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External constraint and economic growth in Italy: 1861-2000

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Abstract:

This paper analyzes the relationship between external constraint and economic growth in Italy from 1861 to 2000. In particular, it investigates whether the persistent current account deficits in the 1861-1913 years constrained output growth. To this aim it studies the genesis of the current account fluctuations, that is whether these were generated by the dynamics of the GDP or by variations in capital inflows. Using integration and co-integration analysis and the Granger causality testing, it shows that in the long run Italy's external position is sustainable: the Italian economy seems to have used the external deficits (surpluses) to smooth its aggregate consumption. Moreover in the shorter 1861-1913 sub-period, the persistent current account deficits, financed by foreign capital inflows, do not seem to have curbed economic growth.

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Keywords: Current account, economic growth, Italy, Granger causality

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1. Introduction

The existence of an external constraint on Italy's economic growth is a widely debated topic. Until the 1980s, the dominant view was the so-called "Bonelli-Cafagna model" (Bonelli 1978; Cafagna 1989). This model was broadly Keynesian and reflected Thirlwall's (1979) theoretical approach according to which the balance of payments (henceforth, BOP) acts as a constraint on GDP growth. This view assumes that exports are totally exogenous, determined by core country demand for the nation's products, while imports are a function of the nation's GDP. In this scenario, trade balance is seen as highly sensitive to the domestic rate of growth; if the rate exceeds some threshold level, the balance would be plunged into deficit. In the short run, this deficit can be financed by selling reserves or by importing capital, while in the medium run, devaluation can provide some relief. However, devaluation is at best a stop-gap measure, since prices are inelastic. The only effective solution to balance of payments (henceforth, BOP) problems is a lower growth rate. That is, a persistent BOP deficit sooner or later requires a correction, which curbs economic growth.

After political unification in 1861, Italy was a relatively backward and resource-poor country and required massive investment in plant, equipment and modern infrastructure to prompt industrialization. Since the import content of domestic output growth was large, the problem was to find the way to ease BOP pressures. According to Bonelli and Cafagna, a long wave of growth began in the late 18th century – well before Italy's political unification – stimulated by an expansion of agricultural exports, particularly raw silk. The upswing also permitted imports of raw materials and semi-manufactured goods to increase without putting pressure on BOP. The agrarian crisis of the 1880s put an end to the leading role of agriculture as Italy's export engine but, by that time, other sectors (especially textiles and other manufactures) had taken up the slack and a mix of emigrant remittances and tourism helped to finance growth-induced imports.

In recent years, this view has been superseded by the intertemporal approach to the current account (henceforth, CA). In this perspective, the CA derives from savings and investment decisions that are based on intertemporal considerations. The CA is an intertemporal phenomenon which smoothes the time profile of consumption in the face of shocks to output, investment, or government expenditures (Obstfeld and Rogoff 1995). Thus, a persistent CA deficit does not necessarily curb economic growth. Attention must be paid to the sustainability of the external deficit, which depends on the economic structure of the country involved (i.e., the degree of openness, the levels of saving and investment, the health of the financial system), the composition of the current account balance and how deficits are financed (Milesi-Ferretti and Razin 1996a). If CA strengthens when output is high and weakens when it is low, its fluctuation is indicative o a nation's ability to smooth its consumption. An ongoing CA deficit in a rapidly growing country may be an indication that investment and growth are not unduly constrained by domestic saving capacity, facilitating the country's convergence to steady state levels of output and capital intensity. In this latter case, there is no reason why a prolonged CA deficit should constrain economic growth as it prompts capital accumulation, increased efficiency in the use of production factors and higher total factor productivity that generate additional export revenues, thereby enhancing intertemporal solvency (Sachs 1981; Corden 1994). A country may also run a large and resilient CA deficit if inflows of equity capital finance it, as the latter does not increase the external debt. Equity allows an economy to sustain larger CA imbalances than CA deficits that are financed by inflows of more liquid assets since it reduces the extent of trade surpluses which are necessary to pay back foreign creditors (Rossini and Zanghieri 2009).

At the same time, sharp reductions in CA deficits are not always disruptive for economic growth. In Milesi-Ferretti and Razin's (1997) sample, the median change in GDP growth between the periods before and after such reversals is zero, with individual cases ranging from -7% to +3%.

From an analytical standpoint, this is not surprising because deficits develop for different reasons. In fact, a deficit reflecting a temporary surge in investment owing to unusually rapid productivity growth and high profitability has different implications than a deficit reflecting a temporary surge in consumption produced by the growth of public consumption or over-evaluation of the currency. Equally, CA deficits can be eliminated for a number of very different reasons, which are likely to have very different output effects. Moreover, crises were lower in frequency and less disruptive under the gold standard than in recent years. Greater wage and price flexibility in an era of unstructured labour markets facilitated the adjustment of relative prices when the CA balance had to be compressed abruptly (Bayoumi and Eichengreen 1996). With government budgets close to balance in peacetime, the twin deficits problem that give rise to "bad CA deficits", financing for which dries up suddenly when concerns arise about the sustainability of public debts, was less prevalent. Because large CA deficits reflected unusually high levels of investment in export-supporting infrastructure, those deficits could be smoothly reduced by increased savings out of progressively higher domestic incomes and increases in exports of goods and services. Since the credibility of the commitment to exchange rate stability was beyond reproach, events that might have interrupted capital inflows and forced disruptive compression of the CA elicited capital inflows that allowed that deficit to be wound down smoothly rather than precipitating a crisis (Adalet and Eichengreen 2005).

The analytical toolbox of the intertemporal approach has been recently used by Fenoaltea (2011) to reinterpret the case of Italy: trade deficits were determined by capital inflows, that financed the imports of machinery, technology and raw materials. These boosted productivity and exports thereby prompting economic growth and BOP readjustment. An international equilibrium can be disturbed by impulses that arise in the market for goods, or in the market for capital. In the first case, if a trade deficit appears because of an increase in imports, it tends to reduce the real exchange rate (either through a devaluation of the currency, with flexible exchange rates, or through a reduction of the internal price level, relative to the foreign one, with fixed exchange rates). The trade deficit is covered by induced capital inflows: with flexible exchange rates the devaluation of the currency may be seen as temporary, causing speculative purchases of the nation's currency in view of its subsequent recovery; with fixed exchange rates the loss of currency causes a net demand for liquidity that attracts foreign loans. In the event, the trade deficit and capital imports increase together, accompanied by a decline in the real exchange rate. If the initial equilibrium is disturbed in the opposite sense, by an increase in exports, the trade deficit and capital imports decline together, while the real exchange rate increases. In the alternative scenario, a BOP disequilibrium appears because the nation imports more capital than before. As a result, the real exchange rate rises (as the currency appreciates, or the domestic price level increases relative to the foreign one). This rise in the real exchange rate in turn increases the trade deficit: the trade deficit and capital imports again rise together, and the real exchange rate rises too. If the initial equilibrium is disturbed in the opposite sense, by a reduction in capital imports, the trade deficit and capital imports decline together, and the real exchange rate also declines. The trade deficit and capital imports move together in any case: but with parallel movements in the real exchange rate if the initial impulse is in financial markets and the capital flows cause the trade deficits, and with opposite movements in the real exchange rates if the initial impulse is in the goods market and the trade deficits cause the flows of capital. Fenoaltea (2011) showed that prior to WW1, the Italian currency was strong when the trade deficits and capital flows were high, and weak when they were low. With a brief exception in the early 1870s, the movement in the real exchange rate was parallel to that in the trade deficit and capital imports: the trade-deficit cycle was generated by the capital-import cycle, and not vice-versa.

