.206)  | -37.3<br>(30.0)   | 0.500     |
|   | 1962–2007 (46) | 0.799a<br>(0.146) | -0.211a<br>(0.082) | 0.182<br>(0.199)  |                   | 0.721     |
| Germany                                     | 1962–1989 (28) | 0.664a<br>(0.080) | -0.093<br>(0.076)  | 0.747a<br>(0.109) | -4.02<br>(6.50)   | 0.849     |
|   | 1962–1989 (28) | 0.655a<br>(0.072) | -0.135a<br>(0.048) | 0.718a<br>(0.100) |                   | 0.929     |
| Dominica                                    | 1982–2005 (24) | 0.816a<br>(0.114) | -0.027<br>(0.381)  | 1.043a<br>(0.209) | -38.6a<br>(11.2)  | 0.702     |
|   | 1982–2005 (24) | 1.067a<br>(0.071) | -0.251<br>(0.381)  | 1.069a<br>(0.224) |                   | 0.952     |
| Denmark<br>1987<br>[0.0054]                 | 1971–2007 (37) | 0.874a<br>(0.068) | 0.017<br>(0.012)   | 0.681a<br>(0.161) | -4.871<br>(3.043) | 0.872     |
|   | 1971–1986 (16) | 0.136<br>(0.194)  | -0.417a<br>(0.102) | 0.437b<br>(0.196) | -16.3a<br>(5.189) | 0.500     |
|   | 1987–2007 (21) | 0.714a<br>(0.079) | 0.017<br>(0.012)   | 0.658a<br>(0.248) | 4.932<br>(3.885)  | 0.789     |
|   | 1971–2007 (37) | 0.857a<br>(0.064) | 0.010<br>(0.012)   | 0.501a<br>(0.124) |                   | 0.888     |
|   | 1971–1986 (16) | 0.788a<br>(0.129) | -0.542a<br>(0.130) | 0.280b<br>(0.125) |                   | 0.696     |
|   | 1987–2007 (21) | 0.768a<br>(0.082) | 0.020<br>(0.011)   | 0.780a<br>(0.203) |                   | 0.942     |



**Table A2 (Continued)**

| country                                     | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|---|----------------|-------------------|--------------------|-------------------|-------------------|-----------|
| Breaking year<br>[P-value of the Chow test] |                |                   |                    |                   |                   |           |
| Dominican Republic                          | 1981-2007 (27) | 1.108a<br>(0.155) | 0.348<br>(0.201)   | 0.109<br>(0.150)  | -1055<br>(4506)   | 0.733     |
|   | 1981-2007 (27) | 1.138a<br>(0.070) | 0.355<br>(0.198)   | 0.107<br>(0.145)  |                   | 0.973     |
| Algeria                                     | 1982-2007 (26) | 0.971a<br>(0.020) | -0.095a<br>(0.032) | 0.962a<br>(0.028) | -47.6a<br>(18.9)  | 0.986     |
| 1989<br>[0.0053]                            | 1982-1988 (7)  | -1.136<br>(0.709) | 0.897<br>(0.534)   | -0.127<br>(0.381) | -21.5<br>(28.0)   | 0.578     |
|   | 1989-2007 (19) | 0.980a<br>(0.021) | -0.143a<br>(0.049) | 0.987a<br>(0.033) | -57.2a<br>(19.0)  | 0.995     |
|   | 1982-2007 (26) | 0.935a<br>(0.017) | -0.036<br>(0.041)  | 0.906a<br>(0.031) |                   | 0.987     |
|   | 1982-1988 (7)  | -1.272<br>(0.815) | 0.831<br>(0.480)   | -0.181<br>(0.449) |                   | 0.540     |
|   | 1989-2007 (19) | 0.935a<br>(0.017) | -0.023<br>(0.028)  | 0.918a<br>(0.028) |                   | 0.994     |
| Ecuador                                     | 1962-1999 (38) | 0.289<br>(0.246)  | -0.501b<br>(0.257) | 0.085<br>(0.076)  | -34941<br>(25535) | 0.276     |
| 1979<br>[0.0011]                            | 1962-1978 (17) | 0.299<br>(0.257)  | -1.364a<br>(0.329) | 0.250a<br>(0.055) | -83473<br>(52787) | 0.611     |
|   | 1979-1999 (21) | -0.004<br>(0.264) | -0.210<br>(0.272)  | 0.009<br>(0.073)  | 13835<br>(15296)  | 0.098     |
|   | 1962-1999 (38) | 0.374<br>(0.230)  | -0.443b<br>(0.251) | 0.096<br>(0.075)  |                   | 0.290     |
|   | 1962-1978 (17) | 0.486b<br>(0.226) | -1.613a<br>(0.540) | 0.231a<br>(0.057) |                   | 0.648     |
|   | 1979-1999 (21) | -0.026<br>(0.257) | -0.237<br>(0.260)  | 0.002<br>(0.071)  |                   | 0.135     |
| Egypt                                       | 1962-2007 (46) | 0.842a<br>(0.087) | -0.080<br>(0.127)  | 0.194<br>(0.151)  | -3465a<br>(1022)  | 0.718     |
|   | 1962-2007 (46) | 0.990a<br>(0.091) | -0.093<br>(0.136)  | 0.148<br>(0.158)  |                   | 0.91      |
| Spain                                       | 1975-1998 (24) | 0.744a<br>(0.149) | -0.197b<br>(0.113) | 0.785b<br>(0.348) | -1302<br>(758)    | 0.703     |
|   | 1975-1998 (24) | 0.957a<br>(0.103) | -0.196b<br>(0.101) | 0.418<br>(0.282)  |                   | 0.907     |
| Ethiopia                                    | 1969-2001 (33) | 1.077a<br>(0.119) | -0.027<br>(0.194)  | 0.042<br>(0.070)  | -88.2<br>(299)    | 0.865     |
|   | 1969-2001 (33) | 1.105a<br>(0.058) | -0.008<br>(0.165)  | 0.046<br>(0.073)  |                   | 0.938     |
| Finland                                     | 1962-1999 (38) | 0.729a<br>(0.044) | -0.131a<br>(0.036) | 0.745a<br>(0.085) | -4.98a<br>(1.023) | 0.952     |
|   | 1962-1999 (38) | 0.765a<br>(0.046) | -0.206a<br>(0.039) | 0.461a<br>(0.060) |                   | 0.925     |
| Fiji  | 1972-2005 (34) | 0.916a<br>(0.204) | 0.092<br>(0.431)   | 0.001<br>(0.160)  | -31.3<br>(24.2)   | 0.538     |
|   | 1972-2005 (34) | 0.954a<br>(0.196) | -0.064<br>(0.411)  | -0.037<br>(0.154) |                   | 0.659     |
| France                                      | 1962-1997 (36) | 0.912a<br>(0.098) | -0.055<br>(0.055)  | 0.326<br>(0.275)  | -19.7<br>(40.3)   | 0.811     |
|   | 1962-1997 (36) | 0.905a<br>(0.089) | -0.077a<br>(0.023) | 0.197b<br>(0.081) |                   | 0.829     |

