Emerging from the War: Current Accounts and the International Business Cycle 1885-1939 *

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September 30, 2010

Abstract

We study the dynamics of international business cycles and capital flows in the UK, the United States and the Emerging Periphery (Australia, Canada, Italy, Japan, Norway and Sweden) in the period 1885-1939. A simple intertemporal model of the current account with non-tradeable goods provides a surprisingly good characterization of the data under *both* the Classical Gold Standard *and* during the Interwar period. This holds true even though there are major changes in important business cycle moments between the two periods: i) output, current accounts and interest rates all become more volatile in the interwar period, ii) the standard deviation of current accounts declines relative to that of GDP and, iii) there are major shifts in the correlation between current accounts and output. We argue that these stylized facts are consistent with a model in which the transmission mechanism is fundamentally stable between the two periods but in which the underlying shocks become more persistent and more global: in the economies emerging from the war, global trend shocks are the main driver of output dynamics. Our results are robust to the exclusion of the Great Depression from the sample.

JEL-Codes:

*For comments and discussions we are grateful to to the participants of various conferences and seminars : the Symposium on Historical Properties of Business Cycles at University of Manchester, the Macroeconomics Research Group (Makroökonomische Aussschuss) of the German Economic Association (VfS) in Munich, the European Economic History Association Conference in Geneva, the Hong Kong University of Science and Technolgy (HKUST), the CESifo MMIF Area Conference in Munich, the SSES Annual Meeting in Fribourg, the EEA Annual Conference in Glasgow, Tokyo University, University of Leipzig, and University of Zurich.

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KEYWORDS:International Capital Flows and Business Cycles, Great Depression, Gold Standard, Emerging Markets

1 Introduction

This paper uses the framework of the intertemporal approach to the current account to characterize the properties of historical business cycles based on data from both developed and emerging economies of the late 19th and early 20th century.

The era of the classical gold standard provides an ideal background for such an exercise. As has been widely discussed, the classical gold standard was characterized by a period of unprecedented international capital mobility and of financial globalization that led to huge net international capital flows. Obstfeld (2004) refers to these unidirectional flows as 'development finance' to suggest that these capital flows should predict future growth in the receiving economies. Conversely, he refers to the present-day pattern of globalization - characterized by huge cross-holdings of financial assets – as 'diversification finance' since it mainly enables countries to diversify macroeconomic risk. It is however exactly the first of these two types of globalization – through development finance – that is stressed in the intertemporal approach as it is usually embodied in the present value model of the current account (PVMCA). We think this makes it particularly interesting to confront the intertemporal approach with historical data and to use this model as a vehicle to collect stylized facts about the role that various types of shocks have played for international transmission.

The first world war and the interwar period certainly marked a major retrenchment on the free international movement of capital and led to a general increase in macroeconomic uncertainty and volatility. It would therefore seem that the interwar period constitutes a major challenge to the validity of the intertemporal approach.

As we argue in this paper, the intertemporal approach provides a surprisingly good characterization of international capital flows *both* under the classical gold standard and during the interwar period. This suggests that key aspects of the macroeconomic transmission mechanism seem to have remained quite stable across our entire sample period which covers the years from 1885 to 1939. This does not mean that the economic environment has remained stable. Quite to the contrary, we document important changes in some key business cycle moments between the gold standard and interwar periods: first, while the volatility of most macroeconomic aggregates increases in the interwar period, the volatility of the current account has increased much less than that of GDP. Secondly, the correlation between GDP growth and net exports also generally changes markedly, even though there is no uniform pattern to the change in this correlation across countries.

We focus on these moments because the intertemporal approach predicts that their changes should be particularly informative about changes in the nature of the underlying shocks to the economy: Glick and Rogoff (1995), Hoffmann 2001*b*, 2003 and Kano (2009) emphasized that global shocks should have no first order effect on the current account. Hence, changes in the relative variability of output and the current account may contain information with respect to the relative importance of global and country-specific shocks.

As has recently been argued by Aguiar and Gopinath (2007), the correlation between the current account and GDP is informative about the relative role of permanent and transitory shocks to output. According to the standard PVMCA, the current account should go into deficit after a trend shock and should go into surplus after a transitory shock.

Hence, while our results suggest that a simple intertemporal model of the current account is in principle able to explain the data for our entire sample period, they also suggest that the structure of shocks hitting economies has changed dramatically after the war. In particular, it seems that the interwar period is characterized by a prevalence of much more global shocks.

These shocks, however (unlike in the prewar period), are not cyclical in nature. Rather, the global factors at work during the interwar period reflect continual structural change - as in emerging market economies today, the cycle in the world economy emerging from the war is the trend!

2 Current Accounts and Business Cycle Patterns in the Pre-WWII Period

The key message we wish to convey in this paper is summarized in Figures 1-3: i) a simple intertemporal model of the current account in which there are no a-priori restrictions to international capital mobility or other frictions in financial markets, explains the current account in virtually all economies in our sample for the entire period 1885-1939. ii) at the same time, key business cycle moments have changed between the pre-war period of the classical gold standard and the interwar period. As we will argue, the first part of this findings is evidence of the fundamental stability in the formation of expectations about key macroeconomics drivers of the current account, including expectations of future output and exchange rates across the two apparently fundamentally different macroeconomic regimes of the Classical Gold Standard period and the Interwar period. The second part of our findings, however, suggests that this fundamental continuity is accompanied by secular change in the structure of the underlying macro-economic shocks.

The first part of this claim is illustrated in Figure 1, where the red line presents the current account of the seven economies in our sample: Australia, Canada, Italy, Japan, Norway, Sweden, the United Kingdom and the United States. The blue (dashed) line gives the prediction from our model as we will discuss it in detail below. The model is estimated based on the entire sample period from 1885-1939 and seems to do a remarkable job in replicating actual current account patterns. This suggests a considerable amount of stability in our model across what would usually to be considered as secular break, i.e. the First World War (WWI) and the breakdown in international capital mobility during the war and in the interwar period.

Figure 2-3 illustrate the second part of our claim by showing that key business cycle moments have changed: Figures 2 reports the relative standard deviations of the current account and (net) output, i.e. GDP less investment and government spending along with the predictions from our model. Across the board, there is a decline in this ratio between the period of the Classical Gold Standard (1885-1913) and the interwar period (1919-39).

Figure 3 presents the correlations between net output growth and the current account, again for both periods and together with the predicted correlations from the model. Here, we also see major shifts. While some countries experience an increase in the correlation between the current account and the business cycle, many are characterized by a marked decline.

To get an impression of the robustness of the stylized facts presented in the figures we also use GDP growth data that are detrended using an HP-filter with a smoothing weight of 100. Standard deviations of the filtered data are displayed in Table 1. The first impression is that business cycles in the interwar period are much more volatile. Notably, the fluctuations of per capita GDP become more volatile in the period after WWI, except for Australia. The same is true for net output and the current account to net output ratio, with the exception of Japan. Note also however, that the current-account / net output ratio generally becomes relatively less volatile than output, consistent with the findings in Figure 1.

These stylized facts represent our point of reference. We now look at them through the lens of an intertemporal approach to the current account (PVMCA).

3 Theoretical and econometric setup

3.1 Theoretical background

As the theoretical backdrop for our analysis we use a simple intertemporal model of the current account in which the representative consumer maximizes

$$\sum_{t=0}^{\infty} E_0 \left[\frac{X\left(C_{Nt}, C_{Tt}\right)^{1-\gamma}}{1-\gamma} \right]$$

where C_N is non-tradeables consumption, C_T is tradeables consumption and $X(.)$defines a Cobb-Douglas consumption bundle. The intertemporal budget constraint is

$$B_t = (1 + r_t)B_{t-1} + Y_t - I_t - G_t - C_t$$

where $B_t$is the stock of foreign assets, $r_t$the world real interest rate and $Y_t, I_t,$ and G_t denote real output, investment, government consumption and $C_t$denotes private consumption expenditure expressed in terms of tradeable goods, i.e.

$$C_t = C_{Tt} + PC_{Nt}.$$

Here, P is the relative price of non-tradeable goods. In this model, the current account balance is given by

$$CA_t = \Delta B_t = r_t^W B_{t-1} + NO_t - C_t$$

where r_t^W is the world interest rate and where we have introduced the notation $NO_t = Y_t - I_t - G_t$ to denote net output, i.e. the national cash flow available for consumption in period t.

Imposing the usual transversality constraint, this law of motion for the current account can be solved forward, to yield the non-linear intertemporal budget constraint.

$$B_{t-1} = \sum_{k=0}^{\infty} E_t \left\{ R_{t+k} \left[C_{t+k} - NO_{t+k} \right] \right\}$$

where $R_{t+k} = \left[\prod_{l=0}^{k} (1 + r_{t+l}^W) \right]^{-1}$. We follow Kano (2008) and log-linearize this expression to obtain a formula for the current-account / net output ratio

$$\frac{\widetilde{CA}_t}{NO_t} = b\widetilde{r}_t^W + c \sum_{k=1}^{\infty} \kappa^k E_t \left\{ \Delta\widetilde{c}_{t+k} - \widetilde{r}_{t+k}^W \right\} + \sum_{k=1}^{\infty} \kappa^k E_t \left\{ \widetilde{r}_{t+k}^W - \Delta\widetilde{no}_{t+k} \right\} \quad (1)$$

Here, Δno and Δc are the growth rates of net output and consumption expenditure respectively and the tilde denotes deviations from the unconditional mean. The parameters b, c, are the long-term means of B/NO, C/NO respectively and $\kappa = exp \left[E(\Delta no_t) - E(r_t) \right]$. Note that the approximation above follows directly from the intertemporal budget constraint. The condition is therefore consistent with arbitrary processes for investment and output and would also hold in a production economy.