This paper analyses the relationship between Italy's BOP and economic growth from 1861 to 2000 by studying the statistical properties of the CA fluctuations. The economic notion of sustainability of the CA unbalances implies the statistical condition of stationarity. External deficits (or surpluses) are sustainable when the CA series is covariance stationary. Broadly speaking, stationarity is possible whether deficits are not too persistent over time. Hence, we test the stationarity of the CA series by using the univariate ADF and KPSS tests (Dickey Fuller 1981; Kwiatkowski *et al.* 1992).

We find that the CA series is stationary over the period 1860-2000, that is, Italian economy satisfies its intertemporal external constraint in the long run by using the external deficits to smooth domestic consumption Hence, these deficits were sustainable and did not slow down economic growth (Obstfeld and Rogoff 1995).

However, we also find that this result is not robust for the shorter 1861-1913 sub-period, when CA is not stationary due to persistent deficits in the 1860s, in the 1880s, and in the five years prior to WW1. So, we test whether CA deficits constrained economic growth in this sub-period by analysing the genesis of Italy's CA fluctuations, that is, whether the latter were generated by the dynamics of the GDP or by variations in capital inflows. We perform a Granger causality test that finds support for the second hypothesis. Italy's persistent CA deficits from Unification to WW1 seem to have been used to prompt the nation's productivity and economic efficiency and so they do not seem to have undermined the nation's intertemporal solvency.

This paper is structured as follows. After this Introduction, section 2 presents the sources and data we have used in our analysis. Section 3 illustrates the evolution of Italian CA balance from Unification to 2000. Section 4 presents the theoretical model that implies a long run equilibrium between imports and exports and stays the statistical condition for the substainability of the external deficits. This Section also presents an econometric strategy to test Fenoaltea's thesis that in the 1861-1913 sub-period CA fluctuations were generated by impulses in the market for capital and not in the market for goods and hence the persistent deficits, financed by imports of foreign capital, do not constraint the economic growth. Section 5 concludes, and the Appendix reports further econometric evidence.

2. Sources and data

In 1957 the Italian national statistical office produced the first estimate of Italy's BOP for the period 1861-1956 (Istat 1957). However, several objections were raised against these series, which proved unreliable and internally inconsistent. In particular, as far as the years prior to WW1 are concerned, Istat seems to have significantly overestimated the earnings of services, and especially of tourism (Marolla and Roccas 1992; Zamagni 1992). But, above all, Istat emigrants' remittances figures seem excessively variable. In fact, these estimates appear to be based on the gross *flow* of migrants, which similarly jumps up in 1901 and 1905, whereas remittances seem more reasonably tied to the savings by the *stock* of Italians abroad, which grew more smoothly from under one million in 1871 to some six million in 1911 (Fenoaltea 2011).

To tackle such criticism, Morys (2006) presented a new and more reliable series of Italy's BOP for the period 1861-1913. The major difference with regard to the Istat series concerns the criteria that have been used to estimate remittances. In the absence of good data relating to the money transferred by Italian emigrants, Morys relied on the number of emigrants and approximated what an average Italian emigrant would transfer home in his first, second, third etc. years based on some general rules on what determines the pattern of remittances that have been discussed in the literature on emigration. As this author reconstructed also the remittances for Austria-Hungary – for which much better data are available – he could double-check his results and found that his new series was very close to the one that would be constructed according to the general rules presented in the literature. For the 1919-1931 years, a new series which revised the Istat one was presented by Falco (1995).

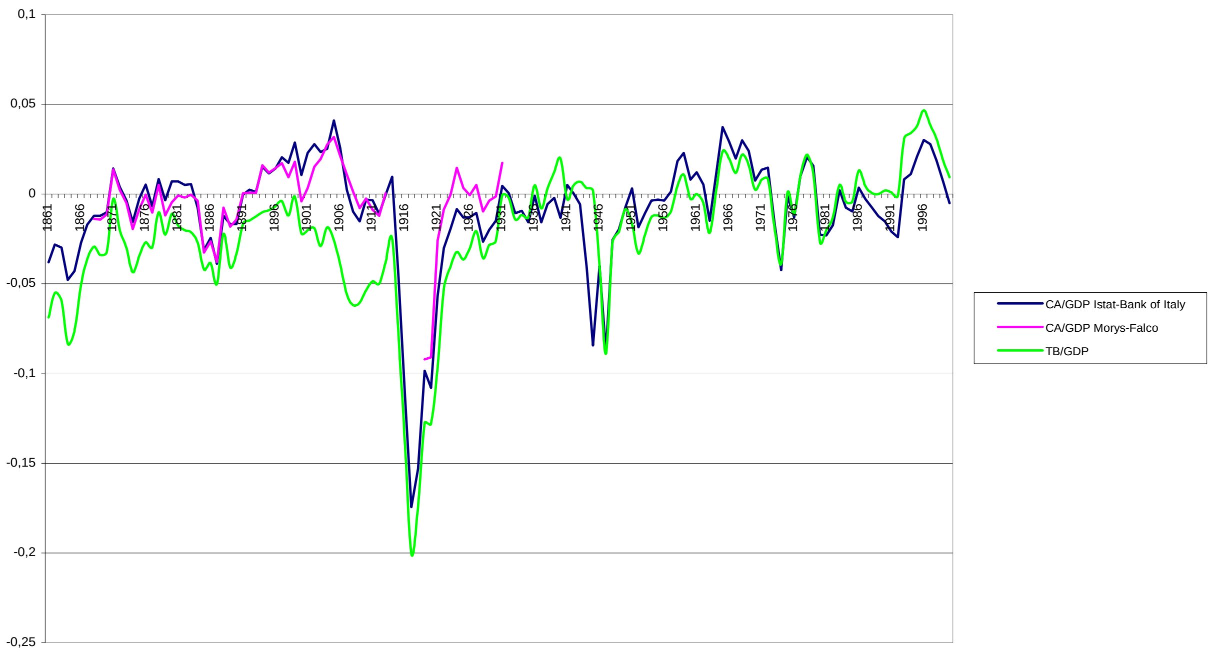
So, in this paper we use the CA data of both the Istat series and the Morys series for the period 1861-1913, and compare them. We also compare the Istat and the Falco series for the 1919-1931 period. We show that the result of our econometric test does not change by using either series. For the years 1914-46 we use the Istat estimates as this is the only source that provides a time series for the whole period. For the years from 1947 onwards the more accurate estimates of Italy's CA are provided by the Bank of Italy. In this paper we use those published in Masera (1970) and Banca d'Italia (2008, 2010).

As to economic growth, we rely on the new series of Italy's GDP that have been provided by the Bank of Italy for the 150th anniversary of the nation's political unification (Baffigi 2011). To proxy the impact of Italy's CA deficits on the productivity of the nation's we use data on real investment (both total and in machinery and equipment) and net capital stock (also in this case both total and in machinery and equipment). Baffigi (2011) provides us the series for the former, while data for the latter are drawn from Braodberry, Giordano and Zollino (2011). The series of Italy's real exchange is instead from Fenoaltea (2011).