Table A2 (Continued)

| country   | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|---|----------------|-------------------|--------------------|-------------------|-------------------|-----------|
| Gabon   | 1970–2005 (36) | 1.001a<br>(0.041) | -0.532<br>(0.613)  | 0.901a<br>(0.036) | -29.3<br>(25.6)   | 0.969     |
| Breaking year<br>1990<br>[P-value of the Chow test] | 1970–1989 (20) | 1.043a<br>(0.079) | 0.903<br>(0.459)   | 0.922a<br>(0.086) | -53.8b<br>(23.8)  | 0.930     |
|   | 1990–2005 (16) | 1.022a<br>(0.034) | -1.806a<br>(0.422) | 0.906a<br>(0.040) | -43.4<br>(28.6)   | 0.986     |
|   | 1970–2005 (36) | 0.958a<br>(0.019) | -0.744<br>(0.549)  | 0.873a<br>(0.036) |                   | 0.982     |
|   | 1970–1989 (20) | 0.923a<br>(0.044) | 0.177<br>(0.624)   | 0.809a<br>(0.099) |                   | 0.938     |
|   | 1990–2005 (16) | 0.964a<br>(0.016) | -1.823a<br>(0.459) | 0.878a<br>(0.036) |                   | 0.995     |
| Ghana   | 1966–1997 (32) | 0.900a<br>(0.115) | -0.264<br>(0.460)  | 0.220a<br>(0.062) | -19.53<br>(17.0)  | 0.697     |
|   | 1966–1997 (32) | 0.980a<br>(0.095) | -0.212<br>(0.464)  | 0.224a<br>(0.072) |                   | 0.801     |
| Grenada   | 1988–2007 (20) | 0.950a<br>(0.193) | 0.100<br>(0.677)   | 0.469<br>(0.648)  | -41.3<br>(34.0)   | 0.688     |
|   | 1988–2007 (20) | 1.047a<br>(0.150) | 0.286<br>(0.595)   | 0.564<br>(0.609)  |                   | 0.920     |
| Guatemala   | 1981–2006 (26) | 1.038a<br>(0.049) | 0.398<br>(2.127)   | 0.269a<br>(0.105) | -985<br>(954)     | 0.929     |
|   | 1981–2006 (26) | 1.105a<br>(0.037) | 0.655<br>(2.32)    | 0.249a<br>(0.089) |                   | 0.978     |
| Honduras  | 1962–2007 (46) | 1.121a<br>(0.045) | -0.325b<br>(0.135) | 0.219<br>(0.164)  | 295<br>(419)      | 0.954     |
|   | 1962–2007 (46) | 1.105a<br>(0.042) | -0.310a<br>(0.127) | 0.229<br>(0.159)  |                   | 0.979     |
| Hungary   | 1985–2007 (23) | 0.575b<br>(0.242) | 0.169<br>(0.075)   | 0.061<br>(0.285)  | -107<br>(71.6)    | 0.471     |
|   | 1985–2007 (23) | 0.663a<br>(0.261) | 0.121<br>(0.058)   | 0.074<br>(0.326)  |                   | 0.456     |
| Indonesia   | 1983–2007 (25) | 0.401b<br>(0.203) | -0.170a<br>(0.063) | 0.289<br>(0.216)  | -21404b<br>(9048) | 0.420     |
|   | 1983–2007 (25) | 0.436b<br>(0.201) | -0.173b<br>(0.072) | 0.068<br>(0.172)  |                   | 0.389     |
| Ireland   | 1962–1998 (37) | 0.840a<br>(0.059) | -0.262a<br>(0.073) | 0.576a<br>(0.108) | -506a<br>(116)    | 0.876     |
| Breaking year<br>1976<br>[0.0064]                   | 1962–1975 (14) | 0.671a<br>(0.067) | -0.132<br>(0.101)  | 0.767a<br>(0.089) | -516a<br>(124)    | 0.832     |
|   | 1976–1998 (23) | 0.634a<br>(0.084) | -0.221a<br>(0.064) | 0.788a<br>(0.144) | -1436a<br>(324)   | 0.910     |
|   | 1962–1998 (37) | 0.983a<br>(0.057) | -0.299a<br>(0.083) | 0.469a<br>(0.116) |                   | 0.937     |
|   | 1962–1975 (14) | 0.991a<br>(0.168) | -0.306<br>(0.184)  | 0.688a<br>(0.107) |                   | 0.876     |
|   | 1976–1998 (23) | 0.985a<br>(0.064) | -0.267a<br>(0.105) | 0.414a<br>(0.151) |                   | 0.945     |
| Iceland   | 1971–2006 (34) | 0.654a<br>(0.212) | -0.912a<br>(0.064) | 0.739a<br>(0.198) | -8589a<br>(0.008) | 0.869     |
|   | 1971–2006 (34) | 0.731a<br>(0.231) | -0.209a<br>(0.069) | 0.558a<br>(0.199) |                   | 0.883     |
| Israel  | 1977–2008 (32) | 0.726a<br>(0.121) | 0.075<br>(0.105)   | 0.053<br>(0.217)  | -10712<br>(5563)  | 0.544     |
|   | 1977–2008 (32) | 0.930a<br>(0.068) | -0.041<br>(0.098)  | -0.061<br>(0.198) |                   | 0.929     |

