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Sudden stops: Determinants and output effects in the first era of globalization, 1880–1913

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ABSTRACT

We study the determinants and output effects of sudden stops in capital inflows during an era of intensified globalization from 1880 to 1913. Higher levels of exposure to foreign currency debt and large current account deficits associated with reliance on foreign capital greatly increased the likelihood of experiencing a sudden stop. Trade openness and strong reserve positions had the opposite effect. Sudden stops accompanied by financial crises are associated with drops in output per capita below trend equal to three to four percent. Frictions in the international capital markets of the day are a likely candidate for these output losses. Sudden stops connected with crises do not seem to bring trend growth downwards. Sudden stops *not* connected with crises appear to be associated with significant declines in trend growth.

1. Introduction

The pattern of sudden stops in capital inflows to emerging market countries in the last 30 years has great resonance to events which occurred in the first era of globalization between 1880 and 1913. This is especially so when we examine events in the late 1880s and early 1890s. In those years many emerging countries were beset by a drastic decline in capital flows from the core countries of Western Europe and many of these emerging markets suffered currency, banking and debt crises. These *sudden stops* of capital inflows have been at the root of volatile economic performance in many emerging markets both today and in this previous period.

Although capital from abroad flowed into virtually every country in this period, the impact on the real economy and the incidence of crises differed markedly. These differences reflected similar factors to those stressed today: structural differences, exposure to shocks, institutions and policies. Especially important in that era, as it has been in the recent past, was external and internal debt denominated and made payable in a fixed amount of gold or other international currencies. This state has been called "original sin" in the recent literature but it is not a new problem.[1] Like today, it exposed countries to the risk of balance sheet induced financial and economic stress accompanied possibly by currency crises and debt defaults. This is a phenomenon very resonant to the role of liability dollarization in the emerging market financial crises of the 1990s. Whether liability dollarization rendered countries more financially fragile or not was related to the presence of strong institutions and sound policy—what Caballero et al. (2005) refer to as country and currency trust. Country trust is based on sound institutions, strong rule of law and stable political systems. Currency trust is based on the ability to adhere to a credible nominal anchor like the gold standard in the nineteenth century, which required following stable monetary policy and fiscal balance.[2]

This paper applies and advances the methods of the recent empirical literature on sudden stops to the late 19th and early 20th century experience. We provide results that are comparable – and strikingly similar – to those of the more recent period which have analyzed sudden

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[1] See Eichengreen and Hausmann (1999) for an analysis of original sin in the recent period. Ford (1962, p.121), in a classic analysis of a financially fragile emerging market, Argentina prior to World War I, emphasized the "contractionary influence" of exchange rate depreciation due to foreign debt-service being payable in gold or sterling.

[2] See Bordo and Kydland (1995) for more on the effects of adherence to the gold standard.

stops and financial crises.[3] First we date sudden stops using a wide-ranging sample of emerging market countries from between 1880 and 1913. Our dating is largely in line with previous research by Catão (2005) who focused on sudden stops as a determinant of currency crises.

We then study a number of determinants of sudden stops, including the size of the external deficit, the degree of trade openness in the economy, the currency composition of debt, the overall burden of debt, the terms of trade, the real exchange rate, and policy variables like the growth rate of money and reserve ratios. Our results show that the ratio of hard currency debt to GDP is a very robust predictor of sudden stops. This provides evidence for the importance of balance sheet effects, with countries that owe large portions of their income stream in foreign currency facing serious difficulties in repaying their debt under the exchange rate depreciations that typically follow sudden stops. Our findings in this regard echo those from the recent period of globalization (Calvo et al., 2004). These vulnerabilities *persist* over the long run despite the fact that they appear to induce economic volatility.

Trade deficits in countries receiving capital inflows are also strongly associated with sudden stops. This illustrates that increased reliance on foreign capital may have made countries more financially fragile. This reliance is shown to interact with exposure to hard currency debt as Calvo et al. (2004) have shown in the recent period. Larger imbalances necessitate larger real depreciations which are likely to be contractionary in the face of 'dollarized' liabilities. We go on to show that this dynamic knocks output significantly below trend. Crises and sudden stops came along with significantly lower levels of output than might have been attained in the absence of such shocks.[4] However we find evidence of quick recovery. Sudden stops that come along with crises have no impact on trend growth rates.

We also find that trade openness reduces the probability of sudden stops, suggesting that the benefits of being able to quickly adjust to current account imbalances are more important than the threat of external shocks when a country is open to trade. Similarly, higher reserve ratios (i.e., gold reserves/money in circulation) also reduce the probability of sudden stops, a fact that reflects the importance of signaling and currency trust in the ability to prevent crises. Some evidence shows that countries used up reserves in attempts to smooth the impact of sudden stops of capital inflows. This former result contrasts sharply with recent research which finds little role for reserves in preventing sudden stops (Jeanne, 2007; Calvo et al., 2004).

Our focus then turns to the relationship between sudden stops and output per capita. Sudden stop events seem to have been associated with negative shocks to economic growth and output that dips significantly below trend. But were sudden stops themselves directly responsible for substantial drops in output, or were these drops the result of other unobservable factors that also triggered the sudden stop itself? While some theoretical models of sudden stops establish a direct link between the sudden stop and drops in output due to balance sheet effects, Chari et al. (2005) present equilibrium models with financial frictions where the sudden stop is associated with a rise in income. On the other hand, Aguiar and Gopinath (2007) argue that sudden stops would be an equilibrium outcome associated with negative and unobservable shocks to trend growth rates.

To answer these questions, we start with empirical models of the output gap that control for the potential endogeneity of sudden stops with a treatment regression approach. The theoretical papers mentioned above suggest that sudden stops are manifestations of changes in (unobservable) borrowing constraints (as in Chari et. al) or shocks to trend growth (e.g., in Aguiar and Gopinath). Estimation of reduced form models without controlling for endogeneity could lead to bias on the coefficient on sudden stops. However, the treatment regression approach shows *little evidence* that sudden stops are in fact empirically related to shocks to the cyclical component of output measured as deviations relative to an HP filter trend in the year they occur. However, as mentioned above, when accompanied by financial crises (banking, currency or debt crises) sudden stops are always associated with a negative impact on the output gap of up to 5% in the year of the event.

We also find that sudden stops not associated with crises are directly associated with lower trend growth consistent with Aguiar and Gopinath (2007). Crises appear and sudden stops appear to purge the system and allow for growth to resume quickly. Sudden stops without crises appear to reflect deeper negative changes in the economy leading naturally to lower investment as capital inflows decline and lower growth in the medium term.

This paper is organized as follows: Section 2 characterizes and identifies sudden stop events for our sample, performs a regression analysis on the determinants of the probability of sudden stops and studies robustness using several definitions commonly found in the literature. Section 3 considers the output effects of sudden stops and other financial crises by using a treatment effects model to control for endogeneity. Section 4 concludes.

2. Characterizing and identifying sudden stops, 1880–1913

2.1. Identifying sudden stops

In this section we identify sudden stop events in our sample of 20 emerging market countries using several identification criteria that are common in the literature.

A sudden stop is generally defined as a *large* and *unexpected* fall in a country's net capital inflows. In theory, sudden stops can occur without a current account reversal if foreign reserves are used to maintain the level of the current account deficit. In practice however, reserves are seldom large enough to be a practical or permanent solution, and eventually the current account and trade balance need to adjust. This makes identification of sudden stops easier, given that trade data can be used, and is particularly convenient for our period of study, for which direct capital flows data are scarce.

Using simple balance of payment accounting identities, we first construct a proxy for net capital inflows by subtracting the trade balance from changes in foreign reserves.[5]

Next, we create several indicator variables for sudden stops. Our first indicator, which we call "SS1", follows Calvo et al. (2004) closely and considers a country as having a sudden stop during a given year if there is an annual drop in net capital inflows of at least two standard deviations below the mean of the year-to-year changes for the period, and/or it is the first year of a drop in net capital inflows that exceeds 3% of nominal GDP over a period shorter than four years, *and* there is a drop in real GDP (of any magnitude) during that year. [6]

With this definition, we are requiring reversals to be sudden and large relative to the volatility experienced by that particular country during the period. This is important, since countries could differ substantially in the type and stability of foreign capital inflows and investments. Our identification strategy also allows for reversals

[3] See, for example, Calvo et al. (2004) and Edwards (2004b).

[4] Bordo and Meissner (2007) analyze capital inflows directly and find similar results.

[5] Balance of Payments = Current Account + Net Capital Inflows (NKI) − Change in Reserves, where Current Account = Trade Balance + Net Factor Payments + Unilateral Transfers. Therefore NKI = Change in Reserves − CA. By using trade balance data instead of current account data, our NKI proxy excludes net factor payments and unilateral transfers which, although potentially important in magnitude for some countries in this period, are not expected to change significantly on a yearly-basis for most countries. Default episodes (of which there are several sovereign defaults) and important immigrant destinations would be most affected. In any case, we explore the sensitivity of our findings using current account estimates below.

[6] The specific conditions, such as the two standard deviation cutoff, are common in the literature. See Calvo et al (2004) and Catão (2005).

Table 1
Sudden stops by country and year.

Country	Year with a sudden stop (SS1)	Year with a sudden stop (SS2)
Argentina	1891	1884, 1887, 1891, 1898, and 1912
Australia	1892	1891, 1899, and 1903
Austria	None	1898
Belgium	None	1881 and 1908
Brazil	None	1883, 1886, 1888, 1891, 1897, 1899, 1906, and 1909
Canada	1892, 1895, and 1908	1889, 1908, and 1913
Chile	1885 and 1894	1882, 1885, 1893, 1898, 1904, 1908, and 1912
Denmark	None	1885 and 1908
Finland	1901	1893 and 1901
Greece	1883, 1892, 1900, and 1906	1883, 1886, 1892, 1900, and 1906
India	1903 and 1911	1901 and 1909
Italy	1888	1888
Japan	1891 and 1899	1891, 1899, 1901, and 1906
New Zealand	1883 and 1888	1883, 1886, 1897, and 1909
Norway	1903	1892 and 1900
Portugal	None	1882 and 1891
Russia	1886 and 1889	1885, 1898, and1909
Spain	None	1887 and 1895
Sweden	1886 and 1912	1886, 1890, and 1911
United States	1896	1895 and 1910

Notes: See Appendix for definitions of sudden stops.

which may take longer to materialize but still represent a significant share of GDP. Finally, the inclusion of the drop in output allows us to differentiate sudden stops in capital inflows (a phenomenon related in spirit to a curtailment of the gross supply of capital from abroad) from positive terms of trade shocks which also lead to current account reversals but are coupled with *increases* in GDP and real exchange rate *appreciations*.