3. The evolution of Italy's current account balance

Figure 1 shows the evolution of Italy's BOP from 1861 to 2000. The dynamics of the CA to GDP and of the balance of trade to GDP ratios are distinctly reported. The balance of trade was negative throughout the period from Unification to 1936. In the years prior to WW1 this persistent deficit was covered by other headings of the CA balance, above all remittances of Italian emigrants abroad. Another important source of earnings was tourism. As a result, the CA balance performed far better and was positive in 24 years (out of 54) for the Istat series and in 21 years for the Morys series. A persistent CA surplus was obtained from the early 1890s to 1907 (to 1908 for the Morys series). However, there were also three periods of persistent CA deficits: 1861-70, 1884-91 (1879-90 for the Morys series), 1908-13 (1909-13 for the Morys series).

Fig. 1 – CA/GDP and TB/GDP ratios in Italy (1861-2000)



Legend: CA/GDP = Current Account to GDP ratio; TB/GDP = Trade Balance to GDP ratio.

During WW1 both the balance of trade and the CA deficits rose to record values (-20% and -17% of GDP, respectively, in 1917) and were financed by increasing capital imports from allied nations, especially the US and the UK (Keynes 1919).

In the early 1920s both balances improved. According to the Istat figures, both of them remained negative until 1935, whereas the new Falco series show that the CA balance was positive for a few years in the mid 1920s and in the early 1930s.

In the 1930s the balance of trade and the CA balance moved closer together than ever before. The CA balance as a share of GDP fluctuated on very low values, as capital controls were imposed and international final markets shut down. This made it impossible to finance high and persistent surpluses, or deficits, with capital flows.

The final year of WW2 and its immediate aftermath saw another big CA deficit, fuelled by the war effort and by the needs of the immediate reconstruction. International relief aid the Marshall plan helped to fund the deficit. In the period from the late 1940s to 2000 the balance of trade and the CA balance moved closer together and Italy never faced persistent CA deficits. When in some years (i.e., 1974, 1981, the early 1990s) the CA deficit jumped to particularly high levels, the Italian economy was always able to set in motion some counterbalancing forces that reduced it and brought it to balance in a short time. A paramount role in this respect was played by the periodical devaluations of the Italian lira, which – by boosting exports and compressing imports – enabled the nation to quickly restore the external balance. The variation of the CA to GDP ratio was smaller in the Bretton Woods years, when capital flows were still heavily controlled, before rising in 1974-2000, when capital flows were liberalized and became more instable (Eichengreen and Adalet 2005). The reduction of the CA balance as a share of GDP after WW2 was also a consequence of the growing intra-industry trade (Vasta 2010), with the result that export and import series tended to increasingly co-move together.[1]

4. Theoretical background and econometric strategy

As anticipated in the Introduction, the sustainability of the CA unbalances implies the statistical condition of stationarity of the CA series. Focusing on the external deficit, its sustainability in the long run is related to the solvency constraint of the economy. An economy is solvent in the long run, when

[1] In fact, in a previous study we found a strong bidirectionality between imports and exports in Italy from 1945 to 2004 (Pistoresi and Rinaldi 2012).

its present-value budget constraint holds, in other words if the country can borrow to finance this deficit (Milesi-Ferretti and Razin 1996a, 1996b). In the following, we outlines a testable model derived from a simple model of intertemporal budget constraint as in Hakkio and Rush (1991), Husted (1992) and Bajo-Rubio (2011). It implies a long run equilibrium between imports and exports and hence the substainability of the external deficits. The individual current-budget constraint is

$$\boldsymbol{C}_0 = \boldsymbol{Y}_0 + \boldsymbol{B}_0 - \boldsymbol{I}_0 - (1 - \boldsymbol{r})\boldsymbol{B}_{-1}$$

where $\boldsymbol{C}_0, \boldsymbol{I}_0, \boldsymbol{Y}_0, \boldsymbol{B}_0$ and $\boldsymbol{r}$ are the current consumption, investment, output, international borrowing and one-period interest rate, respectively. $(1 - \boldsymbol{r})\boldsymbol{B}_{-1}$ is the initial debt. After several assumptions, Husted (1992) derives the following testable model:

$$\boldsymbol{Exp_t} = \alpha + \beta\, \boldsymbol{Im\ p_t} + \varepsilon_t \qquad (1)$$

where Exp and Imp are, respectively, the GDP's ratio of the exports of goods and services and the imports of goods and services plus net interest payments and net transfer payments. Hence, we define the CA balance as a ratio to GDP as CA/GDP = (Exp − Imp). The intertemporal budget constraint implies a strong long run relationship between Exp and Imp, that in terms of equation (1) it requires β = 1 and ε_t stationary. If the time series of Exp and Imp are both non stationary variables I(1), the condition, β = 1 and ε_t stationary, implies the existence of a common trend (i.e cointegration) between Exp and Imp and the deviations from this common trend of the two variables are only temporary. Equivalently, this condition requires the stationarity of the CA/GDP.

4.1 Stationarity of the Italian current accounts

In this section we perform unit root tests to determine the univariate properties of CA/GDP. We perform this analysis on different periods and using different databases for the reason we detailed in Section 2. In particular, we perform ADF tests (OLS/GLS) and KPSS test. The null of the ADF tests is non stationary series (unit root) while the null of the KPSS is stationary series. Hence, if both reject their nulls then we have no confirmation, but if test ADF rejects the null but test KPSS does not (or viceversa) we have confirmation[2].

[2] See Dickey and Fuller (1979) and Kwiatkowski et al. (1992).

The results of the ADF and KPSS tests for the *levels* and *first differences* of the CA/GDP are reported in Tables 1-3 and in the first part of Table 7 where all these results are summarised. Note that we control for different lags of the ADF / KPSS tests and for different specifications of the deterministic part of the models. Moreover, we present the analysis for the 1861-2000 period and for sub-periods of interests: 1861-1913 (different sources available and unreliability of the Istat series), 1929-2000 (from the Great Depression onwards), and 1948-2000 (from WW2 onwards).

We strongly reject the null hypothesis of non stationarity of the ADF tests (see Table 1 and 2) for the period 1860-2000 and the KPSS test confirm this outcome (Table 3). The Italian current account to GDP ratio is a stationary series that is its deviations from the long run equilibrium due to exogenous shocks to imports and/or exports are only temporary. In other words, in the long run the Italian intertemporal budget constraint holds.

However, the nation's solvency may not hold in the short run, that is in particular sub-periods. In particular, we find that the sustainability for the 1861-1913 sub-period is not guaranteed, when CA/GDP is not stationary due to persistent deficits in the 1860s, in the 1880s and in the five years prior to WW1. We find non stationarity for this sub-period by using both the Istat series and the Morys series of Italy's CA. These persistent deficits may have constrained economic growth depending on whether they were generated by the dynamics of the GDP or by variations in capital inflows. We analyse this point in the next section.