Table A2 (Continued)

| country                     | period (Obs.)                | CA(-1)             | DPC(-1)            | DZ                | CONS              | R-squared |
|-----------------------------|------------------------------|--------------------|--------------------|-------------------|-------------------|-----------|
| Italy                       | 1966-1998 (33)               | 0.827a<br>(0.069)  | -0.103<br>(0.120)  | 0.607a<br>(0.243) | -11.9<br>(8.55)   | 0.739     |
|                             | 1966-1998 (33)               | 0.793a<br>(0.069)  | -0.153<br>(0.115)  | 0.350a<br>(0.099) |                   | 0.740     |
| Jamaica<br>1993<br>[0.0066] | 1971-2007 (37)               | 1.086a<br>(0.067)  | -0.184<br>(0.227)  | 0.305b<br>(0.143) | -382<br>(2918)    | 0.886     |
|                             | 1971-1992 (22)               | 0.564a<br>(0.208)  | -0.800a<br>(0.173) | 0.372b<br>(0.182) | -11877b<br>(5211) | 0.624     |
|                             | 1993-2007 (25)               | 1.042a<br>(0.122)  | 0.037<br>(0.375)   | 0.184<br>(0.222)  | -5343<br>(8965)   | 0.876     |
|                             | 1971-2007 (37)               | 1.093a<br>(0.039)  | -0.183<br>(0.224)  | 0.306b<br>(0.139) |                   | 0.965     |
|                             | 1993-2007 (25)               | 1.002a<br>(0.062)  | -0.734a<br>(0.204) | 0.587a<br>(0.153) |                   | 0.940     |
|                             | 1971-2007 (37)               | 1.114a<br>(0.047)  | 0.032<br>(0.381)   | 0.167<br>(0.177)  |                   | 0.98      |
| Jordan                      | 1979-2004 (26)               | 0.613a<br>(0.203)  | -0.038<br>(0.297)  | 0.355<br>(0.316)  | -613b<br>(270)    | 0.229     |
|                             | 1979-2004 (26)               | 1.059a<br>(0.068)  | 0.047<br>(0.340)   | 0.567<br>(0.298)  |                   | 0.967     |
| Kenya<br>1994<br>[0.0000]   | 1966-2006 (41)               | 0.655a<br>(0.185)  | -0.879<br>(0.561)  | -0.235<br>(0.338) | -22100<br>(12102) | 0.578     |
|                             | 1966-1993 (28)               | 0.561a<br>(0.110)  | -1.640a<br>(0.525) | 0.305a<br>(0.104) | -12083<br>(5985)  | 0.686     |
|                             | 1994-2006 (13)               | 0.355<br>(0.354)   | -1.465b<br>(0.723) | -0.513<br>(0.204) | -87059<br>(39084) | 0.680     |
|                             | 1966-2006 (41)               | 0.806a<br>(0.128)  | -0.895<br>(0.705)  | -0.271<br>(0.349) |                   | 0.792     |
|                             | 1966-1993 (28)               | 0.700a<br>(0.088)  | -1.929a<br>(0.542) | 0.303a<br>(0.114) |                   | 0.899     |
|                             | 1994-2006 (13)               | 0.837a<br>(0.175)  | 0.178<br>(0.511)   | -0.904<br>(0.246) |                   | 0.863     |
| St. Kitts and Nevis         | 1982-2007 (26)               | 0.727a<br>(0.162)  | -0.843<br>(0.512)  | 0.498b<br>(0.205) | -32.0<br>(19.5)   | 0.516     |
|                             | 1982-2007 (26)               | 0.866a<br>(0.125)  | -1.192b<br>(0.493) | 0.446b<br>(0.229) |                   | 0.902     |
| Kuwait                      | 1976-2007 (30)<br>1991, 1992 | 1.014a<br>(0.073)  | -0.254<br>(0.299)  | 1.001a<br>(0.091) | -3.360<br>(239)   | 0.927     |
|                             | 1966-2006 (41)<br>1991, 1992 | 0.806a<br>(0.128)  | -0.895<br>(0.705)  | -0.271<br>(0.349) |                   | 0.792     |
| St. Lucia                   | 1986-2007 (22)               | 0.692a<br>(0.193)  | -0.764b<br>(0.433) | 0.795b<br>(0.391) | -46.0b<br>(22.2)  | 0.602     |
|                             | 1986-2007 (22)               | 0.839a<br>(0.200)  | -0.847b<br>(0.429) | 0.763b<br>(0.376) |                   | 0.831     |
| Sri Lanka                   | 1962-2007 (46)               | 1.017a<br>(0.061)  | -0.067<br>(0.136)  | 0.454a<br>(0.171) | -10979b<br>(4720) | 0.839     |
|                             | 1962-2007 (46)               | 1.115a<br>(0.048)  | -0.043<br>(0.128)  | 0.421a<br>(0.174) |                   | 0.948     |
| Lesotho                     | 1981-2006 (22)<br>1997-2000  | 0.9589a<br>(0.091) | -0.567<br>(0.867)  | 0.149<br>(0.267)  | -142<br>(150)     | 0.8261    |
|                             | 1981-2006 (22)<br>1997-2000  | 1.031a<br>(0.049)  | -0.630<br>(0.854)  | 0.130<br>(0.263)  |                   | 0.970     |
| Luxembourg                  | 1971-1998 (25)<br>1994-1996  | 0.632a<br>(0.229)  | 0.082<br>(0.149)   | 0.243<br>(0.314)  | 18.7<br>(10.9)    | 0.459     |
|                             | 1971-1998 (25)<br>1994-1996  | 0.859a<br>(0.124)  | 0.193<br>(0.203)   | 0.304<br>(0.314)  |                   | 0.912     |