Our second sudden stop variable, labeled SS2, does not condition on output drops at all, but keeps all other criteria the same. In essence this is a broader definition that focuses exclusively on large net capital inflow reversals, regardless of the initial impact on output. This measure gives a fair chance for the data to show that sudden stops are not associated with output drops as in Chari et al. (2005).

For robustness we have three other ways to measure sudden stops using other data. SS3 uses a direct measure of gross capital inflows. These are data on capital calls in London which underlie Stone (1999), and they have been used by Catão (2005) in his "eclectic approach" which recognized the incomplete nature of the nineteenth century balance of payments data. These data represent significant proportions of capital inflows for the countries in our data set and their correlation with current account information is reassuringly high for the countries where we have reasonable data. We also use the very same data underlying results in Catão (2005) to generate SS4 and SS5. These data use current account data attempting to include net factor payments and monetary gold flows, though probably not covering much in terms of emigrant remittances.[7] When current account data were unavailable, trade balance data were used. Using these data, SS4 dates a sudden stop using criteria applied above for SS1, including requiring a fall in GDP, while SS5 is equivalent to SS2. We applied these criteria to a sample of 20 emerging market countries between 1880 and 1913: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Denmark, Finland, Greece, India, Italy, Japan, New Zealand, Norway, Portugal, Russia, Spain, Sweden and the United States.[8] The data were compiled from previous work by Bordo et al. (2001), Bordo and Meissner (2006), Catão (2005), Flandreau and Zúmer (2004), Mitchell (1992) and Obstfeld and Taylor (2003), among others. See the Appendix for further details.

The sudden stop events identified in the data are shown in Table 1. During the period 1880–1913, there were 25 SS1 sudden stops and 63 SS2 sudden stops in the countries considered; 14 countries were affected and 7 countries had two or more SS1 sudden stops. For SS2 all 20 countries were affected and every country besides Austria and Italy had more than one sudden stop.

Fig. 1 shows the pattern of average net capital inflows to GDP and the global number of SS1 sudden stops in each year. Capital inflows increased considerably in the early 1880s and then experienced a sharp drop from the early 1890s. Sudden stops occurred every time there was a global downturn in capital inflows, and there is some evidence of "bunching" around the early 1890s and around 1900.[9] These are well-known periods of macroeconomic instability in capital importing countries, as analyzed extensively in the literature on financial crises in the late nineteenth century.[10]

In terms of timing, sudden stops often tended to occur shortly before other financial crises. About 40% of (SS1) sudden stop events were followed by a financial crisis (either debt, currency or banking crisis) within only three years.[11] This provides some evidence for the link between sudden stops, balance sheet effects and financial crises.

Fig. 2 shows discount rates for core countries (UK, Germany and France), which were the main sources of funds for emerging economies. The years that are shaded are those with one or more sudden stops. One of the most striking features is that during the two most prominent periods of sudden stops, around 1890 and 1900, interest rates in the core lending countries were raised sharply. The rise in discount rates in the years preceding 1890, for example, reflected a reaction by the Bank of England and other central banks to a decline in their gold reserves reflecting burgeoning capital outflows to Latin America and other emerging regions to finance an investment boom. The boom occurred in a period of depressed economic conditions in England and the other European countries when low interest rates and sluggish investment made the higher rates of return in the Americas and Australasia very attractive. The boom ended as the European economy recovered at the end of the decade and investment opportunities reappeared. In the face of rising aggregate demand, the Bank of England raised its discount rate from 2 1/2 to 4%. This was matched by the German Reichsbank and other central banks. This policy shock precipitated a massive slowdown in investment abroad.[12]

This particular historical period experienced a pattern of events that included external shocks coming from a tightening of monetary policy in the core, a rise in sovereign yield spreads, a drying up of capital flows, current account reversals, and exchange rate depreciation (albeit somewhat smaller in gold standard countries). We now investigate whether these turnarounds were associated with declines in real output and whether financial crises mattered for these relationships. Catão (2005) provides an extensive investigation of the connection between currency crises and capital flows between 1880 and 1913 and a comparison to findings on this issue from the recent period for the impact of capital flows on emerging markets.

[7] See Esteves and Khoudour-Casteras (2008) on remittances in the nineteenth century. Such payments might help smooth consumption in the event of sudden stops. Unfortunately data are only available for a small handful of countries. Esteves and Khoudour-Casteras (2008) argue that remittances are usually 1–2% of GDP and are up to four times less volatile than capital flows.

[8] Following Bordo and Eichengreen (2002) we treat the US as an emerging country although in most respects it was an advanced country with the principal exception that it was a net recipient of capital inflows until the turn of the twentieth century and it had a relatively unstable banking system.

[9] See Catão (2005) for a preliminary look at evidence on bunching.

[10] See Bordo et al. (2001), Bordo and Eichengreen (2002).

[11] See Table A3 and Fig. A2 in the Appendix for a country-by-country analysis.

[12] See Bordo (2006).

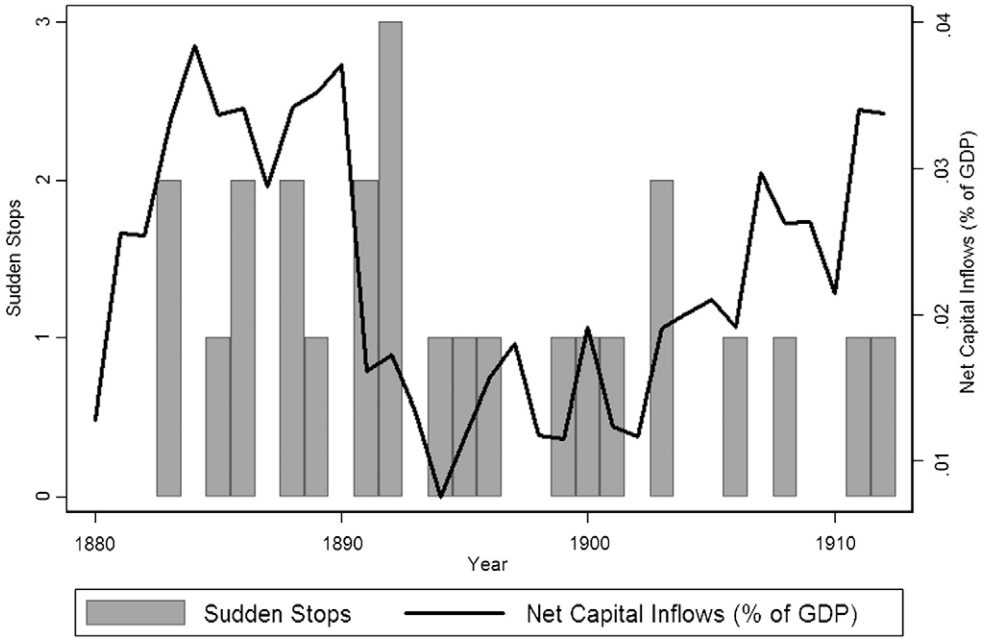

Fig. 1. Sudden stops and the average ratio of net capital inflows to GDP/by year, 1880–1913. Note: Bars show number of sudden stops in each year.

2.2. The determinants of sudden stops

Many factors can contribute to both the likelihood of sudden stops and their effect on economic activity. The degree of openness can play an important but ambiguous role. It can make a country *more* vulnerable to sudden stops simply because it may be more exposed to foreign shocks. But it can also make a country *less* vulnerable because it can facilitate the current account adjustment needed once a sudden stop occurs.[13] For example Calvo and Talvi (2005) demonstrate how a depreciating real exchange rate requires a greater compression by the non-traded goods sector in the case of a relatively closed economy.

The extent of "original sin" can also seriously impact the balance sheet of firms and especially the banking sector. Exchange rate depreciation increases the local currency value of liabilities relative to local currency assets. This can contribute to a banking crisis as the collateral backing bank loans deteriorates. It can also lead to a debt crisis for governments whose debts are in hard currency and whose tax revenues are in local currency. Both a banking crisis and the expectation of a debt crisis can generate currency crises as international reserves which serve to back the banking system's liabilities are drained and the government's balance sheet is threatened. The latter could signal an impending inflationary policy which, like today, was quite often the path chosen by emerging markets in the nineteenth century (Dooley 2000; Mishkin 2003; Catão and Solomou 2005). On the other hand, not all countries had banking systems that were out of kilter, and some had sound fiscal and monetary policies and strong institutions. These helped to both prevent and insulate the economy from such second round effects of sudden stops.

2.3. Regression analysis of determinants

We study the determinants of sudden stops in a multiple regression latent variable framework. These regressions will provide the basis for our treatment regression specifications below and serve to test several hypotheses mentioned above about the determinants of sudden stops. We run pooled probit regressions with standard errors clustered at the country level. Our data set is an unbalanced panel and our observational unit is the country-year.

Our dependent variables are the indicator variable for sudden stops, SS1–SS5. We begin with probits for SS1 and SS2, but below we show the robustness of our findings to the other definitions of sudden stop. We use as independent variables several factors identified in the literature as important determinants: the ratio of the trade balance to GDP, the degree of openness (exports plus imports divided by GDP), the ratio of debt payable in a fixed quantity of gold or foreign currency debt to GDP, the gold coverage ratio (reserves / money in circulation), the ratio of total debt to GDP, the logarithm of GDP per capita, the growth rate of the money stock, the percentage difference between the real exchange rate (a rise is a real depreciation) and terms of trade and their HP filter trends, and the Bank of England discount rate.[14] We lag all variables one period.[15] To control for time effects, we include the Bank of England discount rate in all regressions.