Also, we have not yet made use of our specific assumptions on the form of utility or the presence of traded and non-traded goods. We now do so by assuming that $X_t = C_{Tt}^{\alpha} \times C_{Nt}^{1-\alpha}$ is a unit-elasticity-of-substitution aggregate of traded and non-traded goods where α is the expenditure share of traded goods. It is well known that in this case the intertemporal allocation of consumption can be solved for independently from the intratemporal allocation of consumption between tradeable and non-tradeable goods. Specifically, we can define a price index of aggregate consumption by recognizing that for any such index P^*it must be true that $P_t^* X = C_{Tt} + P_t C_{tNt} = C_t$ for all P_t. Substituting for X in the utility function we obtain the first order condition

$$E_t \left(\left(\frac{C_t}{C_{t+1}} \right)^{\gamma} \left(\frac{P_t^*}{P_{t+1}^*} \right)^{1+\gamma} \right) = \frac{1}{1 + r_{t+1}^W} \quad (2)$$

As shown in Obstfeld and Rogoff (1995) and Bergin and Sheffrin (2000), the aggregate price index for consumption is an expenditure-weighted CES aggregate of the tradeable and non-tradeable goods prices so that $P^*_{t+1}/P^*_t = (P_{t+1}/P_t)^{1-\alpha}$. Hence, (2) links aggregate consumption expenditure growth to the consumption-based real interest rate, which is the world-real interest rate corrected for real exchange rate changes (defined as the change in the relative price of non-traded goods). Assuming that consumption growth, the real exchange rate, and the real interest rate are jointly log-normal, Bergin and Sheffrin (2000) show that this condition can now be log-linearized to obtain

$$E_t(\Delta c_{t+1}) = \frac{1}{\gamma} E_t\left(r_{t+1}\right) + constant$$

where $r_{t+1} = r^W_{t+1} + (\gamma - 1)(1-\alpha)\Delta p_{t+1}$ is the consumption-based real interest rate.

We can use this expression for expected consumption growth to impose more structure on the log-linearized budget constraint (1). Plugging in from the previous equation and rearranging, we obtain the solution for the current-account / net output ratio that is the focus of our empirical analysis here:

$$\frac{\widetilde{CA_t}}{NO_t} = b\widetilde{r^W_t} + \left[\left(\frac{1}{\gamma} - 1\right) c + 1\right] \sum_{k=1}^{\infty} \kappa^k E_t \widetilde{r^W}_{t+k} + c \left[1 - \frac{1}{\gamma}\right] \sum_{k=1}^{\infty} \kappa^k E_t \widetilde{\Delta q}_{t+k} - \sum_{k=1}^{\infty} \kappa^k E_t \Delta\widetilde{no}_{t+k} \quad (3)$$

where $\Delta q_t = (1-\alpha)\Delta p_t$ denotes the change in the real exchange rate.

The first term in (3) measures the impact of net asset income on the current account: an increase in the world interest rate (or a depreciation of the real exchange rate) increases the value of non-tradeable factor income from abroad. *Ceteris paribus*, the current account of a debtor country will deteriorate following an increase in the world interest rate or a real depreciation wheres that of creditor country will improve. The second and third terms are consumption tilting terms: first, an increase in the world real interest rate above its long-run mean lowers consumption today and increases the current account. Second, an expected appreciation of the real exchange rate increases the future relative price of non-tradeables. With $1/\gamma < 1$, this equally provides an incentive to save tradeable goods, increasing the current account. We refer to the first channel as global tilting (because it is driven by global variation in interest rates) and to the second as domestic tilting (since it is driven by idiosyncratic variation in the consumption real interest rate or real exchange rate changes). Clearly, the more willing the representative household is to substitute consumption today for consumption tomorrow (i.e. the higher is the intertemporal elasticity of substitution), the stronger will be the global tilting effect. Finally, the last term is the typical consumption smoothing term in these models: if the sum of future expected output increases is positive, this should induce the country to borrow in order to increase consumption to its permanent level.

In analyzing our historical data set we take guidance from several properties of the model above: first, to the extent that the world interest rate is covariance-stationary and that net output and the real exchange rate are integrated of order no higher than one, the above equation implies that the current account should be covariance-stationary itself. This is a special instance of cointegration in the context of present-value model as first noted by Campbell and Shiller (1987) and it is worth emphasizing here since it has an important bearing on the econometric specification of the model that we will discuss in the next section.

The empirical literature on the PVMCA has emphasized the importance of distinguishing between country-specific and global shocks (Glick and Rogoff 1995; Hoffmann 2001*a*,*b*, 2003; Nason and Rogers 2002). Clearly, countries will only be able to smooth the country-specific component of fluctuations in net output through borrowing and lending. Global shocks to savings and investment demand should — for the average country —find their reflection the world real rate of interest. It will therefore be important to condition on variation in the world real rate of interest (Hoffmann 2003; Kano 2008). Note that in our analysis, this does not preclude the possibility that global interest rate shocks could affect a country's current account through international interest payments as well as through its impact on intertemporal substitution– the global tilting term — and the effect that interest rates will have on the present-value of future cash-flows. However, in global equilibrium this will be possible only to the extent that countries' initial net foreign asset positions or their reaction to a common shock are at least somewhat heterogeneous.

A third lesson we take from the model concerns the role of the persistence of shocks to net output, the real interest rats and the exchange rate: as is apparent from the terms on the right hand side of (3), it is the persistent component of such shocks that matters for current account dynamics. This could either be because the shock is transitory (so that future expected changes in one of the three variables reflect its gradual offsetting) or because the adjustment to the new long-term level of either the real exchange rate or net output (the two variables that are allowed to be non-stationary here) after a permanent shock is gradual. Our empirical methodology allows to identify both transitory and permanent shocks using only the cointegrating information in the data. This allows for the possibility that the latter trigger an only gradual adjustment to the new permanent level of the level. For example, Aguiar and Gopinath (2007) have emphasized the role of gradual adjustment to permanent shocks to net output as the source of the anticyclical behavior of current accounts and the high volatility of consumption in modern-day emerging economies. Here, we have an additional potential source of such sluggish adjustment to permanent shocks — in the real exchange rate. It is an important element of our identification procedure that it lets the data speak about the extent to which the adjustment to trend output shocks is gradual and to what extent they may therefore affect the current account.

4 Empirical implementation

We study the empirical dynamics of the world interest rate, the current account and net output in a vector auto regressive model (VAR):

$$\mathbf{A}(L)\begin{bmatrix} r^W_{t+1} \\ CA_t/NO_t \\ q_t \\ no_t \end{bmatrix} = \epsilon_t \qquad (4)$$

where $A(L)$ is a 4×4 matrix polynomial in the lag operator with no roots inside the unit circle and ϵ_t is a 4×1vector of white noise.

It is well-known that present-value relations such as (3) impose cointegrating restrictions on the data. In the present setup, we assume that the world real interest rate is stationary and that $no_t$and q_t are integrated of order at most one (*I(1)*). [1] Then, (3) implies that CA/NO, as the discounted sum of expected future realizations of a process that is integrated of order zero (I(0)) , is equally I(0). These restrictions allow us to interpret (4) as a cointegrated VAR with two trivial cointegrating relations – the current-account (i.e. CA/NO) and the world interest rate are themselves stationary so that the cointegrating space is spanned by the first two unit vectors.

We can then write the level-VAR in error correction form so that

$$\mathbf{\Gamma}(L)\Delta X_t = \boldsymbol{\alpha}\boldsymbol{\beta}' X_{t-1} + \epsilon_{\mathbf{t}} \qquad (5)$$

where

$$\boldsymbol{\beta} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$$

is the matrix of cointegrating vectors, $\boldsymbol{\alpha}$ is a vector of adjustment loadings and

[1] In fact, these assumptions are necessary for the log-linearization leading up to (3)

$\mathbf{\Gamma}(L)$ is a lag polynomial with all roots outside the unit circle.

Our empirical analysis is based on this VECM-specification. Once $\boldsymbol{\beta}$ is known, the other parameters can straightforwardly be estimated by OLS. Most earlier analyses of the present-value model of the current account (with the exception of Hoffmann 2001*a*,*b*, 2003) have worked with a mixed levels differences specification of the VAR in which the stationary variable appears in levels and the non-stationary variable in differences. The advantage of working with the VECM-formulation is that the long-term dynamics of the cointegrated system can easily be expressed in closed form in terms of the three parameter matrices $\mathbf{\Gamma}(L)$, $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$. Specifically, as we will show next, the permanent and transitory shocks to the system can directly be inferred from knowledge of ϵ_t and the adjustment loadings α. Clearly, this is particularly convenient in our setting here since our interest is in studying the impact of shocks of different orders of persistence on the current account and net output. An additional advantage of exploiting the cointegrated structure of the model in this way is that the just-identification of structural shocks – to the extent that they can be classified as either permanent or transitory – is determined by the data themselves, thus requiring the researcher to impose fewer *a priori* restrictions from economic theory. We will illustrate these points in turn. Before turning to the identification of structural shocks, however, we assess the reduced-form fit of our model.

4.1 Data description

We analyze annual data in the observation period 1885-1939. The countries under analysis are Australia, Canada, Japan, Norway, Sweden, United Kingdom, and United States. The main data source is Jones and Obstfeld (2001) (current account, GDP, fixed investment)[2] and Backus and Kehoe (1992) (government consumption, prices),[3] population data are from Maddison (2004).

[2] http://www.nber.org/databases/jones-obstfeld/.
[3] dge.repec.org/BK92.html.

As proxy for the world interest rate, we use the discount rate for the United Kingdom.[4] Real effective exchange rates are calculated as trade weighted averages of the real exchange rates vis-à -vis the partner countries. For the Japanese real effective exchange rate, we use the data from Shimazaki and Solomou (2001). For the other countries, we determine the main trading partners based on the availability of direction of trade statistics in Mitchell (2003*b*,*c*,*a*) ,Table E.2, and calculated the weights as averages of import and export weights.[5] The consumer price indices are mainly from Mitchell (2003*b*,*c*,*a*), Table H.2;[6] The exception is India, where we use Mukherjee (1969), Table A2.11. The nominal exchange rates are from Schneider, Schwarzer and Denzel (1991, 1992, 1994, 1997). For Norway and Sweden, we use the data base provided by the Riksbank and the Norges Bank.[7]

4.2 Fit of the present value model

To assess the general fit of our model, we follow the approach byCampbell and Shiller (1987) and use the estimated VAR to back out the expectations on the RHS of the current account equation (3). We rewrite the VECM in companion form as[8]

$$Z_{t+1} = \boldsymbol{G} Z_t + \boldsymbol{u}_{t+1}$$

where Z_t is the vector of current and past realizations of ΔX_t and $\boldsymbol{\beta}' X_t$, $\boldsymbol{G}$ the associated companion matrix and $\boldsymbol{u}_{t+1}$ a disturbance term. We then use the Hansen-Sargent prediction formula to proxy the expectations on the right

[4]NBER Macro History Database, /www.nber.org/databases/macrohistory/, file m13016.csv.