Table A2 (Continued)

| country                      | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|------------------------------|----------------|-------------------|--------------------|-------------------|-------------------|-----------|
| Morocco                      | 1962-2007      | 0.863a<br>(0.058) | -0.054<br>(0.129)  | 0.393a<br>(0.104) | -2.44b<br>(1.096) | 0.764     |
|                              | 1962-2007 (46) | 0.922a<br>(0.066) | -0.158<br>(0.109)  | 0.339a<br>(0.101) |                   | 0.806     |
| Madagascar                   | 1967-2007 (39) | 1.018a<br>(0.071) | 0.392<br>(0.499)   | 0.102<br>(0.094)  | -19.0<br>(27.3)   | 0.825     |
|                              | 1967-2007 (39) | 1.052a<br>(0.054) | 0.432<br>(0.409)   | 0.085<br>(0.089)  |                   | 0.929     |
| Mexico                       | 1980-2007 (28) | 0.708a<br>(0.165) | 0.055<br>(0.107)   | -0.141<br>(0.189) | 7.668<br>(32.4)   | 0.561     |
|                              | 1980-2007 (28) | 0.728a<br>(0.136) | 0.065<br>(0.124)   | -0.109<br>(0.105) |                   | 0.565     |
| Mali                         | 1990-2007 (18) | 0.125<br>(0.234)  | 0.600<br>(0.430)   | -0.210<br>(0.140) | -160a<br>(51.6)   | 0.191     |
|                              | 1990-2007 (18) | 0.963a<br>(0.087) | 0.305<br>(0.491)   | -0.146<br>(0.181) |                   | 0.943     |
| Malta                        | 1963-2007 (45) | 0.844a<br>(0.210) | -0.096<br>(0.173)  | 0.708<br>(0.465)  | -22.9a<br>(6.481) | 0.524     |
|                              | 1963-2007 (45) | 0.982a<br>(0.225) | -0.208<br>(0.189)  | 0.720<br>(0.465)  |                   | 0.731     |
| Mauritius                    | 1965-2007 (43) | 0.868a<br>(0.070) | -0.457a<br>(0.072) | 0.800a<br>(0.114) | -958a<br>(321)    | 0.858     |
|                              | 1965-2007 (43) | 0.930a<br>(0.066) | -0.554a<br>(0.066) | 0.747a<br>(0.124) |                   | 0.879     |
| Malawi                       | 1983-2005 (23) | 1.387a<br>(0.303) | 0.333<br>(1.073)   | 0.225b<br>(0.128) | 2734<br>(3847)    | 0.703     |
|                              | 1983-2005 (23) | 1.220a<br>(0.130) | -0.132<br>(1.041)  | 0.206b<br>(0.105) |                   | 0.894     |
| Malaysia<br>1998<br>[0.0000] | 1962-2007 (46) | 0.862a<br>(0.062) | 0.069<br>(0.115)   | 0.885a<br>(0.218) | -4145a<br>(1255)  | 0.953     |
|                              | 1962-1997 (26) | 0.895a<br>(0.124) | -0.121a<br>(0.029) | 0.717a<br>(0.163) | -2037a<br>(830)   | 0.795     |
|                              | 1998-2007 (20) | 0.789a<br>(0.070) | 0.466<br>(0.151)   | 0.464b<br>(0.193) | 3631<br>(3963)    | 0.953     |
|                              | 1962-2007 (46) | 0.847a<br>(0.072) | 0.006<br>(0.113)   | 0.789a<br>(0.235) |                   | 0.949     |
|                              | 1962-1997 (26) | 0.867a<br>(0.148) | -0.162a<br>(0.030) | 0.589a<br>(0.136) |                   | 0.787     |
|                              | 1998-2007 (20) | 0.823a<br>(0.047) | 0.476<br>(0.130)   | 0.523b<br>(0.209) |                   | 0.993     |
| Niger                        | 1971-2004 (34) | 0.874a<br>(0.289) | 0.090<br>(0.337)   | 0.055<br>(0.080)  | -16.4<br>(21.9)   | 0.419     |
|                              | 1971-2004 (34) | 1.056a<br>(0.075) | 0.219<br>(0.349)   | 0.069<br>(0.079)  |                   | 0.883     |
| Nigeria                      | 1963-2004 (42) | 0.402a<br>(0.187) | 1.090<br>(1.045)   | 0.452a<br>(0.153) | -10.3<br>(41.5)   | 0.449     |
|                              | 1963-2004 (42) | 0.397b<br>(0.176) | 1.025<br>(0.977)   | 0.447a<br>(0.150) |                   | 0.466     |
| Norway                       | 1962-2006 (45) | 0.409<br>(0.275)  | 0.428<br>(0.341)   | 0.890a<br>(0.172) | -8.397<br>(20.1)  | 0.351     |
|                              | 1962-2006 (45) | 0.410<br>(0.266)  | 0.357<br>(0.323)   | 0.841a<br>(0.189) |                   | 0.401     |
| Nepal                        | 1977-2007 (31) | 0.865a<br>(0.069) | -0.398<br>(0.262)  | 0.086<br>(0.112)  | -3537<br>(1622)   | 0.894     |
|                              | 1977-2007 (31) | 0.968a<br>(0.033) | -0.370<br>(0.276)  | 0.061<br>(0.108)  |                   | 0.973     |