2.4. Estimation results

Our results are summarized in Table 2 where coefficients shown are average marginal effects on the probability of a sudden stop. We proceed in a general-to-specific approach. Model (1) is our baseline specification with the largest set of likely explanatory variables.

The trade balance to GDP is clearly a strong determinant of sudden stops as expected, the coefficient on the trade balance to GDP is negative and statistically significant. As the trade balance rises, the smaller is the likely depreciation in the real exchange rate associated with a sudden stop (see Calvo et al., 2004). This term interacts with

[13] See, for example, Milesi-Ferretti and Razin (1998). For more on openness and sudden stops, see Cavallo and Frankel (2004).

[14] These variables have also been used in similar papers for more modern historical periods. See Calvo et al (2004), Cavallo and Frankel (2004), Guidotti, Sturzenegger, and Villar (2004) and Edwards (2004). Many of our results in this section are directly comparable to those in these studies.

[15] Many papers in the literature use lagged variables to control for endogeneity, even though most variables are highly persistent. We include lags to follow the literature, but an unreported regression shows that our results, except for the marginal impact of the ratio of the trade balance to GDP, are robust to the removal of lags. Other authors control for endogeneity using instrumental variable techniques. For example, Cavallo and Frankel (2004) use gravity estimates to control for endogeneity in the degree of trade openness. However, most of these studies find that results do not vary significantly after controlling for endogeneity.

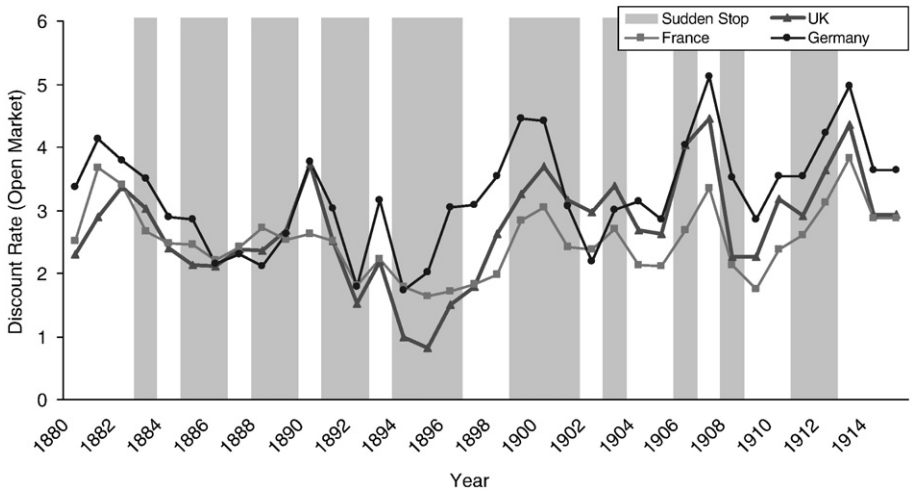

Fig. 2. Discount rates for core countries (Lenders) 1880–1913. Shaded are years in which a Sudden Stop started for at least one of the countries in the sample. Source: Homer and Sylla (2005) for discount rates.

the level of outstanding foreign currency debt as we show below. Our estimates suggest that an increase of 4.6 percentage points in the trade balance to GDP ratio from the mean of −1.7%, which represents a one standard deviation change for this variable in our sample, decreases the predicted probability of a sudden stop from 0.013 (conditional on keeping other variables at their means) to 0.005.[16] This represents a roughly 60% decrease in the predicted probability.

Among the debt variables, the currency composition of debt is very important, as shown by the positive and significant coefficients on the total foreign currency debt relative to GDP. This also provides evidence for the importance of balance sheet effects in our empirical model. The higher the ratio of debt denominated and payable in foreign currency or gold relative to GDP, the higher the chances of facing a sudden stop. A one standard deviation increase of 36 percentage points triples the probability of a sudden stop.

Fig. 3 illustrates the large impact of interactions between exposure to foreign currency liabilities and the trade balance. The predicted probability of a sudden stop is plotted for the sample range of trade deficits. The four curves represent four levels of foreign currency liabilities to GDP: 90% (90th percentile), 50% (75th percentile), 27% (the median) and 0% (the bottom 5th percentile). By raising the exposure of hard currency liabilities, from say the median to the 90th percentile, a country with a trade deficit of 4% of GDP would increase its predicted probability of a sudden stop from 0.01 to 0.13. This is consistent with the finding in Calvo et al. (2004) that foreign currency liabilities generate the possibility for a larger economic downturn but the impact is greater at larger levels of trade deficit. Also the marginal impact of a decline in the trade balance on the predicted probability of a sudden stop is clearly much larger at higher levels of foreign currency debt ratios. This is consistent with the idea that the real exchange rate depreciations may be very hard to deal with in the face of hard currency debt. Hard currency liabilities were a potent catalyst for international financial disruption then just as they are now.

Among policy variables, the gold coverage ratio has a significant negative effect on the probability of a sudden stop. A one standard deviation increase from the mean, equal to 32 percentage points in our sample, decreases this probability by 0.005, or roughly 40%. This variable, measured by the ratio of gold reserves to money in circulation, is taken here as a proxy for the degree of commitment to a sound monetary policy and adherence to the gold standard. Our results then support the view that among emerging countries a high gold coverage ratio signals the country's commitment to stable exchange rates, raises currency trust and reduces the chances of a sudden stop.

We also find that higher levels of trade openness can decrease the probability of experiencing a sudden stop but this variable is not statistically significant. However, this is some support for the view that openness makes the adjustment process easier (improving the trade balance is simpler if the economy is already heavily engaged in international trade), and is in line with empirical results by Edwards (2004a,b), Cavallo and Frankel (2004) and Calvo et al. (2004) for the more recent historical period. In a related vein to all of these findings above, real exchange rate overvaluation is also a very strong predictor of sudden stops. This suggests that eventual corrections (or expected corrections) to the real exchange rate were also a difficulty for emerging markets in this period.

It is important to note that our analysis does not focus on the reasons for the degree of indebtedness in foreign currency. As Eichengreen et al. (2003) point out, creditors can be reluctant to lend in local currency because a country has weak institutions and is prone to manipulating the value of its currency. But original sin can also be a result of other factors and market imperfections beyond a country's control.[17] Nations with good reputations or solid fundamentals can be obliged to issue debt in hard currency, and oppositely, high risk emerging market countries like Russia in the late nineteenth century and Brazil today have managed to sell a large amount of local currency debt to international markets. Regardless of its particular causes then, countries suffering from it may be more prone to liquidity runs and balance sheet effects. Our results show that original sin contributed to the probability of experiencing a sudden stop during the 1880–1913 period.

We also find in column 1 that total debt levels relative to GDP are negatively associated with sudden stops. This is surely due to the high correlation of this variable with the hard currency debt to GDP variable. When we include only total debt, the marginal effect is still negative but not significant leading us to keep the hard currency variable which is more theoretically appropriate.

Finally, the coefficients for the level of real GDP per capita, the gap between the terms of trade and their trend, and the growth of money supply are not statistically significant, and models (3) and (4) in Table 2 show that our main results are fairly robust to the removal of the previously statistically insignificant control variables. The one exception is that the reserve ratio becomes statistically insignificant (p-values are 0.13 and 0.18 in columns 3 and 4). The sign on the UK

[16] Other variables are held at their sample mean.

[17] See for example Bordo, Meissner and Redish (2005) and Flandreau and Sussman (2005) for discussions on the determinants and pace of graduation from original sin.

Table 2
Determinants of sudden stops (SS1 indicator).

	(1)	(2)	(3)	(4)
Trade balance to GDP	−0.359**	−0.421***	−0.354***	–
	[0.159]	[0.151]	[0.132]	
Foreign currency debt to GDP	0.101***	0.049***	0.035***	0.033**
	[0.031]	[0.015]	[0.010]	[0.016]
Trade openness (M + X/GDP)	−0.065	−0.052	−0.055	–
	[0.047]	[0.048]	[0.050]	
Gold coverage ratio	−0.057**	−0.052*	−0.040	−0.032
	[0.023]	[0.028]	[0.027]	[0.024]
Total debt to GDP	−0.060**	–	–	–
	[0.028]			
Real GDP per capita (logs)	0.001	0.013	–	–
	[0.011]	[0.013]		
Growth of money (%)	−0.000	0.010	–	–
	[0.045]	[0.042]		
Terms of trade gap	−0.062	−0.045	–	–
	[0.115]	[0.119]		
Real exchange rate gap	−0.171**	−0.194**	−0.174*	−0.157*
	[0.086]	[0.097]	[0.094]	[0.086]
UK short-term interest	−0.000	−0.002	−0.001	–
Rate	[0.008]	[0.008]	[0.008]	
Observations	440	440	440	440
Pseudo *R*-squared	0.159	0.118	0.108	0.0706

Notes: dependent variable is a binary indicator for sudden stops. Average marginal effects on the probability of sudden stops are reported. A constant is included, but is not reported.
Standard errors clustered at the country level are in brackets.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

short-term interest rate is small, negative and not statistically significant suggesting that after controlling for local factors tighter policy in the financial center of the world was not directly associated with the onset of sudden stops.