[5]Australia: Japan, UK, USA; Canada: Germany, Japan, UK, USA; Japan; China, UK, USA; Norway: Canada, Denmark, France, Germany, Netherlands, Sweden, UK, USA; Sweden: Denmark, France, Germany, Netherlands, Norway, UK, USA; UK: Argentina, Australia, Canada, France, Germany, India, Netherlands, New Zealand, Russia, USA; USA: Canada, France, Germany, Japan, Mexico, UK.

[6]For Japan, we had to use a wholesale price index Mitchell (2003*a*), Table H.1.

[7]www.riksbank.se/templates/Page.aspx?id=27394); www.norges-bank.no/templates/article____42331.aspx

[8]Since Campbell and Shiller (1987) it is conventional to obtain a companion form based on mixed levels-differences VAR in which the cointegrating relations (here: the current account and the real interest rate) appear in levels and the non-stationary variables in differences. We obtain a similar representation, with the important difference that we write the companion form directly as a function of the VECM-parameters $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$ and $\boldsymbol{\Gamma}(L)$. We discuss this issue in the technical appendix.

hand-side of the current-account equation (3). Specifically, we have

$$E_t \{r_{t+i}\} = \mathbf{e'_r G^i} Z_t,\ E_t \{\Delta q_{t+i}\} = \mathbf{e'_{\Delta q} G^i} Z_t \text{and } E_t \{\Delta no_{t+i}\} = \boldsymbol{e'_{\Delta no} G^i} Z_t$$

where e_r, $e_{\Delta q}$ and $e_{\Delta no}$ are the unit vectors associated with the $r-$, $\Delta q_t-$and Δno-equations in the companion-form of the VECM. Plugging into the current account equation (3) we then obtain the predicted current account - net output ratio:

$$\frac{\widehat{CA_t}}{NO_t} = b\widetilde{r}_t^W + \left[\left(\left(\frac{1}{\gamma} - 1 \right) c + 1 \right) e'_r - c \left(\frac{1}{\gamma} - 1 \right) e_{\Delta q} - e_{\Delta no}\prime \right] \kappa G \left[I - \kappa G \right]^{-1} Z_t$$

The predicted current account - net output ratio is a function of the parameters c (the consumption / net output ratio), b (the steady-state foreign asset position), and the intertemporal elasticity of substitution $(1/\gamma)$. As mentioned above, the real exchange rate is $\Delta q_t = (1 - \alpha)\Delta p_t$ and we use data on Δq in our estimation directly, so that we do not have to estimate α. We fix c/no as the sample average from the data. While b could in principle also be obtained from the data, good data on foreign asset positions are very sparse and unreliable for the historical period we are studying here.[9] We therefore estimate b and $1/\gamma$ using a GMM procedure similar to Bergin and Sheffrin (2000) and Kano (1998): to minimize the sum of squared deviations between the actual and the predicted value of CA/NO we perform a grid search over b and $1/\gamma$, letting $1/\gamma$ vary between zero and unity. To initialize the grid search over b, we first obtain an initial measure b_0 of net foreign assets by cumulating the current account and dividing this value by NO_t and averaging over the entire sample period 1885-1939. We then perform the search over the range $b_0 \pm 1$. We also investigate the possibility that the war could have affected steady state asset positions, allowing for a discrete jump Δb in b after 1919.[10]

[9] Lane and Milesi-Ferretti (2007) emphasize that cumulated current accounts are a very imprecise measure of foreign assets in modern data due to valuation effects and measurement error. Meissner and Taylor (2006) study the role of valuation effects in historical data.

[10] Note that our VAR model deliberately does not contain any deterministic controls for structural breaks. Note also that $1/\gamma$ is kept fixed for the entire sample period.

We determine Δb as a third parameter in the grid search procedure that is then performed over the *entire* sample period, 1885-1939.

Figures 1-7 plot the predicted and the actual current account over net output ratio against each other. The first two columns of Table 1 report correlations between $\widehat{CA/NO}$ and its real counterpart in the data as well as relative standard deviations of the two variables. The last columns report the estimates o f $1/\gamma$ and of the steady-state net foreign asset position b (before 1919) and $b + \Delta b$ for the period after 1919.

As is apparent, the model does a remarkable job in replicating the dynamics of historical current accounts. For all countries except Australia, we obtain correlations around 0.9 and the relative standard deviations are close to unity throughout.

Secondly, our results appear particularly remarkable since they have been obtained over a sample period that covers the Classical Gold Standard as well as World War I and the post-war period inclusive of the Great Depression and its aftermath. It would appear that this was a period of severe parameter instability. However, from the graphs it also seems that the parameters of the cointegrated VAR that govern the dynamics of the model – $\boldsymbol{\alpha}$, $\boldsymbol{\beta}'$ and $\boldsymbol{\Gamma}(\mathbf{L})$ – appear remarkably stable. Otherwise we would expect to see a severely lower performance of the model in some subperiods. No such deterioration is, however, generally apparent. This is our first main empirical point: between the Classical Gold Standard and the Interwar periods, there is considerable stability in the expectation formation mechanism underlying the right hand side of equation (3). The same simple model – without any controls for structural breaks etc. — can explain most of the dynamics of the current account in both periods!

But did the relative importance of the channels of external adjustment – interest rates (global tilting), exchange rate changes (domestic tilting), output changes (smoothing) and net factor income flows – change over time? We examine what fraction of the variance of the current account can be explained by each of these channels respectively. To this end, we decompose the variance of CA/NO as follows: first, write the current account as the sum of its predicted value and its residual, res, so that $CA/NO = \widehat{CA/NO} + res$. Then plug in from (3), take the variance on both sides and divide by $var(CA/NO)$ to obtain

$$1 = \beta_b + \beta_r + \beta_{\Delta q} + \beta_{\Delta no} + \beta_{res} \tag{6}$$

where

$$\beta_b = \frac{cov(b\,(\boldsymbol{e}_r' Z_t, CA/NO)}{var(CA/NO)}$$

$$\beta_r = \frac{cov\left((\phi+1)\boldsymbol{e}_r'\kappa\boldsymbol{A}\left[\boldsymbol{I}-\kappa\boldsymbol{A}\right]^{-1}Z_t, CA/NO\right)}{var(CA/NO)}$$

$$\beta_{\Delta q} = \frac{cov\left(-\phi\boldsymbol{e}_{\Delta q}'\kappa\boldsymbol{A}\left[\boldsymbol{I}-\kappa\boldsymbol{A}\right]^{-1}Z_t, CA/NO\right)}{var(CA/NO)}$$

$$\beta_{\Delta no} = \frac{cov\left(-\boldsymbol{e}_{\Delta no}'\kappa\boldsymbol{A}\left[\boldsymbol{I}-\kappa\boldsymbol{A}\right]^{-1}Z_t, CA/NO\right)}{var(CA/NO)}$$

$$\beta_{res} = \frac{cov(res, CA/NO)}{var(CA/NO)}$$

where $\phi = \left(\frac{1}{\gamma} - 1\right)c$. Here, β_b is the contribution of net factor income to the variance of the current account, β_r the contribution of (expected) variation in the world real rate of interest (the global tilting factor), $\beta_{\Delta q}$ the contribution of expected changes in the real exchange rate (the domestic tilting factor), and $\beta_{\Delta no}$ the contribution of output variation (consumption smoothing). The coefficient β_{res} is the fraction of the variance of the current account that remains unexplained by the model.

We refer to these coefficients β_x (where $x = res, \Delta no$,Δq, r and b in turn) as the pattern of external adjustment. In principle, the coefficients β_x can be estimated country-by-country. However, to obtain a better impression of how these patterns vary across time and across countries, we turn to estimating them from panel regressions

$$x_t^k = \alpha + \tau_t + \mu_k + \beta_x^k(t) \times \left[\frac{CA}{NO}\right]_t^k + \nu_t^k \tag{7}$$

where x_t^k stands in turn for the VAR-implied expectations of real interest rates, exchange rates etc. on the right hand side of (3), α is a constant and τ_t and $\mu_k$reflect time- and country effects. We then let $\beta_x^k(t)$ vary as a function of time and country characteristics by positing that

$$\beta_x^k(t) = \beta_{0x} + \sum_{l=1}^{p} \beta_{lx} PeriodDummy_{lt} + \beta_{On,x} OnGS_t^k + \beta_{On,x} OffGS_t^k$$

where $PeriodDummy_{lt}$ is a sequence of dummies that capture plausible break-points in in $\beta_x^k(t)$. We distinguish between WWI, the early interwar period (1919-28) and the period of the Great Depression (1929-39). Finally, we allow $\beta_x^k(t)$ to vary across countries by using two dummies, $OnGS_t^k$ and $OffGS_t^k$, that become one from the point in time at which country k returns ($OnGS_t^k$) or goess off $OffGS_t^k$ the interwar gold standard.

Plugging this parametrization for $\beta_x^k(t)$ back into equation (7) and multiplying out, we obtain a sequence of interaction terms between the dummies and the current account. We add a first-order terms of the gold-standard dummies to control for first order effects so that the equation we estimate becomes

$$\begin{aligned} x_t^k \quad = \quad & \mathbf{1}'\boldsymbol{d_t^k} + \beta_{0,x} \times \left[\frac{CA}{NO}\right]_t^k + \left[\sum_{l=1}^{p} \beta_{l,x} PeriodDummy_{lt}\right] \times \left[\frac{CA}{NO}\right]_t^k \\ & + \beta_{On,x} OnGS_t^k \times \left[\frac{CA}{NO}\right]_t^k + \beta_{Off,x} OffGS_t^k \times \left[\frac{CA}{NO}\right]_t^k + \alpha_{On,x} OnGS_t^k + \alpha_{Off,x} OffGS_t^k + \nu_t^k \end{aligned}$$

where the vector $\boldsymbol{d_t^k} = \begin{bmatrix} \tau_t & \mu_k & \alpha_0 \end{bmatrix}'$ stacks the deterministic terms and $\mathbf{1}$ is a vector of ones. This equation can be estimated by panel OLS. The coefficients β_{0x} reflect the pattern of external adjustment during the pre-1913 period, whereas the estimates of $\beta_{l,x}$ measure how this pattern changes in each superiod (relative to the pre-1913 baseline period). The coefficients $\beta_{On,x}$ and $\beta_{Off,x}$ capture the marginal impact of the return to or leaving of the gold standard. Results are presented in Table 3. For each channel, we sonsider two specifications, one (given in columns with heading 'I') in which we control for period dummies only and a second , in which we also control for the transition to and from gold (column II).