Table A2 (Continued)

| country                                     | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS               | R-squared |
|---|----------------|-------------------|--------------------|-------------------|--------------------|-----------|
| Breaking year<br>[P-value of the Chow test] |                |                   |                    |                   |                    |           |
| New Zealand                                 | 1962–2007 (46) | 0.932a<br>(0.132) | -0.071<br>(0.097)  | 0.675a<br>(0.194) | -1096a<br>(365)    | 0.797     |
| 1993<br>[0.0022]                            | 1962–1992 (31) | 0.787a<br>(0.123) | 0.063<br>(0.041)   | 0.741a<br>(0.186) | -1423a<br>(388)    | 0.743     |
|   | 1993–2007 (15) | 0.455<br>(0.318)  | -0.446b<br>(0.243) | 1.191a<br>(0.214) | -3118a<br>(675)    | 0.880     |
|   | 1962–2007 (46) | 1.072a<br>(0.141) | -0.084<br>(0.094)  | 0.629b<br>(0.266) |                    | 0.902     |
|   | 1962–1992 (31) | 1.012a<br>(0.132) | 0.008<br>(0.069)   | 0.688b<br>(0.029) |                    | 0.813     |
|   | 1993–2007 (15) | 0.740b<br>(0.398) | -0.373<br>(0.321)  | 0.457<br>(0.325)  |                    | 0.964     |
| Netherlands                                 | 1962–1998 (37) | 0.973a<br>(0.066) | -0.024<br>(0.020)  | 0.579a<br>(0.156) | -0.025<br>(0.015)  | 0.885     |
| 1981<br>[0.0000]                            | 1962–1980 (19) | 0.813a<br>(0.100) | 0.019<br>(0.057)   | 0.590a<br>(0.214) | -0.057b<br>(0.023) | 0.745     |
|   | 1981–1998 (18) | 0.579a<br>(0.080) | -0.070a<br>(0.020) | 1.102a<br>(0.250) | 0.060b<br>(0.021)  | 0.888     |
|   | 1962–1998 (37) | 0.911a<br>(0.056) | -0.026<br>(0.019)  | 0.411a<br>(0.142) |                    | 0.929     |
|   | 1962–1980 (19) | 0.770a<br>(0.126) | -0.101a<br>(0.039) | 0.290b<br>(0.129) |                    | 0.691     |
|   | 1981–1998 (18) | 0.718a<br>(0.098) | -0.076a<br>(0.028) | 1.295a<br>(0.342) |                    | 0.977     |
| Pakistan                                    | 1971–2007 (37) | 0.826a<br>(0.130) | -0.927a<br>(0.254) | 0.140<br>(0.118)  | 3.17<br>(14.3)     | 0.604     |
| 1998<br>[0.0000]                            | 1971–1997 (27) | 0.552b<br>(0.246) | 0.219<br>(0.369)   | 0.126<br>(0.214)  | -31.6b<br>(14.0)   | 0.208     |
|   | 1998–2007 (10) | 1.140a<br>(0.107) | -2.207a<br>(0.340) | -0.198<br>(0.080) | 208a<br>(54.2)     | 0.933     |
|   | 1971–2007 (37) | 0.817a<br>(0.123) | -0.908a<br>(0.237) | 0.149<br>(0.112)  |                    | 0.692     |
|   | 1971–1997 (27) | 0.690a<br>(0.237) | -0.014<br>(0.420)  | -0.125<br>(0.181) |                    | 0.496     |
|   | 1998–2007 (10) | 0.880a<br>(0.139) | -1.077a<br>(0.213) | 0.196<br>(0.147)  |                    | 0.799     |
| Panama                                      | 1962–2007 (46) | 0.576a<br>(0.187) | 0.012<br>(0.128)   | -0.224<br>(0.197) | -59.7<br>(61.6)    | 0.402     |
|   | 1962–2007 (46) | 0.587a<br>(0.181) | -0.032<br>(0.123)  | -0.316<br>(0.163) |                    | 0.564     |
| Philippines                                 | 1971–2007 (37) | 0.916a<br>(0.030) | -0.101<br>(0.070)  | 0.724a<br>(0.113) | -28.0b<br>(12.9)   | 0.973     |
| 1986<br>[0.0056]                            | 1971–1985 (15) | 0.452<br>(0.366)  | -0.496a<br>(0.111) | 0.394<br>(0.361)  | -25.0a<br>(13.2)   | 0.487     |
|   | 1986–2007 (22) | 0.884a<br>(0.024) | -0.065<br>(0.040)  | 0.960a<br>(0.073) | -54.0a<br>(8.33)   | 0.994     |
|   | 1971–2007 (37) | 0.956a<br>(0.040) | -0.107<br>(0.081)  | 0.514a<br>(0.062) |                    | 0.967     |
|   | 1971–1985 (15) | 0.697a<br>(0.319) | -0.496b<br>(0.204) | 0.391<br>(0.344)  |                    | 0.688     |
|   | 1986–2007 (22) | 0.951a<br>(0.045) | -0.068<br>(0.084)  | 0.548a<br>(0.068) |                    | 0.983     |
| Papua New Guinea                            | 1976–2004 (29) | 0.616a<br>(0.211) | -0.469<br>(1.517)  | 0.260<br>(0.285)  | 27.3<br>(134)      | 0.424     |
|   | 1976–2004 (29) | 0.621a<br>(0.209) | -0.431<br>(1.482)  | 0.276<br>(0.263)  |                    | 0.428     |