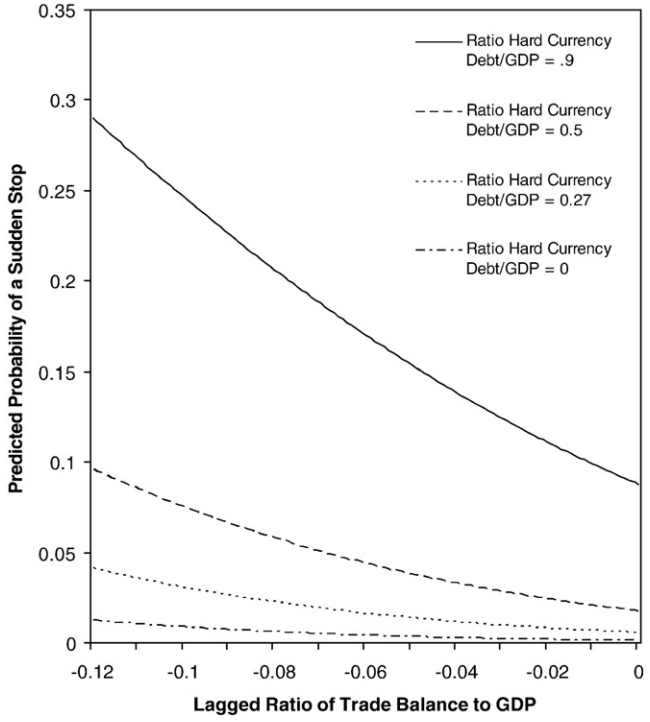

Fig. 3. Predicted probabilities of a sudden stop at various levels of hard currency debt to GDP. Notes: predicted probabilities are for the probit model for sudden stops (SS1) estimated in Table 3 column 1.

2.5. Robustness

We now repeat the probit analysis using our main specification (model 1 in Table 2) for the alternative sudden stop measures SS2, SS3, SS4 and SS5 and show the results in Table 3. We report two probit model specifications for each definition. The first includes all of the determinants considered in column 1 of Table 2 while the second set of results mimic the shorter specification of column 3 of Table 2. These are the models we will use below in our output gap regressions as well. It should also be noted that SS1 (trade balance data and output drop required) and SS2 (trade balance data no output drop required) are the variables the reader should focus on since they provide the cleanest and most comparable information based on the most reliable data. In this regard, the results in Table 3 are tolerably close to those reported Table 2. The probit results for SS2 match up especially closely with those for SS1.

Nevertheless, across definitions there are clear differences. One robust determinant of sudden stops is previous capital inflows. The larger these are, the more likely a sudden stop for each separate definition. Openness to trade carries a negative marginal effect and it is statistically significant when using SS3 (based on capital flows), SS4 (using current account data) and SS5 (also using current account data). Moreover, most of the variables that were not statistically significant in column 1 of Table 2 (GDP per capita, growth rate of money, terms of trade, and the UK interest rate) remain so. Finally, despite changes to their level of statistical significance, in most cases the determinants keep their signs the same throughout.

The marginal effects of the ratio of hard currency debt to GDP and reserves are generally positive as in Table 2, but they are not individually statistically significant in columns 3 through 8. It is important to note that because of the non-linearity of the probit model the average partial effect of hard currency debt however hides an economically and statistically significant marginal impact of this debt ratio at certain values of the covariates. The level of other controls matters as was illustrated in Fig. 3. Quantitatively then, these models have similar impacts on the predicted probabilities in suggesting that hard currency debt with large trade imbalances are associated with a large increase in the predicted probability of a sudden stop.[18] Our bottom line from Table 3 is that our baseline results from Table 2 and columns 1 and 2 of Table 3 are robust, even in slightly more restricted samples and with different measures of the current account.

2.6. Sudden stops and reserves

Jeanne (2007) provides a recent contribution to the connection between reserves, currency crises and sudden stops in the current era of globalization. We explore a similar analysis here. The departure point for his analysis is that reserve accumulation in East Asia post-1997 has been outstandingly high. These reserves appear to be a natural result of large trade surpluses, but many observers believe this accumulation strategy to be an attempt to insure against another meltdown like that of 1997–98. In fact Jeanne observes that Latin American countries also appear to be accumulating reserves despite recent current account deficits. In other words, these nations are using capital inflows to fund reserve accumulation. Nevertheless, the idea that reserves have served the purpose of insuring against sudden stops has limitations. There does not appear to be much evidence that higher reserve ratios (e.g., reserves as a percentage of short-term debt, imports, M2 etc.) decrease the likelihood of a sudden stop in the recent period. On the other hand, Jeanne provides some evidence that reserves do smooth absorption during sudden stop episodes. Between 1980 and 2002, countries typically accumulated reserves prior to

[18] The exception would be in column of Table 4 where the trade balance variable has a positive marginal effect for reasons we have been unable to discern.

Table 3
Determinants of sudden stops: alternative definitions of sudden stops.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	SS2	SS2	SS3	SS3	SS4	SS4	SS5	SS5
Trade balance to GDP,	−0.63**	−0.60**	0.01***	0.01***	−0.40**	−0.37**	−1.18***	−1.01***
Total capital flows to GDP (cols. 3 & 4), current account to GDP (cols. 5–8)	[0.28]	[0.30]	[0.00]	[0.00]	[0.19]	[0.14]	[0.24]	[0.20]
Forg. currency debt to GDP	0.12***	0.11**	0.03	0.03	0.00	0.03	−0.05	0.02
	[0.04]	[0.05]	[0.02]	[0.02]	[0.04]	[0.03]	[0.07]	[0.04]
Trade openness (M + X/GDP)	0.01	0.03	−0.26***	−0.25***	−0.11	−0.13**	−0.12*	−0.14**
	[0.07]	[0.07]	[0.09]	[0.07]	[0.07]	[0.07]	[0.06]	[0.06]
Gold coverage ratio	−0.01	−0.01	−0.02	−0.02	−0.02	−0.03	0.06*	0.02
	[0.04]	[0.04]	[0.02]	[0.02]	[0.03]	[0.03]	[0.03]	[0.03]
Total debt to GDP	−0.00	–	−0.01	–	0.02	–	0.06*	–
	[0.02]		[0.02]		[0.02]		[0.03]	
Real GDP per capita (logs)	0.01	–	−0.01	–	0.01	–	0.00	–
	[0.01]		[0.01]		[0.02]		[0.01]	
Growth of money (%)	0.06	–	−0.04	–	−0.04	–	−0.05	–
	[0.11]		[0.05]		[0.05]		[0.10]	
Terms of trade gap	0.02	–	−0.06	–	−0.11	–	−0.47	–
	[0.18]		[0.19]		[0.16]		[0.34]	
Real exchange rate gap	−0.34*	−0.28	−0.09	−0.10	0.18	0.17	−0.33**	−0.25
	[0.20]	[0.29]	[0.29]	[0.30]	[0.13]	[0.11]	[0.13]	[0.18]
UK short-term interest rate	0.01	–	−0.00	–	−0.01	−0.006	−0.02	–
	[0.02]		[0.02]		[0.02]	[0.018]	[0.02]	
Observations	440	440	406	406	365	365	365	365
Pseudo *R*-squared	0.07	0.07	0.08	0.08	0.11	0.11	0.12	0.09

Notes: dependent variable is a binary indicator for sudden stops. Definitions of sudden stops are given in the Appendix.
Average marginal effects on the probability of sudden stops are reported. A constant is included, but is not reported.
Standard errors clustered at the country level are in brackets.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

sudden stops and lost them during sudden stops. Such smoothing during disruptions to foreign financing allows countries to maintain absorption and stabilize exchange rates to limit the side effects of liability dollarization.

Jeanne's results are consistent with what the data show in the first era of globalization, especially when we use the SS2 definition which is closest to Jeanne's.

Figs. 4, 5 and 6 illustrate changes in key variables in a way comparable with Jeanne (2007) by plotting the coefficients from successive regressions of the sudden stop variable on: leads and lags of net capital inflows; the trade deficit; changes in reserves (and the implied 95% confidence interval for those coefficients; and country fixed effects. The denominator in all cases is GDP in the year before a sudden stop and standard errors are heteroscedasticity robust and clustered at the country level. Sudden stops are seen to be accomplished via elimination of trade deficits.[19] Reserve changes, on average, are an order of magnitude smaller than movements in the trade balance. This does not imply all countries acted the same way in the years before and after a turnaround. Many countries had low reserve ratios to begin with and had few reserves or lost them in the midst of a currency attack. Other countries that had higher reserve ratios seem to have maintained them.

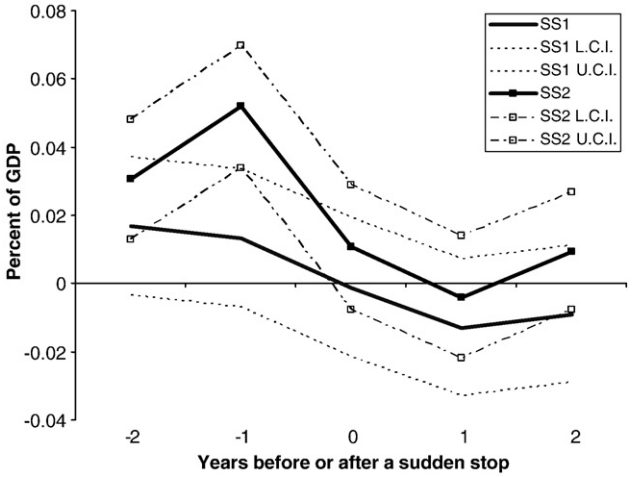

Fig. 4. Net capital inflows before, during and after sudden stops. Notes: solid lines are the average deviations from within country average levels of net capital inflows. Capital flows are measured relative to GDP in the year prior to the sudden stop. See Appendix and text for definition of SS1 and SS2. Dotted lines represent the 95% confidence bounds.

In our probit regressions above, we have found evidence that higher reserve ratios relative to bank notes in circulation lowered the probability of an SS1, but had no relation to an SS2 sudden stop. Similar to what Jeanne found today, Catão (2005) noted that emergers (with pro-cyclical budgets and currency crashes with their sudden stops) lost significant portions of reserves around the years of a sudden stop; in contrast he highlighted that countries which maintained pegs and ran smoother budget cycles actually gained reserves during sudden stops. We find little movement in reserves using the SS1 definition, but using SS2 our data show similar movements to today with nations losing reserves during and just after a sudden stop but accumulating them before.

Countries in our period often maintained high reserve ratios (reserves to circulating bank liabilities) because of gold standard commitments. Still the ratios of reserves to GDP were smaller than ratios seen in emerging markets today. Financial systems in the capital receiving countries were often only weakly insured by central banks or clearing house arrangements and reserves went along with attempts at financial development. Such countries that maintained high reserve ratios also had credibility and a means of financing sharp disruptions via short-term credits (e.g., Canada), played by (or were expected to eventually play by) the rules of the gold standard game by

[19] These conclusions are robust to measures using the current account rather than the trade balance.