Note first that the model does a remarkable job of explaining the variation in current accounts: None of the period dummies is significant in the regression for the the unexplained component in the last two columns. Only the return to the Gold Standard, leads to a significant increase in the unexplained component of the current account – a point to which we return shortly.

Based on the specification witperiod dummies only (column I), we observe that mainly the smoothing and – to a more limited extent – the domestic tilting channels make a significant contribution to the variability of current accounts. Interestingly, the contribution of these channels increases with the onset of WWI. While the role of expected real exchange rate variation declines again after the war, the role of intertemporal smoothing remains high throughout the early interwar and also the Great-Depression periods. Conversely, the global tilting and the factor income channels play no important role. The observation that global variation in interest rates does not affect the current account of the average country in our sample is consistent with theoretical predictions: variation in the world interest rates should mainly reflect global shocks which, in turn, will not impact on the current account of the average country.

The second set of specifications (column II) reveals that a country's return to the Gold Standard seems to have a very dramatic impact on the patterns of external adjustment: the role of smoothing declines significantly ($\beta_{x,\Delta no} - 0.44$) and – as noted previously – the unexplained share of the variance of the current account increases. We interpret this latter fact as evidence of the destabilizing effect that the return to gold had on international capital flows: the standard smoothing role of the current account moves to the background in favor of capital flows that may be driven by speculative motives and that may be outside of our model. It is also interesting to see that, while going on gold has a marked effect on the role of intertemporal smoothing for current account dynamics, going *off* gold makes no significant impact on any of the β_xs. Again, this can be interpreted as an indication of the high degree of continuity across the subperiods that was already apprent from Figure (1). Plausibly, the mindset of policymakers that was shaped by the logic of the gold standard was not particularly changed by going off gold.

The big showing of the intertemporal channel in the interwar period is probaly the most salient feature of the results here. Note that this conclusion is not substantially affected by controlling for the exchange rate regime: while according to specification II transition to the gold standard seems associated with a *drop* in the contribution of the smoothing channel, this effect is more than made up by the general increase in the role of smoothing after 1929. Independently of the specification, our estimates therefore imply that at the onset of the Great Depression in 1929/30 roughly 70 percent of current account variability were explained by time-variation in expected net output growth.[11]

This finding suggests hat international capital flows during and possibly even *before* the Great Depression should have contained significant information about the prospective movements of (net) output growth rates – and therefore about the international spread and depth of the crisis. Figure 4 provides an – as we think – impressive illustration of this point. It plots the smoothing component of the current account obtained from a re-estimate of our model ending in 1928 against a country's cumulated output loss during the period 1929-1935. There is a strong negative relation, with countries

[11] Based on the specification in column I, we would have $\beta_{\Delta no}(t) = \beta_{0,\Delta no} + \beta_{3,\Delta no} = 0.45 + 0.24 = 0.69$. Conversely, for the specification in column II we have $\beta^k_{\Delta no}(t) + \beta_{0,\Delta no} + \beta_{3,\Delta no} + \beta_{OnGS,\Delta no} = 0.43 + 0.68 - 0.44 = 0.67$ which does not differ across countries since in 1929/30 all countries were on gold.

with higher (smoothing-related) surpluses seing the biggest cumulative output losses. This implies that much of how strongly the global slump would affect certain countries was anticipated by markets and was reflected in the directions and magnitudes of international capital flows!

Given this high degree of continuity, what then can account for the shifts in the moments that we presented in the introductory part of the paper — notably the increase in the volatility of output relative to the current account? We argue: different shocks, not a different transmission mechanism. For example, if shocks to the current account become more global, then the current account of the average country will not be affected. In the same mould, if the random walk (permanent) component of output becomes more volatile, then this also should not affect the volatility of the current account, since (the unit-root component of) permanent shocks cannot be smoothed via borrowing and lending.[12] We turn to exploring these possibilities in more detail in the next section, where we present the results from an agnostic identification of the shocks driving current accounts and business cycles.

4.3 Identification of structural shocks: cointegration and heteroskedasticity

In identifying structural shocks from the model, we adopt a novel approach that bridges the gap between two — so far quite distinct — literatures: the first is the literature on the identification of permanent and transitory components in cointegrated systems (Johansen, 1995; Hoffmann, 2001*a*). The important insight we take from here is that the cointegrated structure of our empirical model enables us to identify the space spanned by the permanent and transitory shocks without further restrictions from economic theory. In

[12]Note that this explanation would still be consistent with an overall unchanged pattern of channels of external adjustment: whether a shock to output is positive but transitory or negative and permanent (with a gradual adjustment to the permanently lower level) does not alter the current account response: in both cases, the current account should respond with a surplus. What matters for the response of $CA/NO$is only the size and persistence of the transitory component of the shock, not its ultimate effect on the output level.

our four-variable system, there are two cointegrating relationships which allows us to isolate two permanent shocks (the innovations in the two common trends) and two transitory shocks, with the two types of shocks orthogonal to each other.

The second part of our approach is based on the literature on identification through heteroskedasticity (Rigobon, 2003). Specifically, our results above are consistent with the view that the parameters of our empirical model are quite stable between the Gold Standard and Interwar Periods. But the fact that some key business cycle moments *did* change between periods suggests that the structure of underlying shocks may have changed. This, in turn, should should show up as heteroskedasticity in the reduced-form residuals. We exploit the heteroskedasticity across regimes to further disentangle the permanent and transitory shocks. The notion of stability of the transmission mechanism is in line with the fact that the overiding goal of policy makers in the interwar period was to return to gold,[13] while at the same time, the nature of shocks to the economcy had changed: the extension of the franchise, the emergence of labor parties, the growing public sector, and the collapse of international co-operation have been prominently discussed in the literature as potential sources of this increase in the volatility of shocks (Eichengreen 1992, Feinstein et al. 1997).

To see, first, how the permanent shocks can be identified from the VECM, let $\boldsymbol{\alpha}_{\perp}$be the orthogonal complement of $\boldsymbol{\alpha}$. Then premultiply (5) with $\boldsymbol{\alpha}_{\perp}$to obtain

$$\boldsymbol{\alpha'}_{\perp}\boldsymbol{\Gamma}(\boldsymbol{L})\Delta X_t = \boldsymbol{\alpha'}_{\perp}\boldsymbol{\epsilon_t}$$

In general, if X_t is of dimension n and if there are h cointegrating relationships, then $\boldsymbol{\alpha'}_{\perp}$ will be of dimension $(n-h)\times n$ with full rank. Hence, $\boldsymbol{\alpha'}_{\perp}\boldsymbol{\Gamma}(\boldsymbol{L})\boldsymbol{X_t}$ will be an $(n-h)$-dimensional random walk. Since, according to the Stock-

[13] "A further aspect of great significance was the widespread belief in financial and political circles that it was essential to return to the pre-war gold standard if the growth and prosperity of the pre-1914 era were to be re-established, whatever the sacrifices their countries would have to make in oder to force down wages and prices so that the pre-war value of the currency could be restored." (Feinstein et al. 1997, p. 1)

Watson representation there are exactly $n - h$ common trends in X_t, the permanent shocks in the system are given by $\boldsymbol{\alpha'_{\perp}\epsilon_t}$. By requiring the elements of $\boldsymbol{\alpha'_{\perp}\epsilon_t}$ to be mutually orthogonal and to have unit variance we obtain the orthogonalized permanent shocks as

$$\boldsymbol{\pi_t = (\alpha'_{\perp}\Omega\alpha_{\perp})^{-1/2}\alpha'_{\perp}\epsilon_t}$$

where $\boldsymbol{S}_{\pi} = \boldsymbol{\alpha}'_{\perp}\boldsymbol{\Omega\alpha}_{\perp}$ is the variance-covariance matrix of $\boldsymbol{\alpha}'_{\perp}\boldsymbol{\epsilon}_t$ and $(.)^{1/2}$denotes some matrix root of $\boldsymbol{S}_{\pi}$. Clearly, any root of $\boldsymbol{\alpha}'_{\perp}\boldsymbol{\Omega\alpha}_{\perp}$ will satisfy the orthogonality restriction $var(\boldsymbol{\pi}_t) = \boldsymbol{I}$, reflecting the fact that $\boldsymbol{\alpha}_{\perp}$ is determined only up to multiplication with a non-singular $(n-h) \times (n-h)$-matrix. Hence additional restrictions will generally be needed to achieve just-identification. In our case here, $n = 4$ and $h = 2$,so that $\boldsymbol{\pi}_t$ is a two-dimensional vector. Before we turn to identifying these permanent shocks further, we first identify the vector $\tau_{\mathbf{t}}$ of the two remaining transitory shocks by requiring $\tau_{\mathbf{t}}$ to be orthogonal to $\pi_{\mathbf{t}}$. It is easily verified that this leads us to

$$\boldsymbol{\tau}_t = (\boldsymbol{\alpha}'\boldsymbol{\Omega}^{-1}\boldsymbol{\alpha})^{-1/2}\boldsymbol{\alpha}'\boldsymbol{\epsilon}_{\mathbf{t}}$$

where again the factor $\boldsymbol{S}_{\tau}^{-1/2} = (\boldsymbol{\alpha'\Omega^{-1}\alpha})^{-1/2}$ arises due to the requirement that $var(\boldsymbol{\tau_t}) = \boldsymbol{I}$.

We now have two pairs of shocks: one permanent, one transitory. While all four shocks are constructed to be mutually orthogonal, the two types of shocks are not yet uniquely identified among themselves: any matrix root of $\boldsymbol{S}_{\pi}$ and $\boldsymbol{S}_{\tau}$ respectively will achieve orthogonalization — the orthogonality conditions that $var(\pi) = var(\tau) = I$ impose only three non-redundant restrictions on $\boldsymbol{S}_{\pi}$ and $\boldsymbol{S}_{\boldsymbol{\tau}}$ respectively. To single out a particular choice of normalization, we therefore need to impose one further restriction on each of these two matrices.