Table A2 (Continued)

| country   | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|---|----------------|-------------------|--------------------|-------------------|-------------------|-----------|
| Poland  | 1983-2007 (25) | 0.819a<br>(0.163) | -0.061<br>(0.043)  | 0.120<br>(0.127)  | 0.120<br>(0.127)  | 0.672     |
| Breaking year<br>1991<br>[P-value of the Chow test] | 1983-1990 (8)  | 1.587a<br>(0.134) | -0.020<br>(0.010)  | 0.076a<br>(0.013) | -5141<br>(3171)   | 0.958     |
|   | 1991-2007 (17) | 0.565a<br>(0.111) | -0.408a<br>(0.110) | 0.794<br>(0.130)  | -17491a<br>(2371) | 0.840     |
|   | 1983-2007 (25) | 0.838a<br>(0.157) | -0.048<br>(0.033)  | 0.094<br>(0.085)  |                   | 0.668     |
|   | 1983-1990 (8)  | 1.301a<br>(0.077) | -0.024<br>(0.019)  | 0.054b<br>(0.023) |                   | 0.978     |
|   | 1991-2007 (17) | 0.912a<br>(0.279) | 0.043<br>(0.491)   | 0.284b<br>(0.138) |                   | 0.630     |
| Portugal  | 1962-1997 (36) | 0.985a<br>(0.059) | -0.006<br>(0.128)  | 0.746b<br>(0.317) | -227b<br>(87.1)   | 0.844     |
| Breaking year<br>1986<br>[0.0001]                   | 1962-1985 (24) | 0.938a<br>(0.042) | -0.237b<br>(0.120) | 0.936a<br>(0.193) | -156b<br>(66.7)   | 0.946     |
|   | 1986-1997 (12) | 0.280<br>(0.358)  | 0.319<br>(0.229)   | 0.722<br>(0.460)  | -2008b<br>(709)   | 0.375     |
|   | 1962-1997 (36) | 1.075a<br>(0.049) | -0.094<br>(0.113)  | 0.640b<br>(0.369) |                   | 0.952     |
|   | 1962-1985 (24) | 1.006a<br>(0.045) | -0.363a<br>(0.103) | 0.757a<br>(0.155) |                   | 0.977     |
|   | 1986-1997 (12) | 1.169a<br>(0.070) | 0.139<br>(0.149)   | 0.762<br>(0.786)  |                   | 0.947     |
| Paraguay  | 1964-2007 (44) | 0.854a<br>(0.086) | 0.109<br>(0.163)   | 0.380a<br>(0.084) | -331a<br>(74.8)   | 0.756     |
|   | 1964-2007 (44) | 1.012a<br>(0.075) | -0.131<br>(0.188)  | 0.275a<br>(0.098) |                   | 0.857     |
| Rwanda  | 1970-2005 (32) | 0.979a<br>(0.098) | 0.246<br>(0.320)   | 0.181b<br>(0.091) | -8.84<br>(9.30)   | 0.817     |
|   | 1970-2005 (32) | 1.073a<br>(0.027) | 0.184<br>(0.346)   | 0.181b<br>(0.094) |                   | 0.954     |
| Saudi Arabia  | 1974-2007 (34) | 0.838a<br>(0.075) | 0.633<br>(0.448)   | 0.627a<br>(0.133) | -1.558<br>(5.022) | 0.949     |
|   | 1974-2007 (34) | 0.834a<br>(0.081) | 0.609<br>(0.399)   | 0.626a<br>(0.131) |                   | 0.972     |
| Senegal   | 1971-2001 (31) | 0.522a<br>(0.186) | -0.265<br>(0.688)  | 0.091<br>(0.099)  | -53.6a<br>(17.4)  | 0.255     |
|   | 1971-2001 (31) | 0.992a<br>(0.105) | -0.016<br>(0.743)  | 0.100<br>(0.129)  |                   | 0.809     |
| Singapore   | 1981-2007 (27) | 0.903a<br>(0.059) | -0.011<br>(0.115)  | 0.987a<br>(0.163) | -1325<br>(957)    | 0.954     |
|   | 1981-2007 (27) | 0.889a<br>(0.063) | -0.061<br>(0.089)  | 0.890a<br>(0.140) |                   | 0.978     |
| Sierra Leone  | 1966-2003 (38) | 0.848a<br>(0.126) | -1.421b<br>(0.735) | 0.018<br>(0.067)  | -29539<br>(18133) | 0.636     |
|   | 1966-2003 (38) | 0.920a<br>(0.127) | -1.319<br>(0.783)  | 0.013<br>(0.071)  |                   | 0.712     |
| Suriname  | 1970-1997 (28) | 0.423<br>(0.473)  | -1.657b<br>(0.736) | 0.608b<br>(0.321) | -53.6<br>(42.2)   | 0.511     |
|   | 1970-1997 (28) | 0.613b<br>(0.357) | -1.314b<br>(0.641) | 0.683<br>(0.409)  |                   | 0.554     |
| Sweden  | 1962-2001 (40) | 0.778a<br>(0.031) | -0.065a<br>(0.009) | 0.759a<br>(0.060) | -6.74b<br>(2.51)  | 0.958     |
|   | 1962-2001 (40) | 0.736a<br>(0.037) | -0.081a<br>(0.012) | 0.648a<br>(0.039) |                   | 0.957     |