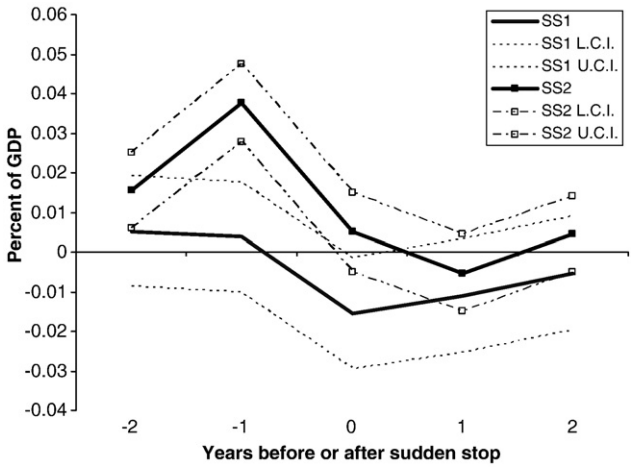

Fig. 5. Trade deficit before, during and after sudden stops. Notes: solid lines are the average deviation from within country average levels of the trade deficit relative GDP in the year prior to the sudden stop. The trade deficit is measured relative to GDP in the year before the sudden stop. Sudden stops are defined in the text and Appendix. Dotted lines represent the 95% confidence bounds.

raising interest rates on the heels of large deficits, or were able to flexibly expand exports of their unique commodities in the face of a capital inflow cutoff.

These countries were quite different from more financially dysfunctional periphery countries where paper currency regimes reigned from time to time and 'forced loans' were frequent. The latter type of country seems to have been all the more vulnerable to sudden stops due to their hard currency debt, their inability or unwillingness to stabilize with countercyclical monetary policy and possibly competitive pressures amongst other similarly structured commodity producers.

Our conclusion from this period of globalization is that, like today, reserves were most likely used to smooth sudden stops. It also appears that they served somewhat as insurance mechanisms and were associated with a lower likelihood of sudden stops. We now turn to a rigorous examination of output losses during sudden stops.

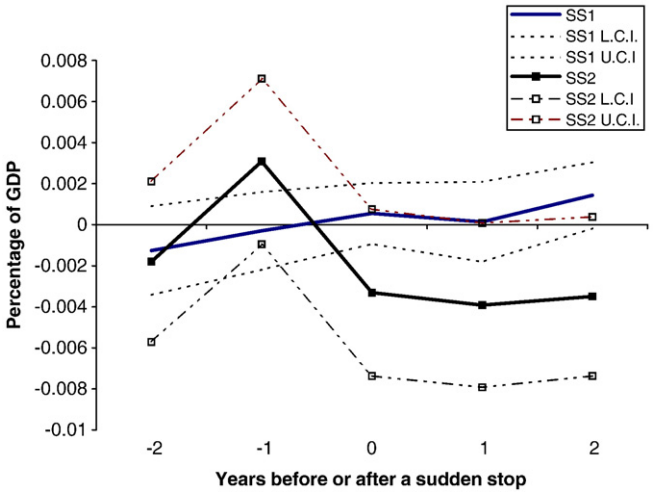

Fig. 6. Changes in reserves before, during, and after sudden stops. Notes: solid lines are the average deviations from within country average levels of the change in reserves relative to GDP in the year prior to the sudden stop. The change in reserves is scaled by GDP in the year before the sudden stop. Dotted lines represent the 95% confidence bounds.

3. Sudden stops, financial crises and output

In this section we study the effects of sudden stops on output. As in Hutchison and Noy (2006) we also examine the way sudden stops interact with financial crises (currency, debt and banking). In the current period, Hutchison and Noy (2006) found that sudden stops were associated with drops in growth of 1%, and when they were associated with a currency crisis the drop in the growth rate went up to 6 to 8% in the year of the event. Different from Hutchison and Noy, our dependent variable in this section is the output gap defined as the difference between the logarithm of output per capita and the HP filter, trend level of (the logarithm of) GDP per capita.

Estimating a regression with a sudden stop dummy by OLS may be problematic due to potential endogeneity problems. Sudden stops are inherently endogenous because unobserved factors such as credit market shocks or shocks to permanent income (cf. Aguiar and Gopinath, 2007 or Chari et al., 2005) that contribute to economic fluctuations may also be working to influence sudden stops. Even if these factors are not driving the trade balance, there could be unobservables that are correlated with both capital inflows and output. Recent theoretical analysis highlights the interaction between credit market imperfections such as contract enforceability, moral hazard etc. (cf. Rancière, Tornell and Westermann, 2008) and sentiment and expectations in financial markets.

The estimation of the impact on an endogenous continuous variable like the output gap using a potentially endogenous binary variable can be attempted using a treatment effects regression.[20] In addition to controlling for the endogeneity of the sudden stop dummy, this model also allows us to estimate the double impact of variables like trade openness on output, both *directly* via its marginal effect in the growth equation and *indirectly* through the impact on the probability of sudden stops.

3.1. Regression analysis of the output gap

Our empirical specification starts with a model related to standard growth equations:

$$y_{i,t} = \alpha + \beta X_{i,t} + \delta D^{ss}_{i,t} + \mu_i + \varepsilon_{it} \quad (1)$$

where $y_{i,t}$ is the difference for country i in year t between the logarithm of GDP per capita and trend (logarithm) GDP per capita calculated using the HP filter with smoothing parameter 6.25; $X_{i,t}$ is a vector of independent variables; $D^{ss}_{i,t}$ is a sudden stop dummy; μ_i is the level of GDP per capita in 1880, or alternatively a set of country dummies or fixed effects; α is a constant and $\varepsilon_{i,t}$ is an idiosyncratic error term. The coefficient δ is interpreted as the average deviation of the output gap during in the year of a sudden stop from the average output gap during the sample period.

Our sudden stop dummy $D^{ss}_{i,t}$ is a possibly endogenous binary variable that depends on the realization of an unobserved latent variable $L^*_{i,t}$ according to:

$$D^{ss}_{i,t} = \begin{cases} 1 & \text{if } L^*_{i,t} > 0 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

$$L^*_{i,t} = aW_{i(.)} + \xi_{i,t} \quad (3)$$

[20] Ranciere et al. (2006) use this procedure to analyze the impact of financial liberalization on the probability of crises and growth. Edwards (2004b) and Edwards (2005) use a related three-step mechanism to study the effects of sudden stops and current account reversals on growth. Similarly, Raziz and Rubinstein (2006) study the growth effects of exchange rate regimes and currency crises. All of these papers focus on the recent crisis experience of the late 20th and early 21st centuries.

Table 4
Effects of sudden stops and financial crises on output gap using SS1 as the treatment variable.

	(1)	(2)	(3)	(4)
Growth equation				
Sudden stop (SS1)	−0.024**	−0.021	−0.021	−0.017
	[0.010]	[0.018]	[0.020]	[0.021]
Financial crisis	–	–	–	0.006
				[0.006]
Financial crisis and SS (SS1)	–	–	–	−0.054***
				[0.014]
Initial real GDP per capita	−0.001	−0.001	–	–
	[0.002]	[0.002]		
Inflation	−0.031	−0.031	−0.048*	−0.052**
	[0.021]	[0.022]	[0.025]	[0.026]
Expenditures/revenue	−0.003	−0.003	−0.002	0.001
	[0.009]	[0.011]	[0.012]	[0.011]
Education enrollment	0.000	0.001	−0.039	−0.038
	[0.017]	[0.024]	[0.071]	[0.077]
Investment/GDP (−2)	−0.005	−0.005	−0.011	−0.013
	[0.035]	[0.037]	[0.064]	[0.063]
Trade openness	0.007	0.007	0.068	0.063
(M+X/GDP) (−2)	[0.011]	[0.010]	[0.047]	[0.045]
Population growth	0.106	0.103	−0.037	0.094
	[0.081]	[0.082]	[0.122]	[0.173]
Constant	0.010	0.009	–	–
	[0.008]	[0.013]		
Country fixed effects	No	No	Yes	Yes
Treatment probit (SS1 is dep. var.)				
TB to GDP (−2)	–	−12.105**	−12.117**	−11.966**
		[5.272]	[5.304]	[5.241]
Trade openness (−2)	–	−2.112	−2.127	−2.110
		[2.066]	[2.072]	[2.048]
Hard currency debt/GDP	–	1.050**	1.050**	1.048**
(−2)		[0.502]	[0.499]	[0.497]
Gold Coverage Ratio (−1)	–	−1.149***	−1.145***	−1.146***
		[0.391]	[0.381]	[0.376]
Real exchange rate gap	–	0.545	0.538	0.350
		[1.348]	[1.550]	[1.552]
UK short-term interest	–	−0.013	−0.013	−0.008
rate (−1)				
		[0.217]	[0.219]	[0.206]
Correlation (ρ)	–	−0.05	−0.04	0.01
		[0.18]	[0.20]	[0.17]
Observations	260	260	260	260

Notes: Top panel dependent variable is the output gap. Bottom panel gives results for treatment regressions (probits), with sudden stop dummy (SS1) as the dependent variable. Probit coefficients shown. Standard errors clustered at the country level in brackets.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

where $W_{i(\cdot)}$ is a set of control variables and $\xi_{i,t}$ is a random error term.[21] Under assumptions of normality, Eqs. (2) and (3) can be written as a probit model. The treatment effects model simply allows for correlation between the error term in the probit model and the growth regression.[22]

To illustrate what our treatment model is actually doing, consider the simple two-step procedure for estimation. First, the *treatment* equation for the probability of a sudden stop is estimated using a probit regression of sudden stops on a set of independent controls $W_{i(\cdot)}$ and a *hazard* is then obtained for each observation.[23] Second, Eq. (1) is estimated including this hazard as an additional independent variable. This model is a generalization of Heckman's bivariate selection model to the treatment effects context and can be also estimated in one step by maximum likelihood.[24] This is the procedure we follow.