We obtain these restrictions by recognizing that the reduced-form model parameters $\boldsymbol{\Gamma}(L)$, $\boldsymbol{\beta}$ and $\boldsymbol{\alpha}$ that govern the conditional expectations in (3) seem stable across time while key second moments of the vector X – such as the relative volatility of output and the current account or the correlation between the two variables — seem to have changed. It may therefore be reasonable to assume that the variance of shocks has not been stable across time, while the transmission mechanism as such has been stable. To see how this assumption imposes the required restrictions, let $\mathbf{\Omega}^{GS}$ be the reduced-form residual covariance matrix in the Gold Standard period and $\mathbf{\Omega}^{IW}$ during the interwar period.

Let $\boldsymbol{S}_{\pi}^{GS}$ be the covariance matrix of the permanent shocks in the gold standard period. Then the set of orthogonality conditions.

$$var(\boldsymbol{\pi}_t) = \left(\boldsymbol{S_{\pi}^{GS}}\right)^{\boldsymbol{-1/2}} \boldsymbol{\alpha}'_{\perp}\boldsymbol{\Omega^{GS}}\boldsymbol{\alpha}_{\perp} \left(\boldsymbol{S_{\pi}^{GS}}\right)^{\boldsymbol{-1/2\prime}} = \boldsymbol{I}$$

will be satisfied for any matrix root $(.)^{1/2}$ of $\boldsymbol{S}_{\pi}^{GS}$. Note that

$$\left(\boldsymbol{S}_{\pi}^{GS}\right)^{-1/2} \boldsymbol{\alpha}'_{\perp}\mathbf{\Omega}^{IW}\boldsymbol{\alpha}_{\perp} \left(\boldsymbol{S}_{\pi}^{GS}\right)^{-1/2} = \mathbf{\Sigma}$$

will be a positive definite symmetric matrix. Hence there exists an orthonormal basis of Eigenvectors of $\mathbf{\Sigma}$, so that in the spectral decomposition,

$$\mathbf{\Sigma} = \mathbf{Q}\mathbf{\Lambda}_{\pi}^{IW}\boldsymbol{Q}'$$

the matrix $\boldsymbol{Q}$ is orthogonal, i.e. $\boldsymbol{Q}'\boldsymbol{Q} = \boldsymbol{I}$ and $\mathbf{\Lambda}^{IW}$ is diagonal with positive entries. Since $\boldsymbol{Q}$ is orthogonal, the matrix

$$\mathbf{S}_{\pi}^{-1/2} = \mathbf{Q}' \left(\mathbf{S}_{\pi}^{GS}\right)^{-1/2}$$

for any initial choice of $\left(\mathbf{S}_{\pi}^{GS}\right)^{-1/2}$ will satisfy the orthogonality constraint for the Gold Standard period, but it will also satisfy the condition that

$$\boldsymbol{S}_{\pi}^{-1/2}\boldsymbol{\alpha}'_{\perp}\mathbf{\Omega}^{IW}\boldsymbol{\alpha}_{\perp}\boldsymbol{S}_{\pi}^{-1/2} = \mathbf{\Lambda}_{\boldsymbol{\pi}}$$

which means, it achieves orthogonalization of the permanent shocks *also* in the interwar period. Furthermore, because they are positive, the diagonal entries of $\mathbf{\Lambda_{\pi}}^{IW}$ can directly be interpreted as the variances (relative to the gold standard period, where they were normalized to unity) of the two permanent shocks in the interwar period.

The restriction that achieves the identification of $\mathbf{S}_{\pi}^{-1/2}$ here is that $\mathbf{S}_{\pi}^{-1/2}\boldsymbol{\alpha}_{\perp}'\mathbf{\Omega}^{IW}\boldsymbol{\alpha}_{\perp}\mathbf{S}_{\pi}^{-1/2}$ must be diagonal. Hence, the off-diagonal zero in $\mathbf{\Lambda}^{IW}$ is the source of this restriction (*not* the diagonal elements, which are allowed to be freely determined). Clearly, this additional zero restriction must be non-redundant, i.e. it must be different from the zero-restriction which arises from the set of orthogonality restrictions for the first period. This will be the case, whenever $\mathbf{\Omega}^{IW}$ and $\mathbf{\Omega}^{GS}$ are not exact multiples of each other or, equivalently, if the relative increase in variance of the underlying shocks is not uniform across structural shocks, i.e. whenever the diagonal elements of $\mathbf{\Lambda}_{\pi}$ are not equal.

The transitory shocks can now be identified following a completely analogous approach. Here, the respective orthogonality restrictions are to chose the matrix root of $\boldsymbol{S}_{\tau}$ such that

$$\boldsymbol{S}_{\tau}^{-1/2}\boldsymbol{\alpha}'\mathbf{\Omega}^{GS^{-1}}\boldsymbol{\alpha}\boldsymbol{S}_{\tau}^{-1/2\prime} = \boldsymbol{I}$$

and

$$\boldsymbol{S}_{\tau}^{-1/2}\boldsymbol{\alpha}'\mathbf{\Omega}^{IW^{-1}}\boldsymbol{\alpha}\boldsymbol{S}_{\tau}^{-1/2\prime} = \mathbf{\Lambda}_{\tau}$$

so that $\mathbf{\Lambda}_{\tau}$ is diagonal with positive diagonal entries.

Once we have identified $\boldsymbol{S}_{\tau}^{-1/2}$ and $\boldsymbol{S}_{\pi}^{-1/2}$ in this way, we can now invert the relation between the permanent and transitory shocks $[\boldsymbol{\tau}_t, \boldsymbol{\pi_t}]'$ and ϵ_t so that

$$\epsilon_t = \boldsymbol{P}(\mathbf{\Omega}^{\boldsymbol{R}}) \begin{bmatrix} \tau_{\mathbf{t}} \\ \pi_t \end{bmatrix}$$

where $R = GS,\ IW$ stands for the respective regime and where (as shown in

Hoffmann (2001)), the matrix $\boldsymbol{P}$ is given by

$$\boldsymbol{P}(\boldsymbol{\Omega}^{\boldsymbol{R}}) = \left[\begin{array}{cc} \boldsymbol{\alpha} \boldsymbol{S}_{\boldsymbol{\tau}}^{-1/2}, & \boldsymbol{\Omega}^{r} \boldsymbol{\alpha}_{\perp} \boldsymbol{S}_{\boldsymbol{\pi}}^{-1/2} \end{array} \right]$$

The variance of the structural shocks in the first period is then just the identity matrix, wheres in the second (interwar) period, it will be given by

$$var\left(\left[\begin{array}{c} \boldsymbol{\tau}_{\mathbf{t}} \\ \boldsymbol{\pi}_{t} \end{array} \right] \right) = \left[\begin{array}{cc} \boldsymbol{\Lambda}_{\tau} & \mathbf{0} \\ \mathbf{0} & \boldsymbol{\Lambda}_{\boldsymbol{\pi}} \end{array} \right]$$

This completes our identification procedure. Note that $\boldsymbol{\Lambda}_{\tau}$ and $\boldsymbol{\Lambda}_{\pi}$ (and therefore the corresponding matrices of eigenvectors, $\boldsymbol{Q}_{\boldsymbol{\pi}}$and $\boldsymbol{Q}_{\tau}$) are unique only up to the permutation of the diagonal elements. For normalization, we therefore assume that the Eigenvalues on the diagonal appear in decreasing order. We refer to the first shock in each group as the high-volatility shock. Below, we discuss the economic interpretation of these shocks in more detail.

Panel A of Table 4 presents the shock variances for the interwar era relative to the pre-war period as we obtain them from this identification procedure. Our procedure reveals huge shifts in relative volatilities: while transitory shocks become less volatile overall , there is a dramatic increase in the relative variance of trend shocks, and in particular for the high-volatility trend shock. Again, this supports our claim that the world economy of the interwar period shared important features with modern emerging markets: the trend here is clearly the cycle — permanent shocks appear as the dominant source of variability in all eight economies.[14]

Panel B of Table 4 reveals that shocks – and in particular the more volatile of the two permanent shocks – become considerably more global in the Interwar period. For each of the four types of shock, the panel presents the share of the variance of the cross-section of all eight countries' shocks that is explained by the first principal component. The first line of the panel presents

[14]See Aguiar and Gopinath (2007) who document this very pattern for modern-day emerging markets.

results for the Gold Standard period, line two for the entire Interwar period (1919-39). To demonstrate that our conclusions are no unduly affected by the fact that shocks became more global, lines three and four present results for periods that exclude the Great Depression (1919-28) and the big postwar recession of 1920/21 (1923-1939).

The results show that the share of the first principal component increases for all types of shocks vis á vis the Gold Standard period. But the increase is particularly pronounced for the high-volatility permanent shock – from around 20 to more than 60 percent. In the prewar period, this shock was the least "common", whereas there was a prevalent "global" transitory shock. This suggests that the permanent high-volatility shock largely reflects global factors. Moreover, the global fluctuations of the interwar period are not actually cyclical but predominantly trend shocks.

Table 5 where we present the share of permanent shocks in the forecast error variance, again for the two periods 1885-1913 and 1919-39. While output is dominated by permanent shocks in both periods, the importance of these shocks for no increases further in the second period. Also, while transitory shocks played an important role for the dynamics of real interest rates, the real exchange rate and, notably, the current account, under the Classical Gold Standard, the increase in the variance of trend output shocks implies that all these variables become determined mainly be permanent shocks in the interwar period.

The two trend shocks affect different variables differently, however. Table 6 provides the share of the variance of for the two permanent shocks. First, the high-volatility permanent shock dominates the variance of the current account in most countries (or at least accounts for a much larger share than in the first period), with Japan and the UK being exceptions. However, the decomposition also reveals that this high-volatility shock means different things in different countries. For the US, the UK and Sweden, it is mainly an exchange rate shock that has virtually no bearing on the variability of net output. For the other four economies, the high-volatility shock is the main driver of both the real exchange rate and of net output. Note also that the high-volatility permanent shock explains the bulk of the variance in the the real interest rate in all economies except the UK.