4.2 The period 1860-1913: external deficits and economic growth

This section addresses the role of the external constraint on Italian economic growth for the sub-period 1860-1913. Persistent external deficits can constraint economic growth because they could increase the Italian interest rates to attract foreign capital, and they could impose an excessive burden on future generations increasing interest payments and a lower standard of living. However, there are cases in which persistent CA deficits are not linked to severe domestic macroeconomic imbalances and hence they do not curb economic development. As anticipated in the Introduction, Fenoaltea (2011) suggests that Italy's external deficits in the sub-period 1860-1913 were determined by capital inflows, that boosted the investment cycle, i.e., they financed the imports of machinery, technology and raw materials. These boosted productivity and exports thereby prompting economic growth and BOP readjustment.[3]

Hence, a BOP disequilibrium appears because the nation imports more capital than before. As a result, the real exchange rate rises (as the currency appreciates, or the domestic price level increases relative to the foreign one). This rise in the real exchange rate in turn increases the trade deficit: the trade deficit and capital imports again rise together, and the real exchange rate rises too. A similar arguments holds if the initial equilibrium is disturbed in the opposite sense, by a reduction in capital imports: the trade deficit and capital imports decline together, and the real exchange rate also declines.

Fenoaltea (2011) shows that prior to WW1, the Italian currency was strong when the trade deficits and capital flows were high, and weak when they were low. With a brief exception in the early 1870s, the movement in the real exchange rate was parallel to that in the trade deficit and capital imports: the trade-deficit cycle was generated by the capital-import cycle, and not vice-versa.

The Fenoaltea's argument can be represented by using this sequence of causation (henceforth, Fenoaltea's cycle):

↑↓ Foreign capital inflows → ↑↓ real exchange rate → ↑↓ trade deficits→ ↑↓ CA deficits→ ↑↓ economic or productivity growth

This nexus among the changes in real exchange rate, deficits and economic growth or productivity growth could be analysed in an econometric framework by using techniques appropriate for estimating long run equilibrium and testing causation. In the case of time series data a test for the direction of causation is suggested by Granger (1969). For simplicity, Equations (1) to (4) present the testing strategy for the bivariate case. A variable X improves the prediction of a variable Y, that is X Granger causes Y, if current Y can be predicted better by using past values of X than by not doing so, given that all other past information in the information set is used. Suppose X and Y are linear *covariance stationary* time series.[4] Thus X and Y can be written as follows:

[3] The CA balance is the theoretical variable in Fenoaltea's argument. However, as the movement of goods is the least uncertain component of Italy's CA, and because of the reduced importance, and reduced variability, of the other components of CA, this author uses the trade balance as a proxy for the CA balance.

[4] Time series are said to be covariance stationary if their moments up to the second order do not depend on time. Hence, for instance the mean must be constant and the shocks affecting stationary series have only temporary effects. These time series are also said I(0). By contrast a series is said to be difference stationary if its first difference is stationary but the series itself

(1) $X_t = \sum_{i=1}^{m} a_i X_{t-i} + \sum_{j=1}^{n} b_j Y_{t-j} + \varepsilon_t$

(2) $Y_t = \sum_{i=1}^{m} c_i Y_{t-i} + \sum_{j=1}^{n} d_j X_{t-j} + u_t$

where ε_t, u_t are zero mean and finite covariance matrix random vector. The *causality test* is

a) X causes Y if $H_0 : d_j = 0, j = 1,...,n$ is rejected

b) Y causes X if $H_0 : b_j = 0, j = 1,...,n$ is rejected

Bidirectional causality occurs if both (a) and (b) hold. Unidirectional causality from X to Y occurs if (a) holds but (b) does not. In order to test these null hypothesis in (a) and (b), F statistics are calculated for jointly significance of the d_j in equation (1) and for b_j in equation (2).

For the Granger causation test, the hypothesis of covariance stationarity of the time series used is crucial to avoid spurious results. In general, the levels of the time series are not covariance stationary while their first difference are stationary. The growth rate of these variables (ΔX and ΔY) are stationary, while X and Y are not. If these are the statistical properties of the variables, we can only test for Granger causation by using first difference stationary models, that is

(3) $\Delta X_t = \sum_{i=1}^{m} a_i \Delta X_{t-i} + \sum_{j=1}^{n} b_j \Delta Y_{t-j} + \varepsilon_t$

(4) $\Delta Y_t = \sum_{i=1}^{m} c_i \Delta Y_{t-i} + \sum_{j=1}^{n} d_j \Delta X_{t-j} + u_t$

However, the nexus among real exchange rate, CA deficit (or surplus) and economic growth or productivity growth may be a long run relationship. If this long run nexus exists but we do not include it in the estimation of model (3) and (4) we have mis-specification and “spurious causality”. Hence, we have to test for Granger causation, to take into account the possible long run relationship among *the*

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is not. A property of difference stationary series is that they do not have necessarily constant means and the variance grows with time without limit, moreover the shocks affecting them are permanent. These series are also said I(1).

levels (values) of real exchange rate, current accounts, economic or productivity growth among their short run dynamics. Granger type causality tests for a long run relationship are valid if the relevant variables are found to be *cointegrated*, that is they move together so closely over the long run that they share a stochastic (and possibly also deterministic) trend in common. In this latter case, as stressed by Granger (1988), there is a presumption for causality to run in at least one direction.

Suppose X is the current account ratio to GDP, Z the Italian real exchange rate (and Y is the Italian real GDP (in logs). Moreover suppose these series are not covariance stationary, but they are cointegrated co-moving over time. In this case a three variables generalization of the Granger causality test, as in point (a) and (b) stated before, must be performed on the following ECM models:

$$(5) \qquad \Delta X_t = \sum_{i=1}^{m} a_i \Delta X_{t-i} + \sum_{j=1}^{n} b_j \Delta Y_{t-j} + \sum_{k=1}^{K} e_k \Delta Z_{t-k} + \delta ECT_{t-1} + \varepsilon_t$$

$$(6) \qquad \Delta Y_t = \sum_{i=1}^{m} c_i \Delta Y_{t-i} + \sum_{j=1}^{n} d_j \Delta X_{t-j} + \sum_{k=1}^{K} f_k \Delta Z_{t-k} + \delta ECT_{t-1} + \varepsilon_t$$

$$(7) \qquad \Delta Z_t = \sum_{i=1}^{m} g_i \Delta Z_{t-i} + \sum_{j=1}^{n} h_j \Delta Y_{t-j} + \sum_{k=1}^{K} l_k \Delta X_{t-k} + \lambda ECT_{t-1} + \eta_t$$

where ECT is the error correction term derived by cointegration analysis representing the long run equilibrium among the variables.