In the treatment regression, $W_{i(\cdot)}$ includes the same variables as our shorter probit regression in Section 2 (e.g., model 3 in Table 3). These variables are strong determinants of sudden stops, but are not expected to affect output growth directly. To avoid further endogeneity issues, we lag by two years all variables with GDP in the denominator.

In the output gap regression, $X_{i,t}$ includes variables that are standard in the growth literature: inflation, the ratio of government expenditure to revenues, trade openness, education enrolment, population growth and the investment to GDP ratio. Again, we lag by two years all variables with GDP in the denominator.

Note that the level of trade openness is included in both the growth and treatment regressions, since it can affect growth directly or indirectly via the Sudden Stop event. This model is identified even when all variables are included in both equations (i.e. when $W_{i,t}=X_{i,t}$), due to the non-linearity of the probit treatment equation.[25]

3.2. Estimation results

Estimation results from the maximum likelihood efficient one step model are shown in Table 4 for SS1 and Table 5 for SS2. Further regressions for SS3, SS4 and SS5 are reported in Table 6. The bottom panel shows results for the treatment equation while the top panel shows results for the output gap equation. The number of observations drops significantly as a consequence of jointly estimating both growth and treatment equations.[26]

First focus attention on the top panel in Table 4, which shows the results from the output gap equation.[27] Model (1) includes only a sudden stop dummy variable and does not estimate the treatment model. Sudden stops are shown to have a negative association with the output gap. Our point estimate suggests that output per capita is roughly 2.5% lower than the trend level in the year when a sudden stop occurs. The coefficient is of the same magnitude but less precisely estimated (i.e., statistically significant at just above the 10% level) in column 2 where we introduce the treatment estimator and in column 3 where we present a treatment regression including country fixed

[21] The subscript $(\cdot)$ means there may be different lags for different variables.
[22] Formally, the model requires the following assumptions: i) $(\varepsilon,\xi)\sim N(0,Z)$ where $Z=\begin{pmatrix}\sigma_\varepsilon^2 & \pi\\ \pi & 1\end{pmatrix}$ and ii) (ε,ξ) independent of X and W.

[23] The hazard, also called the "Inverse Mills ratio" is defined by:

$$h_i=\begin{cases}\phi(\hat{a}W_{i,t})/\Phi(\hat{a}W_{i,t}) & \text{if } D_{i,t}^{ss}=1\\ -\phi(\hat{a}W_{i,t})/[1-\Phi(\hat{a}W_{i,t})] & \text{if } D_{i,t}^{ss}=0\end{cases}$$

where Φ and ϕ are the c.d.f and density functions of the normal distribution.
[24] The Heckman model was initially developed in the wage equation context to deal with selection based on unobservables (for example, when only wages for employed people are observed) and later generalized. The difference between the wage equation and the treatment context is that in the latter the outcome is observed for all units, whether "treated" or not (i.e. we observe growth both with or without a sudden stop).
[25] The model is identified even if $W_{i,t}=X_{i,t}$ due to the non-linearity of the probit treatment equation, but Monte Carlo simulations have shown that in finite samples this leads to weak identification. The reason is a high degree of collinearity between the hazard and the regressors in the outcome equation. Exclusion restrictions, variables in the treatment equation that are not in the outcome equation, provide stronger identification.
[26] The countries included are Argentina, Australia, Canada, Denmark, Italy, Norway, Spain and the US.
[27] In none of the treatment models for the output gap did we find evidence of correlation between the unobserved factors in the output gap model and the error term of the sudden stop model. Although the treatment model adds some noise to the estimation we present these results. However the outcome was similar in OLS regressions as column A of Table 4 shows.

Table 5
Effects of sudden stops and financial crises on output gap using SS2 as the treatment variable.

	(1)	(2)	(3)	(4)	(5)
Growth equation					
Sudden stop (SS2)	−0.003	−0.005	−0.003	0.001	0.003
	[0.009]	[0.035]	[0.042]	[0.198]	[0.009]
Financial crisis	–	–	–	0.009	0.009
				[0.006]	[0.005]
Financial crisis and SS (SS2)	–	–	–	−0.052***	−0.052**
				[0.017]	[0.017]
Initial real GDP per capita	−0.000	−0.000	–	–	–
	[0.002]	[0.002]			
Inflation	−0.040**	−0.040***	−0.060***	−0.065***	−0.065***
	[0.013]	[0.014]	[0.018]	[0.019]	[0.019]
Expenditures/revenue	−0.007	−0.007	−0.005	−0.004	−0.004
	[0.009]	[0.012]	[0.012]	[0.013]	[0.009]
Education enrollment	−0.010	−0.011	−0.025	−0.038	−0.037
	[0.015]	[0.022]	[0.095]	[0.165]	[0.104]
Investment/GDP (−2)	−0.011	−0.010	−0.022	−0.032	−0.032
	[0.032]	[0.029]	[0.051]	[0.047]	[0.060]
Trade openness (M+X/GDP) (−2)	0.010	0.010	0.081*	0.074*	0.074
	[0.011]	[0.010]	[0.044]	[0.038]	[0.044]
Population growth	0.133	0.132*	0.049	0.208	0.209
	[0.078]	[0.073]	[0.129]	[0.158]	[0.148]
Constant	0.010	0.010	–	–	–
	[0.008]	[0.012]			
Country fixed effects	No	No	Yes	Yes	Yes
Treatment probit					
TB to GDP (−2)	–	−7.550	−7.692	−7.544	–
		[4.673]	[5.488]	[16.985]	
Trade openness (−2)	–	−1.753	−1.837	−1.764	–
		[1.830]	[2.226]	[7.821]	
Hard currency debt/GDP (−2)	–	0.590***	0.587***	0.591***	–
		[0.191]	[0.163]	[0.225]	
Gold coverage ratio	–	−0.091	−0.073	−0.089	–
		[0.230]	[0.339]	[1.492]	
Real exchange rate gap	–	−1.771	−1.565	−1.744	–
		[3.715]	[4.536]	[18.948]	
UK short-term interest	–	0.086	0.086	0.085	–
Rate		[0.209]	[0.209]	[0.239]	
Correlation (ρ)	–	0.052	−0.003	0.037	–
		[0.562]	[0.726]	[3.808]	
Observations	260	260	260	260	260

Notes: Top panel dependent variable is the output gap. Bottom panel gives results from treatment regressions (probits), with sudden stop dummy (SS2) as the dependent variable. Probit coefficients shown. Standard errors clustered at the country level are in brackets.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

effects in the growth model. In column 4 we include an interaction between the sudden stop dummy and an indicator for whether a country had any or all of the following: a banking crisis, a currency crisis, or a debt crisis. The negative impact on the output gap of a sudden stop is now not statistically distinguishable from zero unless the sudden stop is accompanied by a crisis. When a sudden stop is accompanied by a crisis, the output gap is roughly negative 7.5%, and this marginal effect is statistically significant.

There is little evidence for actually using a treatment regression in Table 4 since the correlation between the error terms of both equations is never estimated to be statistically significant. Also, few of the other variables that are included as determinants of the output gap are statistically significant. Only inflation appears to be inversely related to the output gap and this is so only once we include country fixed effects. On the other hand, the results for the first stage of the treatment model are in line with those of Table 4.

In Table 5 we provide a similar set of regressions using the SS2 measure that does not demand a fall in output to date sudden stops. These regressions provide a fair test of the hypothesis in Chari et al. that sudden stops are not themselves associated with output losses but rather with a rise in output. Table 5 is consistent with the idea that sudden stops are not associated with a drop in output, but only when they are not accompanied by financial crises. As in Table 4, there is a negative relationship between sudden stops and the output gap when a sudden stop is accompanied by a financial crisis. This finding also does not appear to be due to endogeneity given the treatment regression yields a similar result as before.

A close examination of the results in column 4 of Table 5 reveals that the total marginal impact on the output gap of a sudden stop, given there is also a crisis event, is negative, but this marginal effect is not statistically significant since the standard error on the sudden stop variable blows up to an unbelievably high 0.19.[28] This result appears to be due to collinearity amongst included explanatory variables or possibly due to data issues associated with the degrees of freedom that arise with the treatment model. To be sure we re-estimated the model in column 4 by OLS (with country fixed effects) and present results in column 5. Since the correlation between the error terms was not estimated to be statistically significant there is little support for using the treatment model anyways. In column 5, the coefficient on sudden stops is again not statistically significant. The coefficient is 0.002, but it has a much lower standard error of 0.009. However, we do find again that the marginal effect of a sudden stop given a crisis is negative and statistically significant. The total marginal effect is to

[28] In column (4) the marginal impact of a crisis, given there is also a sudden stop, is negative and statistically significant bringing output below trend by 4%.

Table 6
Effects of sudden stops and financial crises on output gap using alternative measures of sudden stop as the treatment variables.