Conversely, the second permanent shock explains virtually all of the output variance in the UK, Sweden and the US and virtually nothing of the output variability in the other economies. At the same time, however, it is exactly this second shock that drives almost all the variability in the UK interest rate.

Our interpretation of these facts is the following: the first permanent shock is a shock originating in the instability of the bipolar interwar exchange rate regime – it mainly reflects real exchange rate fluctuations of the two major (rival) currencies, the dollar and pound stirling. For the other countries (with the exception of Sweden, which was particularly closely tied to the UK, becoming a member of the stirling block after the demise of the interwar gold standard and closely following UK monetary policy, (see Straumann and Woitek 2009), this is essentially a common (global) shock that is the main driver of their business cycles and current accounts. The two big economies — the UK and the US — still preserve some notion of an independent output shock (as does, surprisingly, Sweden), whereas for the other countries, the volatility generated by the global shock completely wipes out the influence of idiosyncratic components.

The observation that shocks certainly become more permanent and also more global also has immediate implications for the decline in the volatility of the current account relative to output: more volatile and more global unit root components in national outputs are hard to smooth, implying that current account volatility will increase less than proportionally.

5 Conclusions

This paper has applied a simple intertemporal, present-value model of the current account to study capital flows and international business cycles in the period between 1885 and 1939. To our knowledge, we are the first to rigorously apply such a model to historical data. The period of the classical gold standard with its high levels of international capital mobility and unidirectional capital flows (Obstfeld (2004)) would appear as an ideal testing ground for such a model. Our main result, however, is not that this model fits data from the Gold-Standard period well. More importantly, the very same model — that does not have any hard-wired frictions or limitations on international capital flows — explains the data for both the Classical Gold Standard and the Interwar period.

At the same time, we document that key business cycle moments changed between the interwar period and the pre-war Gold Standard: the volatility of the current account relative to output generally decreases, as do the correlations between output and the current account. What can explain this simultaneous pattern of continuity and change? We argue that a) the predictive stability of our model is an indication of a fundamental stability in the macroeconomic transmission mechanism but that b) the shifting correlations and volatilities highlight the importance of changes in the structure of underlying shocks.

Our explanation follows a recent literature in modern-day emerging market macroeconomics in arguing that basic models without frictions match the data from emerging market economies quite well once the underlying shocks are allowed to be more persistent than usually specified for industrialized economies. This does *not* mean that financial or goods market frictions are unimportant in these economies. Rather, these frictions manifest themselves in the structure of the underlying shocks — their volatility and persistence — rather than in a breakdown of the fundamental model of the transmission mechanism. Following this logic, we argue that the change in the moments that we document here can be explained by more permanent and volatile shocks to trend output and exchange rates. Our results suggest that these shocks seem to have become much more global. These structural shifts seem to have interacted to lower the variability of the current account relative to output and the correlation between these two variables. Similar patterns have been documented for modern-day emerging economies, which suggests that, in many ways, the world economy emerging from the war shared important features with today's emerging markets. In particular, the first global business cycle in the interwar period is actually directly driven by gobal instability, hitting the economies emerging from the war.

Our findings complement more narrative evidence on the relative roles of continuity and change in explaining the experience of the interwar period: first, our finding that shocks have changed — more volatile, more persistent and more global — is consistent the view that that World War I was the watershed for international capital mobility (Obstfeld and Taylor (2004)) and that the interwar period saw goods and financial markets that were much more segmented. Secondly, our result that the transmission mechanism has stayed remarkably constant lines up with the view (Eichengreen, 1992) that there was remarkable continuity in policymakers' mindset and in their policy and institutional responses (such as the ill-fated return to the gold exchange standard) to what were effectively very different shocks.

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Technical Appendix

[To be added]

Table 1: Volatility of Business Cycle Components

	GDP	NO	CA/NO	r_w
1885-1913				
AUS	0.05	0.03	0.04	1.64
CAN	0.04	0.03	0.02	1.66
JAP	0.04	0.05	0.03	1.72
NOR	0.02	0.01	0.02	1.89
SWE	0.02	0.01	0.01	1.74
UK	0.02	0.02	0.01	1.05
USA	0.04	0.03	0.01	1.76
1919-1939				
AUS	0.05	0.04	0.08	1.29
CAN	0.09	0.06	0.03	1.4
JAP	0.04	0.03	0.02	1.54
NOR	0.04	0.05	0.03	1.26
SWE	0.04	0.03	0.02	1.16
UK	0.03	0.04	0.02	1.56
USA	0.09	0.06	0.01	1.61

Standard deviations of HP-filtered data (GDP, NO, and r_w in logs, smoothing weight: 100)

Table 2: Statistics for the Predicted and Actual Current Account (1885-1939)

	Correlation $\rho(\widehat{CA/NO}, CA/NO)$	Rel. Std. Dev. $\frac{\sigma(\widehat{CA/NO})}{\sigma(CA/NO)}$	Subst. Elasticity $(1/\gamma)$	Net Foreign Assets (b) before 1919	Net Foreign Assets (b) after 1919
AUSTRALIA	0.80	0.82	0.01	-0.37	-0.17
CANADA	0.92	1.31	0.61	-0.85	-0.05
ITALY	0.93	0.95	0.01	-0.52	-0.72
JAPAN	0.89	1.25	0.21	-0.01	0.09
NORWAY	0.82	1.16	0.81	-0.22	-0.12
SWEDEN	0.98	0.98	0.01	0.30	0.30
UK	0.90	1.79	0.01	0.16	0.26
USA	0.92	0.94	0.41	0.23	0.23

Table 3: Beta Decomposition of CA/NO

Regressors		Interest income I	Interest income II	Global Tilting I	Global Tilting II	Domestic Tilting I	Domestic Tilting II	Smoothing I	Smoothing II	Unexplained I	Unexplained II
$[CA_t^k/NO_t^k]$	(β_{x0})	.03	0.24	0.20	0.32	**0.19**	-0.03	**0.45**	**0.43**	0.13	0.02
		(1.15)	(1.22)	(1.27)	(1.30)	(2.99)	(-0.16)	(3.57)	(2.41)	(0.66)	(0.10)
Interactions of $[CA_t^k/NO_t^k]\times$...											
$WWI-dummy$	(β_{x1})	-0.15	-0.14	-0.21	-0.21	**0.27**	**0.27**	**0.27**	**0.27**	-0.19	-0.19
		(-1.90)	(-1.95)	(-1.43)	(-1.42)	(6.13)	(6.07)	(2.36)	(2.36)	(-1.12)	(-1.13)
$1919-1928-dummy$	(β_{x2})	-0.05	-0.03	-0.16	-0.17	-0.01	-0.04	**0.34**	**0.41**	-0.12	-0.17
		(-0.65)	(-0.37)	(-1.05)	(-1.05)	(-0.17)	(-0.49)	(1.90)	(2.30)	(-0.52)	(-0.71)
$1929-39-dummy$	(β_{x3})	-0.05	-0.10	-0.03	-0.22	-0.08	-0.05	**0.24**	**0.68**	-0.08	-0.29
		(-0.68)	(-0.42)	(-0.46)	(-1.09)	(-1.60)	(-0.22)	(2.90)	(3.00)	(-0.63)	(-1.45)
$OnGS_t^k$	$(\beta_{x,on})$		-0.13		0.09		0.16		**-0.44**		**0.32**
			(-1.15)		(0.65)		(0.91)		(-2.99)		(3.44)
$OffGS_t^k$	$(\beta_{x,off})$		-0.21		-0.13		0.21		0.02		0.10
			(-1.16)		(-1.10)		(1.39)		(0.11)		(0.63)
$\overline{R}^2$		0.03	0.03	0.07	0.06	0.34	0.34	0.57	0.58	0.01	0.01

The Table reports the results of panel regressions of the form

$$x_t^k = \boldsymbol{d_t^k} + \beta_0 \times \left[\frac{CA}{NO}\right]_t^k + \left[\sum_{l=1}^{p} \beta_{lx} PeriodDummy_{lt}\right] \times \left[\frac{CA}{NO}\right]_t^k + \beta_{on,x} OnGS_t^k \times \left[\frac{CA}{NO}\right]_t^k + \beta_{off,x} OffGS_t^k \times \left[\frac{CA}{NO}\right]_t^k + \alpha_{on} OnGS_t^k + \alpha_{off} OffGS_t^k + + \nu_t^k$$

where x_t^kstands, in turn, for the VAR-implied expectations of the interest income, global tilting, domestic tilting and consumption smoothing channels and for the unexplained component $CA_t - \widehat{CA}_t^k$. t-statistics, based on (heteroskedasticity- and autocorrelation-consistent) standard errors clustered by country appear in parentheses. The dummies $OnGS_t^k$ and $OffGS_t^k$ are zero before and one after a country has gone on / off gold. First-order coefficients for $OnGS$ and $OffGS$ not reported.