Suppose that the cointegration does not exists among these variables the ECM models above collapse in these short run specifications (ADL models)

$$(8) \qquad \Delta \boldsymbol{X}_t = \sum_{i=1}^{m} \boldsymbol{a}_i \Delta \boldsymbol{X}_{t-i} + \sum_{j=1}^{n} \boldsymbol{b}_j \Delta \boldsymbol{Y}_{t-j} + \sum_{k=1}^{K} \boldsymbol{e}_k \Delta \boldsymbol{Z}_{t-k} + \varepsilon_t$$

$$(9) \qquad \Delta \boldsymbol{Y}_t = \sum_{i=1}^{m} \boldsymbol{c}_i \Delta \boldsymbol{Y}_{t-i} + \sum_{j=1}^{n} \boldsymbol{d}_j \Delta \boldsymbol{X}_{t-j} + \sum_{k=1}^{K} \boldsymbol{f}_k \Delta \boldsymbol{Z}_{t-k} + \varepsilon_t$$

$$(10) \qquad \Delta \boldsymbol{Z}_t = \sum_{i=1}^{m} \boldsymbol{g}_i \Delta \boldsymbol{Z}_{t-i} + \sum_{j=1}^{n} \boldsymbol{h}_j \Delta \boldsymbol{Y}_{t-j} + \sum_{k=1}^{K} \boldsymbol{l}_k \Delta \boldsymbol{X}_{t-k} + \eta_t$$

To conclude, the causality testing procedure involves three steps. The first step is to test if our variables of interests are stationary or not (*integration analysis*). If they are not stationary, the second step is to *test for cointegration* that is for the existence of long run relationships among them. If cointegration exists *Granger causality* must be tested on the ECM models 5-7, if cointegration does not exist on models 8-10.

Now we present the outcome for the steps stated before: integration and cointegration analysis and finally Granger causality. In tables 4- 7 we summarise the results of the integration analysis for the variables involved in the Fenoaltea's cycle: the CA to GDP ratio (CA/GDP), real exchange rate (ε), real GDP (logs) and different proxies for produttivity: real total capital (logs) and real capital in machinery and equipment (logs), real total investment (logs) and real investment in machinery and investment (logs). They are all non stationary variables, in particular I(1), so we need to use in the analysis their first differences. Table 8 shows that there is no cointegration in the sub-period 1861-1913, that is the relationships among the changes in real exchange rate, current accounts, economic or productivity growth have a short-medium term nature. In other words these variables do not share common trends in the long run[5]. This result implies that to test for the Fenoaltea's cycle we have to use the ADL models 8-10.

Tables 9 to 20 details the results of Granger causality for different ADL spefications (lags). In particular, Tables 9 and 10 focus on the link between the CA deficits and the real exchange rate by using different lags in the ADL specifications and different sources for the CA series (Istat vs Morys). In all the cases the Granger causation appears unilateral: changes in real exchange rate cause movements in the current accounts. In Tables 11 to 20 we also include in the Granger causation analysis the economic or productivity growth to close the Fenoaltea's cycle: movements of international capitals move real exchange rate, current accounts and hence foster economic development. In particular, Tables 11 and 12 include the growth of real GDP, Tables 13 and 14 the growth in real capital in machinery and equipment, Tables 15 and 16 the growth in real total capital, Tables 17 and 18 the growth in real investment in machinery and equipment, and finally Tables 19 and 20 the growth in real total investment.

The ADL specifications in Tables 11 and 12 show the unidirectional causation from real exchange rate to the CA to GDP ratio by using both Istat and Morys data. However, the same Tables show that changes in the CA to GDP ratio do not cause GDP growth. In particular, the prolonged CA deficits in the 1860s, 1880s and in the years preceding WW1 do not seem to have triggered faster growth and this

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[5] The no cointegration result is also obtained with DOLS and Johansen cointegration procedure. For DOLS see Stock and Watson (1993) while for Johansen procedure see Johansen (1991).

may induce to question the intertemporal sustainability of such deficits. Such a result might reflect the high weight of agriculture on Italy's GDP in the post-Unification years. In fact, in the 1860s agriculture was still the largest sector of the Italian economy accounting for about 45 per cent of the GDP. Its share declined slowly over time: it was still 40 per cent in 1890 and dropped below one third only at the eve of WW1 (Baffigi 2011). Agriculture was at once the largest sector, and the most variable. Ciccarelli and Fenoaltea (2007) have identified a short cycle (roughly four years long) in Italy's GDP series that is essentially determined by its agricultural component. These short cycles were quite sharp until about 1890, then were much reduced. These wide agriculture-derived cyclical fluctuations of GDP have probably affected the result of our causality test on the link between external imbalances and GDP growth. So, the fact that we found no evidence that persistent CA deficits elicited economic growth does not rule out that they might nonetheless have prompted productivity and economic efficiency in the more modern sectors of the Italian economy.

This hypothesis seems corroborated by the results of the tests we show in Tables 13 to 20. In fact, these tests show that changes in the CA to GDP ratio caused variations in all the variable we chose to proxy productivity. In particular, Tables 13 and 14 tell us the unidirectional causation from real exchange rate to CA by using both the Istat and the Morys series and moreover a role of the real capital growth (machinery and equipment). The sequence in this case is the following: changes in real exchange rate cause CA movements and real capital growth variations. Tables 15 and 16 show a similar story for the real total capital but the outcome is less robust. Lastly, Tables 17 to 20 show that the Fenoaltea's cycle holds for the real investment (total and machinery and equipment) too: changes in real exchange rate cause CA movements and real investment growth variations.

5. Conclusions

This paper has analysed the relationship between Italy's BOP and economic growth from 1861 to 2000. We have shown that despite Italy's trade balance was negative throughout the period from Unification to 1936, the CA balance performed much better due to earnings from emigrant remittances and tourism. Apart from the periods of the two world wars, Italy's CA balance presented persistent deficits only in the 1860s, in the 1880s and in the five years prior to WW1.

From the late 1940s to 2000 the balance of trade and the CA balance moved closer together and Italy never faced persistent CA deficits. When in some years the CA deficit jumped to particularly high levels, some counterbalancing forces were always readily set in motion. After the end of the Bretton Woods system, the periodical devaluations of the lira – by boosting exports and compressing imports – were crucial to quickly restore Italy's external balance.

We have then presented an econometric strategy to study the sustainability of the Italian current accounts over the period 1861 to 2000 and within different sub-periods. To this aim we use the fact that the economic notion of sustainability of the CA unbalances is linked the statistical condition of stationarity. External deficits (or surpluses) are sustainable when the CA series is statistically covariance stationary.

We find that the CA series is stationary over the period 1861-2000, that is, Italian economy satisfies its intertemporal external constraint in the long run by using the external deficits to smooth domestic consumption Hence, these deficits were sustainable and do not seem to have slowed down economic growth.

However, we also find that this result is not robust for the shorter 1861-1913 sub-period, when CA is not stationary due to persistent deficits in the 1860s, in the 1880s, and in the five years prior to WW1. So, we test whether CA deficits constrained economic growth in this sub-period by analysing the genesis of Italy's CA fluctuations, that is, whether the latter were generated by the dynamics of the GDP or by variations in capital inflows. We perform a Granger causality test that finds support for the second hypothesis. Thus, Italy's persistent CA deficits from Unification to WW1 seem to have been used to prompt the nation's productivity and economic efficiency and so they do not seem to have undermined the nation's intertemporal solvency.