	(1-SS3)	(2-SS4)	(3-SS5)
Growth equation			
Sudden stop	−0.022**	−0.03*	0.01
	[0.011]	[0.02]	[0.01]
Financial crisis	−0.001	0.00	0.01
	[0.008]	[0.01]	[0.01]
Financial crisis and SS	0.036	0.03**	−0.02***
	[0.025]	[0.01]	[0.01]
Inflation	−0.064***	−0.04	−0.07***
	[0.024]	[0.03]	[0.02]
Expenditures/revenue	−0.005	−0.00	−0.01
	[0.012]	[0.01]	[0.01]
Education enrollment	−0.080***	−0.05	−0.01
	[0.031]	[0.06]	[0.08]
Investment/GDP (−2)	−0.015	−0.02	−0.03
	[0.064]	[0.07]	[0.06]
Trade Openness (M+X/GDP) (−2)	0.070	0.08*	0.08
	[0.048]	[0.05]	[0.05]
Population growth	−0.064***	−0.05	0.07
	[0.024]	[0.13]	[0.15]
Country fixed effects	Yes	Yes	Yes
Treatment probit			
Current account to GDP (−2)	–	−2.945	−5.162*
		[5.028]	[3.103]
Capital flows to GDP (−2)	0.049***	–	–
	[0.018]		
Trade openness (−2)	−2.298***	−1.69***	−0.94
	[0.840]	[0.56]	[1.01]
Hard currency debt/GDP (−2)	0.275	1.10***	0.40
	[0.233]	[0.39]	[0.30]
Gold coverage ratio	−0.310	−0.78**	0.03
	[0.237]	[0.31]	[0.27]
UK short-term interest rate	4.639*	0.06	0.01
	[2.748]	[0.31]	[0.17]
Real exchange rate gap	−0.181	3.01**	1.66
	[0.209]	[1.35]	[2.36]
Correlation (ρ)	−0.084	0.02	−0.06
	[0.236]	[0.05]	[0.13]
Observations	260	260	260

Notes: top panel dependent variable is the output gap. Bottom panel gives results from treatment regressions (probits), with sudden stop dummies noted at top of columns as the dependent variables. SS3 uses capital flows and requires output to fall in the year of a turnaround. SS4 uses current account data when available and requires and output fall. SS5 uses current account data when available but does not require an output fall to date the sudden stop. Probit coefficients are shown. Standard errors clustered at the country level are in brackets.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

bring output below trend by roughly 5%. All of this seems to suggest that many sudden stops are not related to short-term disruptions to output, but that sudden stops and crises—possibly emanating from other important market frictions— together do bring output significantly below trend in the short run.

In Table 6 we explore similar regressions for the SS3, SS4, and SS5 definitions of sudden stops. When we condition on an output fall to date sudden stops, with SS3 and SS4, sudden stops are related to a drop in output. The coefficient in both cases is roughly −2 to −3%. The coefficient on sudden stops for SS4 is not significant at better than the .15 level (p-value = 0.12).

In column 3, where we do not require an output drop for SS5, we find that the marginal impact of a sudden stop is not statistically significant whether or not a crisis occurs. However, consistent with the results from Table 5 for SS2, we find, that the marginal impact of a crisis, given there is a sudden stop, is to bring output down. The impact is negative 1.5% (p-value .10). Also, since we cannot reject the use of standard OLS, we ran, but do not report, OLS regressions and can show that the negative impact of a sudden stop accompanied by a crisis is again −1.5% with a lower p-value of 0.036.

The above results suggest that in the broadest definition of a sudden stop, using SS2 or SS5, sudden stops not related with financial crises in the same year are not associated with short-run declines in output per capita. However, sudden stops linked to financial crises are associated with economically sizeable output losses. This supports the idea that in the nineteenth century it took a number of systemic weaknesses to be present in order to have a negative impact of sudden stops. This is also parallel to the results in Hutchinson and Noy that sudden stops accompanied by crises had the largest negative impact on growth in the recent period of globalization.

3.3. Sudden stops and trend growth

In Table 7 we explore the impact of sudden stops and crises in the medium run. Our dependent variable is now the growth rate of the HP filter trend of the log of output per capita. We ask whether sudden stops and their interaction with crises (or vice versa) have an impact over several years. The dates in Table 1 for SS2 show that even when we did not condition on output drops there are many SS2 sudden stops in the year just before or after SS1 events. It could be that

Table 7
Effects of sudden stops and financial crises on trend growth of per capita output.

	(1) (SS1)	(2) (SS1)	(3) (SS2)	(4) (SS2)
Growth equation				
Sudden stop	−0.03***	−0.03***	−0.02***	−0.02***
	[0.01]	[0.01]	[0.01]	[0.01]
Financial crisis	–	−0.01***	–	−0.01***
		[0.00]		[0.00]
Financial crisis and SS	–	0.03***	–	0.01*
		[0.01]		[0.01]
Inflation	−0.00	0.00	−0.02	−0.01
	[0.01]	[0.01]	[0.02]	[0.02]
Expenditures/revenue	−0.01	−0.01	−0.01	−0.01
	[0.01]	[0.01]	[0.01]	[0.01]
Education enrollment	0.37***	0.36***	0.37***	0.37***
	[0.08]	[0.07]	[0.10]	[0.08]
Investment/GDP (-2)	−0.09*	−0.09**	−0.09*	−0.09**
	[0.05]	[0.04]	[0.05]	[0.05]
Trade openness (M+X/GDP) (−2)	0.08***	0.08***	0.09***	0.09***
	[0.02]	[0.03]	[0.03]	[0.03]
Population growth	0.36	0.25	0.41*	0.35*
	[0.23]	[0.17]	[0.21]	[0.19]
Country fixed effects	Yes	Yes	Yes	
Treatment probit				
TB to GDP (−2)	−15.27***	−15.13***	−12.45***	−11.95***
	[3.51]	[3.80]	[3.34]	[3.30]
Trade openness (−2)	−1.45	−1.43	−2.68**	−2.41**
	[2.23]	[2.33]	[1.12]	[1.07]
Hard currency debt/GDP (−2)	2.01***	2.05***	0.67***	0.78***
	[0.49]	[0.69]	[0.25]	[0.23]
Gold coverage ratio	−1.40***	−1.47***	−0.28	−0.37***
	[0.40]	[0.37]	[0.19]	[0.13]
UK short-term interest rate	−0.21	−0.12	0.04	−0.01
	[0.14]	[0.14]	[0.19]	[0.19]
Real exchange rate gap	−0.85	−0.53	−3.22	−2.74
	[1.99]	[1.77]	[2.93]	[2.62]
Correlation (ρ)	0.69*	0.68	0.79***	0.68***
	[0.24]	[0.28]	[0.11]	[0.14]
Observations	260	260	260	260

Notes: top panel dependent variable is the growth rate of the HP filter trend of log real GDP per capita. Bottom panel gives results from treatment regressions (probits), with sudden stop dummies noted at top of columns as the dependent variables. Probit coefficients are shown. Standard errors clustered at the country level are in brackets.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

imprecise dating (see Table A2) or noise in the GDP data are giving rise to somewhat misleading results when we focus on annual data as in Tables 4 through 6. Aguiar and Gopinath (2007) also argue that sudden stops are associated not just with short-run deviations from trend growth but with changes to the trend itself.

In Table 7 we present treatment regressions exactly parallel to those above. The results suggest that sudden stops, when unaccompanied by crises are in fact associated with significantly lower trend growth rates.[29] This result is robust to all definitions of sudden stops. The point estimates suggest trend growth is lower by between two and three percentage points in the wake of a sudden stop. Given the smoothing in the data, it is not surprising to find that in columns 1 through 4, there is correlation between the two error terms. This correlation is always estimated to be positive. This correlation is statistically significant in three out of the four models. Such correlation produces bias upwards (i.e., towards zero) in simple OLS models. One explanation for this could be that capital inflow "bonanzas", which were associated with a high likelihood of an eventual sudden stop as our probit regression have shown, were also associated with periods of relatively high growth rates, credit booms and overall exuberance.

In contrast to the findings above, there is little evidence that sudden stops associated with financial crises bring down trend growth rates. This is evidence that even though economic growth contracts strongly in the very short run when a sudden stop is paired with a crisis shock, growth rebounds strongly in the aftermath of such shocks. One interpretation is that sudden stops paired with crisis shocks bring important structural changes to economies and also reforms allowing growth to resume at trend. Such events include realignments of overvalued exchange rates which, once undertaken, could have beneficial impacts on exports. Meanwhile, sudden stops unaccompanied by crises may reflect equilibrium changes in the medium term prospects for growth. Such a turnaround diminishes capital inflows reducing investment in relatively poor, savings-constrained emerging markets.

Results from other included variables suggest more open economies, higher education levels, and larger population growth rates were associated with higher trend growth rates. The negative coefficient on the investment ratio is somewhat counterintuitive. However, the investment ratio is lagged by two periods. When we put in the contemporaneous value of the investment ratio, the coefficient is positive but not statistically significant. The negative sign could be evidence that capital importing countries grew more slowly during periods of low capital inflow (i.e., after sudden stops). In the years immediately prior to sudden stops, both investment and capital inflows would have been quite high so that lagging investment by two periods produces the strong inverse correlation.

4. Conclusions

Our analysis of the determinants and output effects of sudden stops in emerging economies, between 1880 and 1913, shows that the pattern of events was remarkably similar to the experience of the 1990s and first years of the 21st century. Financial globalization a century ago made many countries quite vulnerable to external shocks via capital inflows as today.

We find that low levels of hard currency liabilities relative to GDP, high levels of trade openness and sound monetary policies are important in reducing the probability of experiencing a sudden stop. Other authors have shown similar results for the more recent period.[30]

Sudden stops associated with financial crises have a negative impact on the output gap but no discernible impact on trend growth. These events could reflect realignments of overvalued currencies. Also balance sheet accelerators, a result of the combination of high levels of original sin and currency depreciation, may play an important role. These capital market frictions can make for high rates of default in the event of a crisis but growth appears to quickly resume to trend as in Rancière et al. (2008). In other words, once a crisis occurs and weaknesses are purged from an economy via default and so forth growth appears to resume at its trend level. There is a sharp rebound or "phoenix" recovery (Calvo et. al., 2006).

On the other hand, sudden stops unaccompanied by crises appear to be associated with lower trend growth. Such a finding is perhaps consistent with the argument in Aguiar and Gopinath (2007) that in emerging markets sudden stops themselves are equilibrium outcomes reflecting shocks to permanent income or dramatic policy switches. These types of reversals could imply periods of low investment, lack of capital inflows and overall lower growth in the medium run.

Another lesson from the long run appears to be that the persistence of exposure to foreign currency liabilities and the inability to get a foothold in global markets by expanding the export sector are key reasons for financial turmoil and volatile output performance. If the past proves illuminating in any regard, it begs the question of how emerging countries develop the financial and fiscal institutions of the advanced economies which appear to have much less volatile growth. Many advanced countries of today made this transition in the late nineteenth century. Today's emergers may wish to investigate the historical experience of countries that were the emergers of a century ago (like the US, Canada, Australia, New Zealand and the Scandinavian countries), to find out how they learned from the experiences of their financial crises and were able to advance to greater financial stability.[31] As these countries developed, they maintained credibility in financial markets by keeping strong reserve positions, implementing less pro-cyclical fiscal programs and expanding and diversifying their industrial base thereby reducing exposure to systemic financial crises. As Caballero et al. (2005) put it, many countries have yet to develop *country* and *currency trust*. The determinants of these deeper fundamentals remain an open question but one that needs investigation as global capital markets become increasingly connected.