Table 4: Properties of structural shocks 1919-39 vs. 1885-1913

Panel A: volatility 1919-39 relative to Gold Standard period

	transitory		permanent	
	high vol.	low vol.	high vol.	low vol.
AUSTRALIA	0.70	0.06	4.31	0.77
CANADA	0.77	0.52	3.73	0.74
JAPAN	0.28	0.19	5.28	3.65
ITALY	3.41	0.45	2.01	0.83
NORWAY	0.19	0.10	12.74	1.95
SWEDEN	0.70	0.30	15.08	4.11
UK	0.26	0.16	4.04	2.23
USA	0.60	0.17	3.54	1.97

Panel B: variance share of first principal component (%)

1885-1913	31.29	49.72	22.43	22.85
1919-39	46.50	62.29	61.17	36.84
1919-28	68.77	61.77	66.46	62.88
1923-39	57.56	70.38	65.48	38.91

Table 5: **Variance contribution of Permanent shocks**

	1885-1913				1919-1939			
Horizon/yrs	r	CA/NO	q	no	r	CA/NO	q	no
AUSTRALIA								
1	0.28	0.02	0.81	0.88	0.99	0.09	1.00	1.00
3	0.28	0.03	0.89	0.92	0.99	0.44	1.00	1.00
5	0.27	0.03	0.96	0.97	0.99	0.59	1.00	1.00
8	0.27	0.03	0.97	0.98	0.99	0.60	1.00	1.00
CANADA								
1	0.09	0.25	0.80	0.97	0.98	0.64	1.00	1.00
3	0.29	0.26	0.76	0.90	0.98	0.86	1.00	0.98
5	0.32	0.28	0.85	0.88	0.98	0.90	1.00	0.95
8	0.31	0.29	0.91	0.92	0.97	0.90	1.00	0.96
ITALY								
1	0.19	0.14	0.92	0.70	0.99	0.94	1.00	1.00
3	0.34	0.35	0.89	0.54	1.00	0.97	1.00	1.00
5	0.34	0.39	0.92	0.57	1.00	0.98	1.00	1.00
8	0.34	0.39	0.95	0.73	1.00	0.98	1.00	1.00
JAPAN								
1	0.29	0.13	0.75	0.66	0.98	0.00	0.75	0.15
3	0.21	0.12	0.78	0.66	0.95	0.01	0.82	0.33
5	0.17	0.12	0.90	0.79	0.91	0.08	0.95	0.74
8	0.17	0.12	0.94	0.85	0.91	0.09	0.97	0.82
NORWAY								
1	0.09	0.19	0.92	0.32	1.00	1.00	1.00	1.00
3	0.09	0.17	0.95	0.49	1.00	1.00	1.00	1.00
5	0.10	0.16	0.98	0.75	1.00	1.00	1.00	1.00
8	0.10	0.16	0.99	0.83	1.00	1.00	1.00	1.00
SWEDEN								
1	0.14	0.05	0.97	0.55	0.95	0.99	1.00	1.00
3	0.17	0.09	0.79	0.65	1.00	0.98	1.00	1.00
5	0.15	0.11	0.76	0.79	1.00	0.99	1.00	1.00
8	0.15	0.11	0.84	0.86	1.00	0.98	1.00	1.00
UK								
1	0.01	0.38	0.99	0.10	0.98	0.93	1.00	0.92
3	0.02	0.38	1.00	0.18	0.98	0.93	1.00	0.95
5	0.03	0.38	1.00	0.47	0.98	0.94	1.00	0.98
8	0.03	0.38	1.00	0.66	0.98	0.94	1.00	0.99
US								
1	0.18	0.19	0.79	0.99	1.00	0.78	1.00	1.00
3	0.18	0.21	0.83	0.99	1.00	0.89	1.00	1.00
5	0.19	0.24	0.90	1.00	1.00	0.94	1.00	1.00
8	0.19	0.24	0.94	1.00	1.00	0.95	1.00	1.00

Table 6: **Variance contribution of the permanent shocks – breakdown by volatility**

	1919-39							
	high-volatility shock				low-volatility shock			
Horizon/yrs	r	CA/NO	q	no	r	CA/NO	q	no
AUSTRALIA								
1	0.98	0.00	0.99	1.00	0.01	0.09	0.01	0.00
3	0.98	0.39	0.99	0.99	0.01	0.05	0.01	0.01
5	0.98	0.56	0.99	0.99	0.02	0.03	0.01	0.01
8	0.98	0.56	1.00	0.99	0.02	0.03	0.00	0.01
CANADA								
1	0.97	0.63	1.00	0.94	0.01	0.02	0.00	0.06
3	0.96	0.86	1.00	0.87	0.01	0.01	0.00	0.11
5	0.96	0.89	1.00	0.74	0.02	0.01	0.00	0.21
8	0.96	0.89	1.00	0.70	0.01	0.01	0.00	0.26
ITALY								
1	0.98	0.21	0.99	0.13	0.01	0.73	0.01	0.87
3	0.89	0.39	0.99	0.12	0.11	0.58	0.01	0.88
5	0.89	0.70	0.99	0.10	0.11	0.28	0.01	0.90
8	0.89	0.71	1.00	0.13	0.11	0.27	0.00	0.87
JAPAN								
1	0.97	0.00	0.52	0.03	0.00	0.00	0.23	0.13
3	0.95	0.00	0.61	0.22	0.00	0.00	0.20	0.11
5	0.90	0.08	0.86	0.62	0.00	0.00	0.09	0.12
8	0.90	0.08	0.90	0.69	0.00	0.00	0.07	0.13
NORWAY								
1	0.92	1.00	0.97	1.00	0.08	0.00	0.03	0.00
3	0.94	1.00	0.98	1.00	0.06	0.00	0.02	0.00
5	0.94	1.00	0.99	1.00	0.06	0.00	0.01	0.00
8	0.94	1.00	0.99	1.00	0.05	0.00	0.01	0.00
SWEDEN								
1	0.16	0.97	1.00	0.44	0.80	0.02	0.00	0.55
3	0.96	0.94	1.00	0.34	0.04	0.05	0.00	0.66
5	0.96	0.93	1.00	0.26	0.04	0.05	0.00	0.74
8	0.96	0.93	1.00	0.24	0.04	0.05	0.00	0.76
UK								
1	0.01	0.00	1.00	0.25	0.97	0.93	0.00	0.67
3	0.01	0.00	1.00	0.19	0.97	0.93	0.00	0.76
5	0.01	0.00	1.00	0.11	0.96	0.93	0.00	0.87
8	0.01	0.00	1.00	0.09	0.96	0.93	0.00	0.90
USA								
1	1.00	0.59	0.93	0.07	0.00	0.19	0.06	0.93
3	1.00	0.80	0.94	0.05	0.00	0.10	0.05	0.95
5	1.00	0.89	0.96	0.02	0.00	0.05	0.04	0.98
8	1.00	0.90	0.97	0.02	0.00	0.04	0.03	0.98

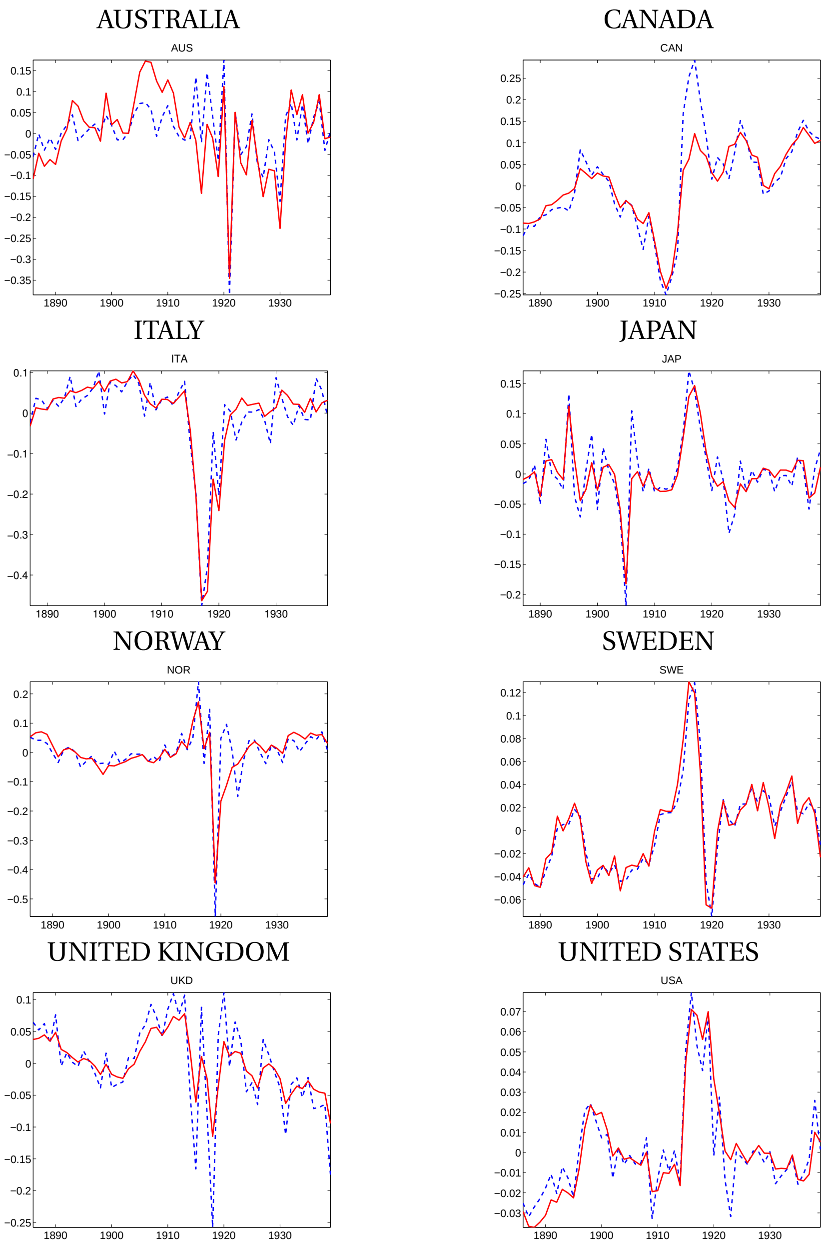


Figure 1: Actual current account/ net output ratio (solid, red line) vs. predicted current account (dashed line).