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Appendix

Table 1. Stationarity of the current account to GDP ratio - ADF tests – (OLS)

Variable	Model 1 No constant included	Model 2 Constant included	Model 3 Constant and trend included	Presence of unit roots	Degree of integration
1861-2000, N = 139. Source: Istat-Bank of Italy series					
CA/GDP	ADF(0): -3.60 (0.00)	ADF(0): -3.71 (0.00)	ADF(0): -3.72 (0.00)	NO	I(0)
CA/GDP	ADF(1): -3.79 (0.00)	ADF(1): -3.94 (0.00)	ADF(1): -3.95 (0.00)	NO	I(0)
CA/GDP	ADF(4): -3.55 (0.00)	ADF(4): -3.71 (0.00)	ADF(4): -3.70 (0.02)	NO	I(0)
1861-1913, N = 52. Istat series					
CA/GDP	ADF(0):-2.66 (0.00)	ADF(0):-2.60 (0.09)	ADF(0): -2.65 (0.25)	NO/YES	I(0)/I(1)
CA/GDP	ADF(1): -2.27 (0.02)	ADF(1): -2.22 (0.19)	ADF(1): -2.24 (0.46)	NO/YES	I(0)/I(1)
CA/GDP	ADF(4):-2.90 (0.00)	ADF(4):-2.84(0.052)	ADF(4):-2.54 (0.30)	NO/YES	I(0)/I(1)
Δ(CA/GDP)	ADF(0): -8.22 (0.00)	ADF(0): -8.16 (0.00)	ADF(0): -8.13 (0.00)	NO	I(0)
1861-1913, N = 52. Morys series					
CA/GDP	ADF(0): -2.91 (0.044)	ADF(0): -2.88(0.055)	ADF(0): -3.02 (0.13)	NO/YES	I(0)/I(1)
CA/GDP	ADF(1): -2.33 (0.018)	ADF(1): -2.29 (0.17)	ADF(1): -2.32 (0.42)	NO/YES	I(0)/I(1)
CA/GDP	ADF(4): -1.77 (0.07)	ADF(4): -1.74 (0.40)	ADF(4): -2.22 (0.47)	YES	I(1)
Δ(CA/GDP)	ADF(0): -8.63 (0.00)	ADF(0): - 8.54(0.00)	ADF(0): - 8.46 (0.00)	NO	I(0)
1929-2000, N = 72. Istat-Bank of Italy series					
CA/GDP	ADF(0):-3.80 (0.00)	ADF(0): -3.85 (0.00)	ADF(0):- 4.01 (0.01)	NO	I(0)
CA/GDP	ADF(1): -3.18 (0.00)	ADF(1): -3.22 (0.01)	ADF(1): -3.37 (0.05)	NO	I(0)
CA/GDP	ADF(4): -2.74 (0.00)	ADF(4): -2.82(0.05)	ADF(4): -3.06 (0.11)	NO/YES	I(0)/I(1)
1948-2000, N = 55. Bank of Italy series					
CA/GDP	ADF(0):- 5.17 (0.00)	ADF(0):- 5.08 (0.00)	ADF(0):- 4.80 (0.00)	NO	I(0)
CA/GDP	ADF(1): -4.94 (0.00)	ADF(1): -4.84 (0.00)	ADF(1): -4.51 (0.00)	NO	I(0)
CA/GDP	ADF(4): -4.13 (0.00)	ADF(4): -3.99 (0.00)	ADF(4): -3.61 (0.02)	NO	I(0)

Notes: I(0) means stationary series (no unit root is present). I(1) means non stationary series (i.e presence of at least one unit root).
ADF(p) indicates Augmented Dickey Fuller tests with differents lags p.
In parenthesis, next to the coefficients, find the p-values calculated by MacKinnon (1996)

Table 2. Stationarity of the current account to GDP ratio- ADF tests – (GLS)

Variable	Model 1 Constant included	Model 2 Constant and trend included	Presence of unit roots	Degree of integration
1861-2000, N = 139. Istat-Bank of Italy series				
CA/GDP	ADF(0): -3.05 (0.00)	ADF(0): - 3.59	NO	I(0)
CA/GDP	ADF(1): -3.20 (0.00)	ADF(1): -3.82	NO	I(0)
CA/GDP	ADF(4): -2.74 (0.00)	ADF(4): -3.45	NO	I(0)
1861-1913, N = 52. Istat series				
CA/GDP	ADF(0):-1.69 (0.08)	ADF(0):-2.56	YES	I(1)
CA/GDP	ADF(1): -1.39 (0.15)	ADF(1): -2.19	YES	I(1)
CA/GDP	ADF(4):- 1.34 (0.16)	ADF(4):-2.27	YES	I(1)
Δ (CA/GDP)	ADF(0): -8.63 (0.00)	ADF(0): - 8.06	NO	I(0)
1861-1913, N = 52. Morys series				
CA/GDP	ADF(0): -2.63 (0.00)	ADF(0): -3.09	NO	I(0)
CA/GDP	ADF(1): -2.04 (0.04)	ADF(1): -2.40	NO/YES	I(0)/I(1)
CA/GDP	ADF(4): -1.60 (0.10)	ADF(4): -2.29	YES	I(1)
Δ (CA/GDP)	ADF(0): -8.62 (0.00)	ADF(0): - 8. 50	NO	I(0)
1929-2000, N = 72. Istat-Bank of Italy series				
CA/GDP	ADF(0):-3.66 (0.00)	ADF(0): - 4.20	NO	I(0)
CA/GDP	ADF(1): -2.71 (0.05)	ADF(1): -3.40	NO	I(0)
CA/GDP	ADF(4): -2.70 (0.05)	ADF(4): -3.11	NO	I(0)
1948-2000, N = 55. Bank of Italy series				
CA/GDP	ADF(0):- 4.40 (0.00)	ADF(0):- 5.24	NO	I(0)
CA/GDP	ADF(1): - 1.44 (0.13)	ADF(1): - 2.66	YES/NO	I(1)/I(0)
CA/GDP	ADF(4): - 1.84 (0.06)	ADF(4): -2.82	YES	I(1)

Notes: I(0) means stationary series (no unit root is present). I(1) means non stationary series (i.e presence of at least one unit root). ADF(p) indicates Augmented Dickey Fuller tests with differents lags p. Note that in this table the ADF test are estimated by generalized least squares - GLS - as proposed by Elliot et al. (1996). These tests have greater power than the regular ADF test (OLS). For Model 1 in parenthesis find the p-values calculated by by MacKinnon (1996). For model 2 p-values are not available and we consider the critical values proposed by Elliot et al. (1996): 10% cv= -2.64 ; 5% cv = -2.93; 2.5% cv = -3.18; 1% cv = -3.46