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[29] We ran similar treatment regressions for SS3, SS4, and SS5. The point estimate on the sudden stop dummy was −0.02 in all cases and these were statistically significant at better than the .1 level expect in the case of SS3 which had slightly larger standard errors and a *p*-value of 0.16. Also sudden stops paired with crises had no statistically significant impact on trend growth.

[30] See Calvo et al. (2004), Cavallo and Frankel (2004), among others.

[31] On learning from crises, see Bordo (2007) and Hoffman et al. (2007).

Appendix A

Our dataset is an unbalanced panel with annual data from 1880 to 1913 for 20 emerging market countries: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Denmark, Finland, Greece, India, Italy, Japan, New Zealand, Norway, Portugal, Russia, Spain, Sweden and the United States.

Data sources:

Bordo et al. (2001), Bordo and Meissner (2006), Flandreau et al. (2004), Kostelenos (1995), Mitchell (1992), Catão (2005) and Obstfeld and Taylor (2003).

Table A1
Sudden Stop Indicator Variables.

Identification criteria	SS1	SS2	SS3	SS4	SS5
There is an annual drop in net capital inflows of at least 2 standard deviations below the mean of the year-to-year changes for the period in that country and/or it is the first year of a drop in net capital inflows that extends over a period shorter than four years and exceeds 3% of that year's nominal GDP	●	●	"Gross" capital flows ●	●	●
and there is a drop in real GDP (any magnitude) during that year .	●		●	●	
Alternative data:			Stone (1999)	Catão (2005)	Catão (2005)
Number of sudden stops in sample	25	63	40	28	58

Table A2
Timing of sudden stops vs financial crises (SS1 indicator).

	# of sudden stops coinciding with a financial crisis	% of total
Same year (t)	6	18%
From t to t + 1	7	21%
From t to t + 2	11	32%
From t to t + 3	14	41%

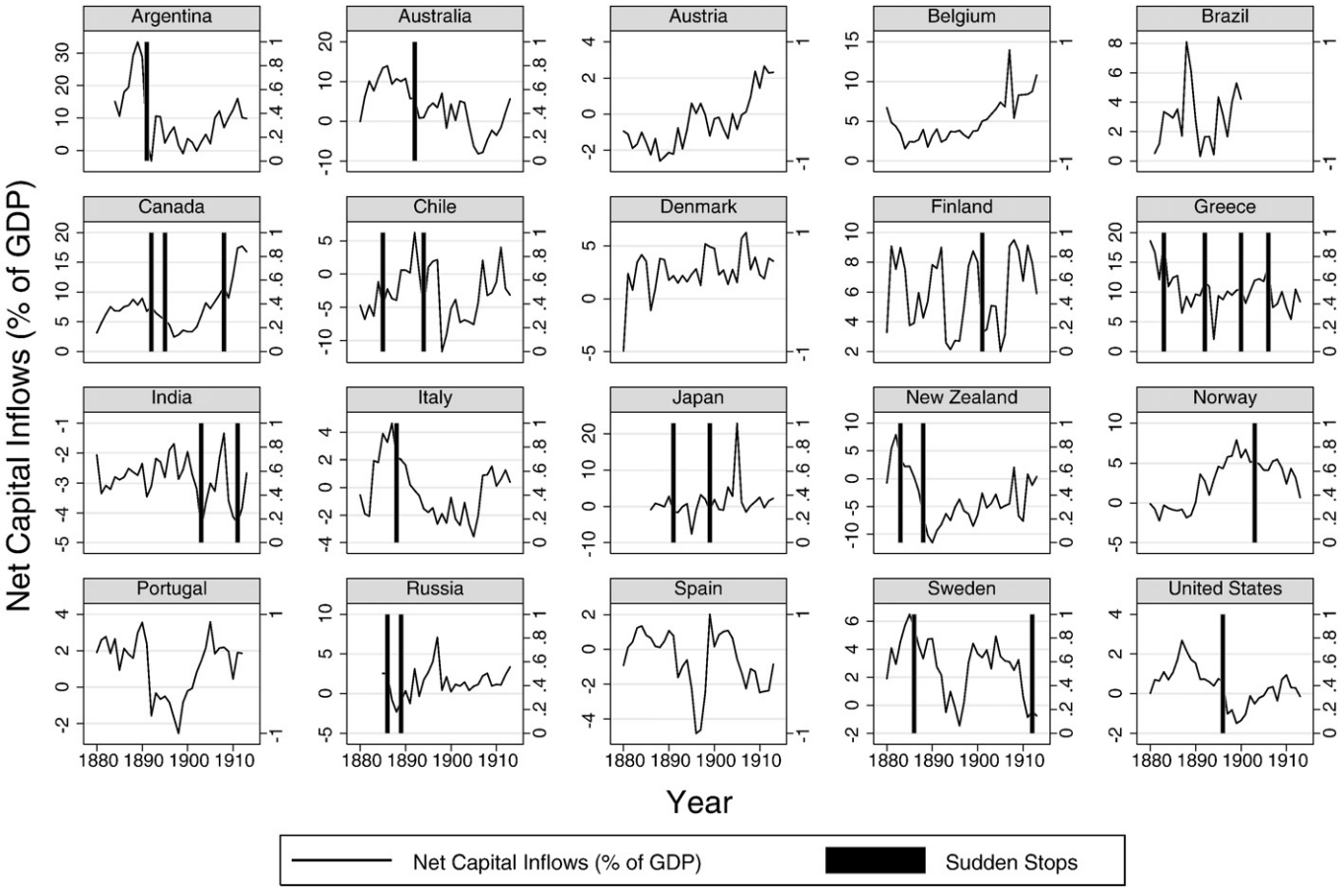

Fig. A1. Sudden stops and NKF by country (SS1 Indicator). Graphs by country.

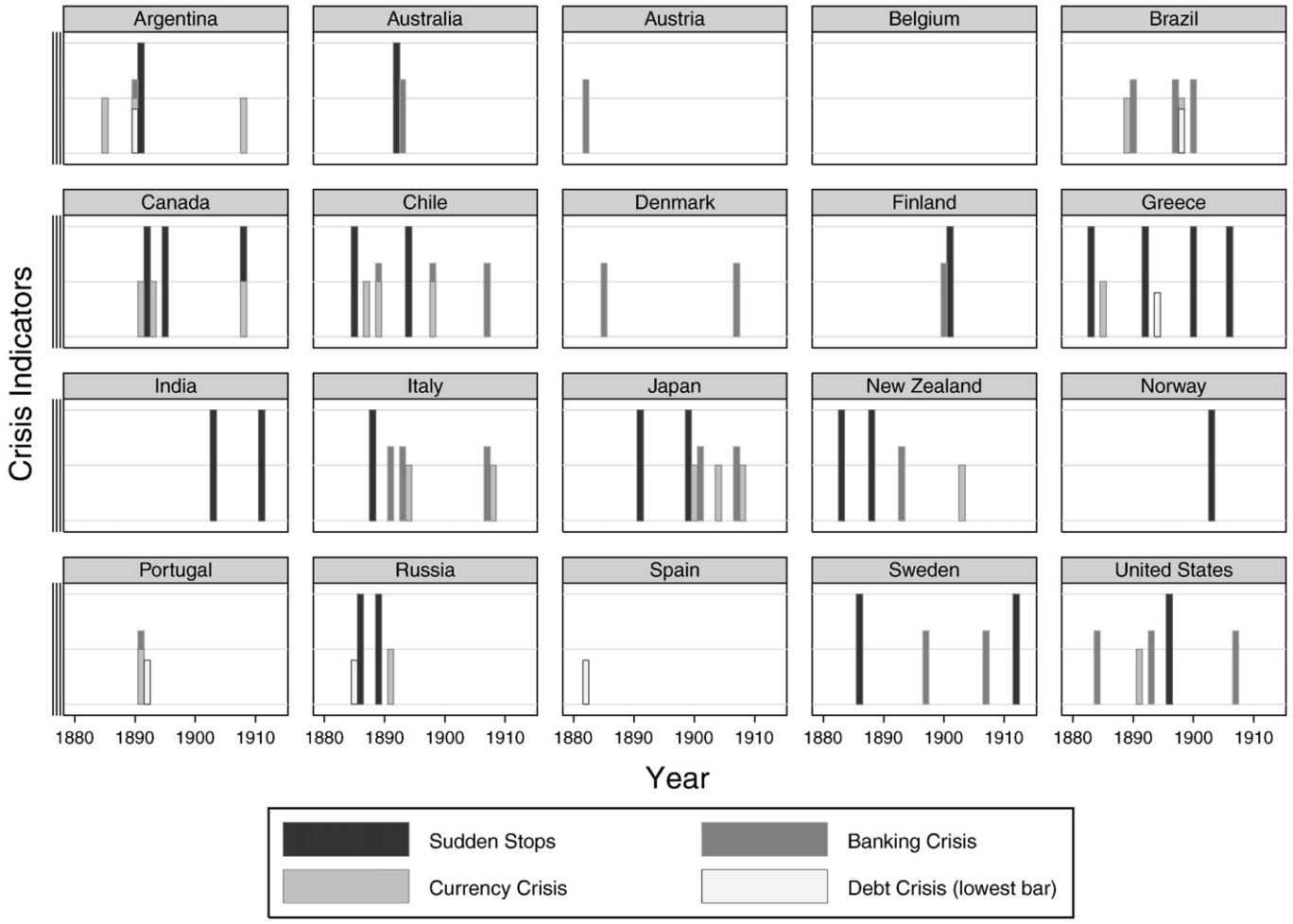

Fig. A2. Sudden stops and financial crises by country (SS1 indicator). Differences in bar height represent different types of crises.

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