**Table A2 (Continued)**

| country                                     | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS             | R-squared |
|---|----------------|-------------------|--------------------|-------------------|------------------|-----------|
| Breaking year<br>[P-value of the Chow test] |                |                   |                    |                   |                  |           |
| Swaziland                                   | 1973–2006 (34) | 0.871a<br>(0.076) | -1.348b<br>(0.603) | 0.168<br>(0.241)  | -77.7<br>(105)   | 0.744     |
|   | 1973–2006 (34) | 0.917a<br>(0.060) | -1.475a<br>(0.535) | 0.138<br>(0.236)  |                  | 0.872     |
| Seychelles                                  | 1978–1998 (21) | 0.897a<br>(0.315) | -0.980<br>(0.853)  | 0.283<br>(0.189)  | -53.3<br>(92.3)  | 0.412     |
|   | 1978–1998 (21) | 1.058a<br>(0.095) | -1.152<br>(0.677)  | 0.317<br>(0.200)  |                  | 0.899     |
| Syrian Arab Republic<br>1997<br>[0.0027]    | 1965–2006 (42) | 0.906a<br>(0.086) | -0.066<br>(0.416)  | 0.135<br>(0.129)  | -3622<br>(4368)  | 0.810     |
|   | 1965–1996 (32) | 0.773a<br>(0.097) | -1.393a<br>(0.552) | -0.120<br>(0.094) | -9424b<br>(4597) | 0.776     |
|   | 1997–2006 (10) | 0.900a<br>(0.208) | -0.923<br>(0.883)  | 0.573b<br>(0.277) | -5123<br>(10314) | 0.657     |
|   | 1965–2006 (42) | 0.939a<br>(0.073) | -0.147<br>(0.429)  | 0.109<br>(0.121)  |                  | 0.857     |
|   | 1965–1996 (32) | 0.905a<br>(0.074) | -1.143b<br>(0.596) | -0.151<br>(0.099) |                  | 0.911     |
|   | 1997–2006 (10) | 0.833a<br>(0.124) | -0.855<br>(0.821)  | 0.499b<br>(0.190) |                  | 0.856     |
| Togo  | 1973–2007 (35) | 0.831a<br>(0.147) | 0.101<br>(0.478)   | 0.482a<br>(0.190) | -29.1<br>(17.4)  | 0.609     |
|   | 1973–2007 (35) | 1.019a<br>(0.075) | 0.042<br>(0.529)   | 0.518b<br>(0.190) |                  | 0.853     |
| Thailand<br>1997<br>[0.0029]                | 1968–2007 (40) | 0.828a<br>(0.142) | -0.082<br>(0.071)  | 1.042a<br>(0.185) | -86.5a<br>(15.3) | 0.842     |
|   | 1968–1996 (29) | 0.577a<br>(0.152) | -0.237a<br>(0.060) | 0.576a<br>(0.142) | -52.1a<br>(16.7) | 0.927     |
|   | 1997–2007 (11) | 0.891a<br>(0.258) | 0.035<br>(0.117)   | 1.101a<br>(0.304) | -86.7<br>(72.5)  | 0.633     |
|   | 1968–2007 (40) | 0.751a<br>(0.151) | -0.116<br>(0.088)  | 0.672a<br>(0.168) |                  | 0.756     |
|   | 1968–1996 (29) | 0.841a<br>(0.132) | -0.187a<br>(0.068) | 0.372a<br>(0.129) |                  | 0.935     |
|   | 1997–2007 (11) | 0.687a<br>(0.189) | 0.001<br>(0.110)   | 0.852a<br>(0.188) |                  | 0.842     |
| Trinidad and Tobago                         | 1962–2001 (40) | 0.441a<br>(0.169) | -0.411b<br>(0.221) | 0.611a<br>(0.106) | -435<br>(340)    | 0.601     |
|   | 1962–2001 (40) | 0.470a<br>(0.153) | -0.494b<br>(0.260) | 0.596a<br>(0.106) |                  | 0.601     |
| Turkey                                      | 1989–2007 (19) | 0.173<br>(0.467)  | -0.579<br>(0.424)  | 0.133<br>(0.129)  | -2611b<br>(1140) | 0.268     |
|   | 1989–2007 (19) | 0.519<br>(0.420)  | -0.492<br>(0.434)  | 0.136<br>(0.115)  |                  | 0.412     |
| Uganda                                      | 1984–2006 (23) | 1.247a<br>(0.184) | 4.317<br>(2.844)   | -0.192<br>(0.134) | 27.3<br>(93.6)   | 0.891     |
|   | 1984–2006 (23) | 1.224a<br>(0.126) | 4.237<br>(2.624)   | -0.180<br>(0.115) |                  | 0.967     |
| Uruguay                                     | 1978–2007 (30) | 0.558a<br>(0.153) | -0.058<br>(0.035)  | -0.090<br>(0.056) | -1662<br>(964)   | 0.396     |
|   | 1978–2007 (30) | 0.752a<br>(0.104) | -0.053<br>(0.042)  | -0.115<br>(0.053) |                  | 0.679     |