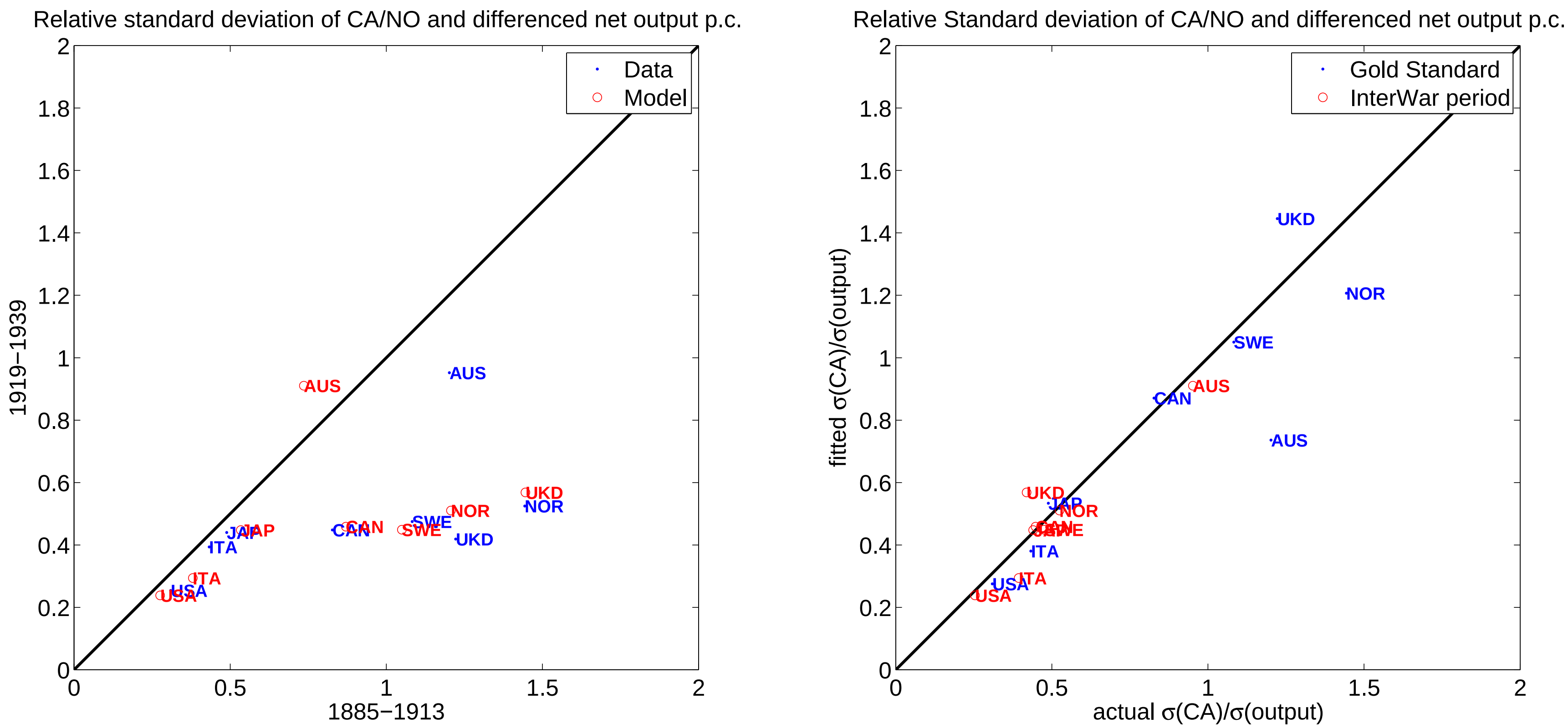
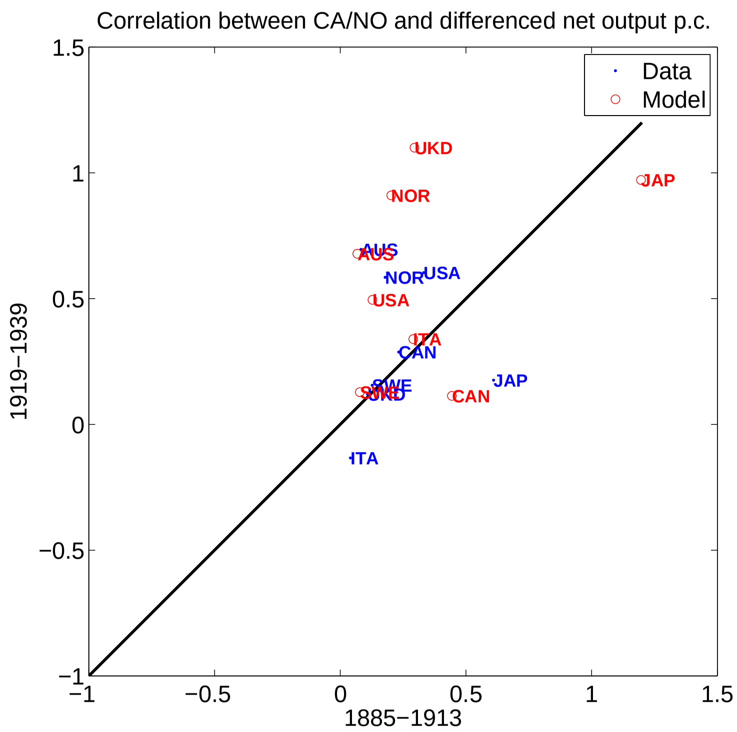


Figure 2: Relative standard deviations of the Current account / net output ratio and net output growth ($\sqrt{(var(CA/NO)/var(\Delta no)}$).
The left panel offers a comparison across the two periods 1885-1913 and 1919-39, with a point below the 45-degree line indicating a lower relative standard deviation in the interwar period. Blue dots indicate the data, red circles are the fitted moments predicted from the model. The right panel plots the actual relative standard deviation against the one predicted from the model, where blue dots indicate the Gold Standard period (1885-1913) and red circles the interwar period (1919-39). The black line is the 45-degree line.



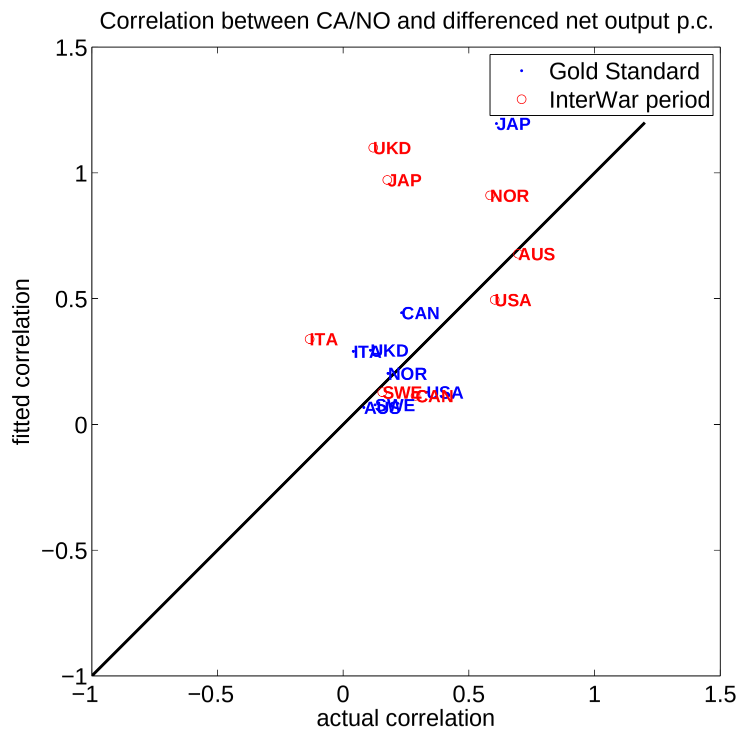


Figure 3: Correlation between the Current account / net output ratio and net output growth.
The left panel offers a comparison across the two periods 1885-1913 and 1919-39, with a point below the 45-degree line indicating a lower correlation in the interwar period. Blue dots indicate the data, red circles are the fitted moments predicted from the model.
The right panel plots the actual correlations against the ones predicted from the model, where blue dots indicate the Gold Standard period (1885-1913) and red circles the interwar period (1919-39). The black line is the 45-degree line.

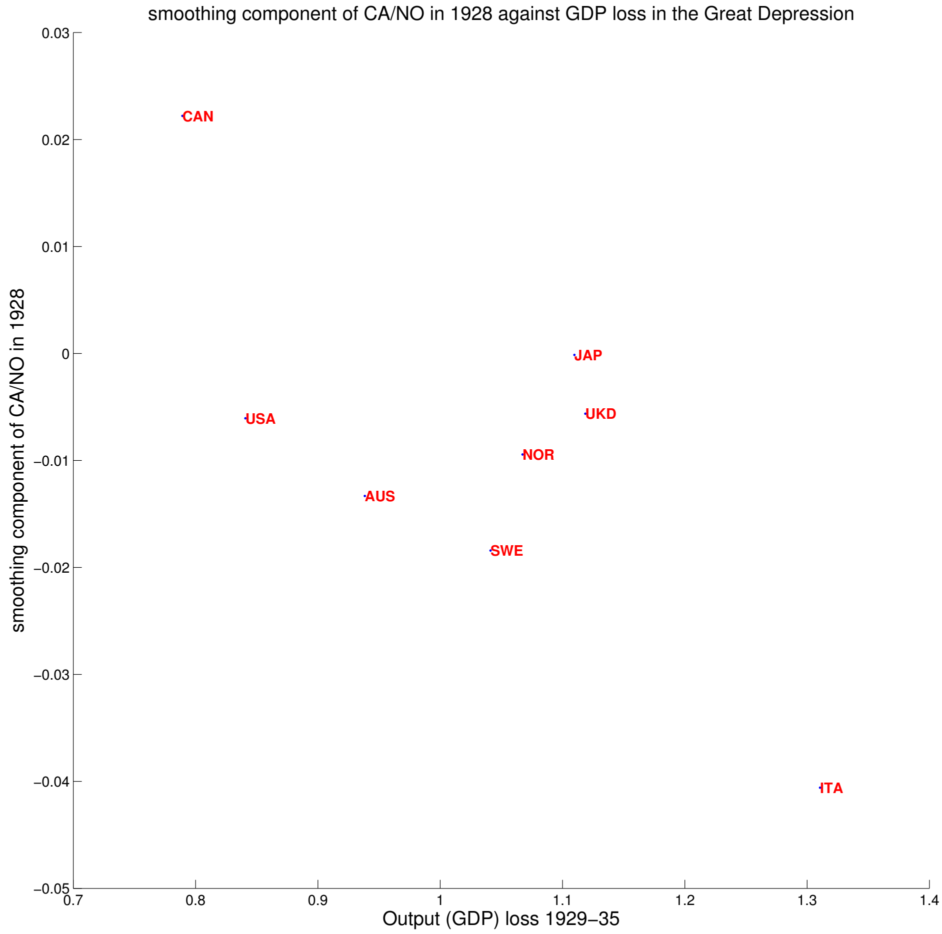


Figure 4: The figure plots the cumulative output loss during 1929-35 ($log(GDP_{1935}) - log(GDP_{1929})$) against the smoothing component of the current account ($-\sum_{k=1}^{\infty} \kappa^k E_t \Delta\widetilde{no}_{t+k}$) implied by the VAR estimated from the sample period 1885-1928.