Table 3. Stationarity of the current account to GDP ratio- KPPS tests

Variable	Model 1 Constant included	Model 2 Constant and trend included	Presence of unit roots	Degree of integration
1861-2000, N = 139. Istat-Bank of Italy series				
CA/GDP	KPSS(0): 0.17	KPSS(0): 0.11	NO	I(0)
CA/GDP	KPSS(1): 0.32	KPSS(1): 0.22	NO	I(0)
CA/GDP	KPSS(4): 0.17	KPSS(4): 0.11	NO	I(0)
1861-1913, N = 52. Istat series				
CA/GDP	KPSS(0): 0.50	KPSS(0): 0.09	YES/NO	I(1)/I(0)
CA/GDP	KPSS(1): 1.03	KPSS(1): 0.15	YES	I(1)
CA/GDP	KPSS(4): 0.51	KPSS(4): 0.08	YES/NO	I(1)/I(0)
Δ (CA/GDP)	KPSS(0): 0.10	KPSS(0): 0.04	NO	I(0)
1861-1913, N = 52. Morys series				
CA/GDP	KPSS(0): 0.40	KPSS(0): 0.09	NO	I(0)
CA/GDP	KPSS(1): 0.65	KPSS(1): 0.15	YES	I(1)
CA/GDP	KPSS(4): 0.36	KPSS(4): 0.09	NO	I(0)
Δ (CA/GDP)	KPSS(0): 0.05	KPSS(0): 0.04	NO	I(0)
1929-2000, N = 72. Istat-Bank of Italy series				
CA/GDP	KPSS(0): 0.37	KPSS(0): 0.09	NO	I(0)
CA/GDP	KPSS(1): 0.58	KPSS(1): 0.13	YES/NO	I(1)/I(0)
CA/GDP	KPSS(4): 0.33	KPSS(4): 0.08	NO	I(0)
1948-2000, N = 55. Bank of Italy series				
CA/GDP	KPSS(0): 0.14	KPSS(0): 0.11	NO	I(0)
CA/GDP	KPSS(1): 0.21	KPSS(1): 0.10	NO	I(0)
CA/GDP	KPSS(4): 0.13	KPSS(4): 0.11	NO	I(0)

Notes: I(0) means stationary series (no unit root is present). I(1) means non stationary series (i.e presence of at least one unit root). Model 1: 1% cv = 0.73, 5% cv = 0.47; 10% cv = 0.35. Model 2: 1% cv = 0.21, 5% cv = 0.14; 10% cv = 0.12. Source: Kwiatkowski et al. (1992)

Table 4. Stationarity of the real exchange rate, real GDP (logs), real capital stock (logs) and real investment (logs) - ADF tests – (OLS), 1861-1913, N = 52

Variable	Model 1 No constant included	Model 2 Constant included	Model 3 Constant and trend included	Presence of unit roots	Degree of integration
Real exchange rate, 1911 prices					
ε	ADF(0): 3.96 (0.99)	ADF(0): - 0.11(0.94)	ADF(0): - 1.06 (0.92)	YES	I(1)
ε	ADF(1): 1.51 (0.96)	ADF(1): -1.13 (0.70)	ADF(1): - 2.87 (0.18)	YES	I(1)
ε	ADF(4): 1.52 (0.96)	ADF(4): -0.23 (0.93)	ADF(4): -2.04 (0.57)	YES	I(1)
$\Delta\,\varepsilon$	ADF(0): - 2.62(0.008)	ADF(0) -0.22(0.018)	ADF(0): - 3.19 (0.08)	NO	I(0)
Real GDP in logs, 1911 prices					
LrealGDP	ADF(0): 5.46 (0.99)	ADF(0): 1.44 (0.89)	ADF(0): 0.88 (0.95)	YES	I(1)
LrealGDP	ADF(1): 3.75(1)	ADF(1): 1.27 (0.99)	ADF(1): - 1.15 (0.91)	YES	I(1)
LrealGDP	ADF(4): 2.64 (0.99)	ADF(4): 2.60 (1)	ADF(4): -1.41(0.85)	YES	I(1)
Δ LrealGDP	ADF(0): - 4.27(0.00)	ADF(0): - 6.05 (0.0)	ADF(0): - 6.33 (0.00)	NO	I(0)
Real capital stock (total) in logs, 2010 prices					
Lreal K	ADF(0): 11.43 (1)	ADF(0): 3.04 (1)	ADF(0): -0.24 (0.99)	YES	I(1)/I(2)
Lreal K	ADF(1): 1.37 (0.96)	ADF(1): -0.75 (0.83)	ADF(1): - 4.37 (0.00)	YES/NO	I(1)/I(0)
Lreal K	ADF(4): 2.05 (0.98)	ADF(4): 0.61 (0.99)	ADF(4): -3.50 (0.03)	YES/NO	I(1)/I(0)
Δ Lreal K	ADF(0): -0.95 (0.29)	ADF(0): - 1.55(0.49)	ADF(0): - 1.49 (0.00)	YES/NO	I(1)/I(0)
Real capital stock (equipment and machinery) in logs, 2010 prices					
Lreal KE	ADF(0): 9.55 (1)	ADF(0): -1.21 (0.66)	ADF(0): -0.89 (0.94)	YES	I(1)/I(2)
Lreal KE	ADF(1): 0.88 (0.89)	ADF(1): -2.28 (0.17)	ADF(1): - 3.75 (0.09)	YES	I(1)/I(2)
Lreal KE	ADF(4): 1.32 (0.95)	ADF(4): -1.23 (0.66)	ADF(4): -2.65 (0.27)	YES	I(1)/I(2)
Δ Lreal KE	ADF(0): -1.05 (0.29)	ADF(0): - 1.55(0.49)	ADF(0): - 1.49 (0.00)	YES/NO	I(1)/I(0)
Real investment (total) in logs, 1911 prices					
Lreal I	1.68 (0.97)	-0.97 (0.75)	-2.27 (0.43)	YES	I(1)
Lreal I	0.96 (0.95)	-1.13 (0.70)	-3.53 (0.03)	YES/NO	I(1)/I(0)
Lreal I	1.27 (0.94)	-0.65 (0.85)	-2.97 (0.13)	YES	I(1)
Δ Lreal I	-4.92 (0.00)	-5.04 (0.00)	-4.99 (0.00)	NO	I(0)
Real investment (equipment and machinery) in logs, 1911 prices					
Lreal IE	2.59 (0.99)	-2.19(0.20)	-1.46 (0.83)	YES	I(1)
Lreal IE	1.79 (0.98)	-2.07 (0.25)	-0.13 (0.64)	YES	I(1)
Lreal IE	1.34 (0.95)	-1.61 (0.47)	-1.91 (0.64)	YES	I(1)
Δ Lreal IE	-5.09 (0.00)	-5.70 (0.00)	-6.00 (0.00)	NO	I(0)

Note: I(0) means stationary series (no unit root is present). I(1) means non stationary series (i.e presence of at least one unit root).
ADF(p) indicates Augmented Dickey Fuller tests with differents lags p.
In parenthesis, next to the coefficients, find the p-values calculated by MacKinnon (1996)

Table 5. Stationarity of the real exchange rate, real GDP (logs), real capital stock (logs) and real investment (logs) - ADF tests – (GLS), 1861-1913, N = 52