**Table A2 (Continued)**

| country                           | period (Obs.)  | CA(-1)            | DPC(-1)            | DZ                | CONS              | R-squared |
|-----------------------------------|----------------|-------------------|--------------------|-------------------|-------------------|-----------|
| Breaking year                     |                |                   |                    |                   |                   |           |
| [P-value of the Chow test]        |                |                   |                    |                   |                   |           |
| St. Vincent<br>and the Grenadines | 1980-2006 (27) | 0.719a<br>(0.143) | 0.066<br>(0.598)   | 1.467a<br>(0.318) | -63.7a<br>(19.1)  | 0.569     |
| 1999<br>[0.0023]                  | 1980-1998 (19) | 0.385a<br>(0.116) | -1.552b<br>(0.631) | 1.448a<br>(0.289) | -65.4a<br>(17.4)  | 0.715     |
|                                   | 1999-2006 (8)  | 0.522b<br>(0.182) | 2.356<br>(0.624)   | 1.379a<br>(0.353) | -161b<br>(36.9)   | 0.904     |
|                                   | 1980-2006 (27) | 1.021a<br>(0.105) | -0.650<br>(0.572)  | 1.238a<br>(0.371) |                   | 0.878     |
|                                   | 1980-1998 (19) | 0.752a<br>(0.099) | -2.182a<br>(0.668) | 1.014a<br>(0.316) |                   | 0.902     |
|                                   | 1999-2006 (8)  | 1.284a<br>(0.185) | 0.576<br>(0.453)   | 2.008b<br>(0.738) |                   | 0.932     |
| Venezuela                         | 1974-2007 (34) | 0.636a<br>(0.060) | -0.346a<br>(0.099) | 0.742a<br>(0.138) | 0.573<br>(0.700)  | 0.701     |
|                                   | 1974-2007 (34) | 0.675a<br>(0.068) | -0.349a<br>(0.098) | 0.763a<br>(0.127) |                   | 0.859     |
| South Africa                      | 1964-2007 (44) | 0.839a<br>(0.151) | -0.107a<br>(0.040) | 0.542a<br>(0.187) | -7121a<br>(2871)  | 0.612     |
| 1986<br>[0.0011]                  | 1964-1985 (22) | 0.613a<br>(0.152) | 0.096<br>(0.082)   | 0.883a<br>(0.156) | -14308a<br>(2807) | 0.720     |
|                                   | 1986-2007 (22) | 1.149a<br>(0.183) | -0.066b<br>(0.027) | 0.312<br>(0.191)  | -5453<br>(-5302)  | 0.777     |
|                                   | 1964-2007 (44) | 0.851a<br>(0.145) | -0.123a<br>(0.036) | 0.354a<br>(0.155) |                   | 0.629     |
|                                   | 1964-1985 (22) | 0.744a<br>(0.207) | -0.212<br>(0.123)  | 0.645b<br>(0.258) |                   | 0.497     |
|                                   | 1986-2007 (22) | 1.092a<br>(0.207) | -0.078a<br>(0.023) | 0.156<br>(0.126)  |                   | 0.794     |