Variable	Model 1 Constant included	Model 2 Constant and trend included	Presence of unit roots	Degree of integration
Real exchange rate, 1911 prices				
ε	ADF(0): 1.61 (0.97)	ADF(0):- 1.13	YES	I(1)
ε	ADF(1): -0.23 (0.60)	ADF(1): -2.80	YES	I(1)
ε	ADF(4): 0.41 (0.80)	ADF(4):-2.14	YES	I(1)
$\Delta\,\varepsilon$	ADF(0): - 2.66 (0.007)	ADF(0): - 2.88*	NO	I(0)
Real GDP in logs, 1911 prices				
LrealGDP	ADF(0): 3.32 (0.99)	ADF(0):- 1.05	YES	I(1)
LrealGDP	ADF(1): 2.14 (0.99)	ADF(1): -1.33	YES	I(1)
LrealGDP	ADF(4): 2.10 (0.99)	ADF(4):- 1.70	YES	I(1)
Δ LrealGDP	ADF(0): - 2.34 (0.01)	ADF(0): - 3.06	NO	I(0)
Real capital stock (total) in logs, 2010 prices				
Lreal K	ADF(0): 5.10 (0.99)	ADF(0):- 0.23	YES	I(1)
Lreal K	ADF(1): -0.92 (0.31)	ADF(1): -4.15	YES/NO	I(1)/I(0)
Lreal K	ADF(4): 0.06 (0.70)	ADF(4):- 2.92	YES	I(1)
Δ Lreal K	ADF(0): - 2.34 (0.01)	ADF(0): - 3.06	NO	I(0)
Real capital stock (equipment and machinery) in logs, 2010 prices				
Lreal KE	ADF(0): 2.91 (0.99)	ADF(0): -0.82	YES	I(1)/I(2)
Lreal KE	ADF(1): -1.46 (0.13)	ADF(1): -3.49	YES/NO	I(1)/I(0)
Lreal KE	ADF(4): -0.38 (0.54)	ADF(4): -2.22	YES	I(1)/I(2)
Δ Lreal KE	ADF(0): -1.42 (0.14)	ADF(0): -1.56	YES	I(1)
Real investment (total) in logs, 1911 prices				
Lreal I	ADF(0): 0.09 (0.71)	ADF(0): -2.33	YES	I(1)
Lreal I	ADF(1): -0.41 (0.80)	ADF(1): -3.60	YES/NO	I(1)/I(0)
Lreal I	ADF(4): 0.08 (0.71)	ADF(4): -3.02	YES/NO	I(1)/(I(0)
Δ Lreal I	ADF(0): - 4.63 (0.00)	ADF(0): -4.90	NO	I(0)
Real investment (equipment and machinery) in logs, 1911 prices				
Lreal IE	ADF(0): 0.34 (0.74)	ADF(0): -1.29	YES	I(1)
Lreal IE	ADF(1): -0.006 (0.68)	ADF(1): -1.72	YES	I(1)
Lreal IE	ADF(4): 0.072 (0.70)	ADF(4): -1.66	YES	I(1)
Δ Lreal IE	ADF(0): -6.08 (0.00)	ADF(0): -5.76	NO	I(0)

Note: I(0) means stationary series (no unit root is present). I(1) means non stationary series (i.e presence of at least one unit root). ADF(p) indicates Augmented Dickey Fuller tests with differents lags p. Note that in this table the ADF test are estimated by generalized least squares - GLS - as proposed by Elliot et al. (1996). These tests have greater power than the regular ADF test (OLS). For Model 1 in parenthesis find the p-values calculated by by MacKinnon (1996). For model 2 p-values are not available and we consider the critical values proposed by Elliot et al. (1996): 10% cv= -2.64 ; 5% cv = -2.93; 2.5% cv = -3.18; 1% cv = -3.46 .

Table 6. Stationarity of the real exchange rate, real GDP (logs), real capital (logs) and real investment (logs) - KPSS test, 1861-1913, N = 52

Variable	Model 1 Constant included	Model 2 Constant and trend included	Presence of unit roots	Degree of integration
Real exchange rate, 1911 prices				
ε	KPSS(0): 1.00	KPSS(0): 0.12	YES	I(1)
ε	KPSS(1): 1.84	KPSS(1): 0.21	YES	I(1)
ε	KPSS(4): 0.84	KPSS(4): 0.10	YES	I(1)
$\Delta\, \varepsilon$	KPSS(0): 0.09	KPSS(0): 0.09	NO	I(0)
Real GDP in logs, 1911 prices				
LrealGDP	KPSS(0): 1.37	KPSS(0): 0.24	YES	I(1)
LrealGDP	KPSS(1): 2.61	KPSS(1): 0.43	YES	I(1)
LrealGDP	KPSS(4): 1.12	KPSS(4): 0.20	YES	I(1)
Δ LrealGDP	KPSS(0): 0.35	KPSS(0): 0.07	NO	I(0)
Real capital stock (total) in logs, 2010 prices				
Lreal K	KPSS(0): 1.37	KPSS(0): 0.24	YES	I(1)
Lreal K	KPSS(1): 2.61	KPSS(1): 0.43	YES	I(1)
Lreal K	KPSS(4): 1.12	KPSS(4): 0.20	YES	I(1)
Δ Lreal K	KPSS(0): 0.35	KPSS(0): 0.07	NO	I(0)
Real capital stock (equipment and machinery) in logs, 2010 prices				
Lreal KE	KPSS(0): 1.34	KPSS(0): 0.19	YES	I(1)
Lreal KE	KPSS(1): 2.56	KPSS(1): 0.36	YES	I(1)
Lreal KE	KPSS(4): 1.10	KPSS(4): 0.15	YES	I(1)
Δ Lreal KE	KPSS(0): 0.14	KPSS(0): 0.08	NO	I(0)
Real investment (total) in logs, 1911 prices				
Lreal I	KPSS(0): 1.24	KPSS(0): 0.09	YES	I(1)
Lreal I	KPSS(1): 2.33	KPSS(1): 0.15	YES	I(1)
Lreal I	KPSS(4): 1.02	KPSS(4): 0.08	YES	I(1)
Δ Lreal I	KPSS(0): 0.04	KPSS(0): 0.04	NO	I(0)
Real investment (equipment and machinery) in logs, 1911 prices				
Lreal IE	KPSS(0): 1.30	KPSS(0): 0.15	YES	I(1)
Lreal IE	KPSS(1): 2.46	KPSS(1): 0.24	YES	I(1)
Lreal IE	KPSS(4): 1.07	KPSS(4): 0.13	YES	I(1)
Δ Lreal IE	KPSS(0): 0.24	KPSS(0): 0.06	NO	I(0)

Notes: I(0) means stationary series (no unit root is present). I(1) means non stationary series (i.e presence of at least one unit root). Model 1: 1% cv = 0.73, 5% cv = 0.47; 10% cv = 0.35. Model 2: 1% cv = 0.21, 5% cv = 0.14; 10% cv = 0.12. Source: Kwiatkowski et al. (1992)

Table 7. Stationarity of the Italian current account to GDP ratio, real exchange rate, real GDP (logs), real capital stock (logs), real investment (logs)- A summary

Variable	Degree of integration from the ADF test - OLS	Degree of integration from the ADF test - GLS	Degree of integration from the KPSS test
Current Account: 1861-2000, N = 139. Istat-Bank of Italy series			
CA/GDP	I(0)	I(0)	I(0)
CA/GDP	I(0)	I(0)	I(0)
CA/GDP	I(0)	I(0)	I(0)
Current Account: 1861-1913, N = 52. Istat series			
CA/GDP	I(0)/I(1)	I(1)	I(1)/I(0)
CA/GDP	I(0)/I(1)	I(1)	I(1)
CA/GDP	I(0)/I(1)	I(1)	I(1)/I(0)
Δ (CA/GDP)	I(0)	I(0)	I(0)
Current Account: 1861-1913, N = 52. Morys series			
CA/GDP	I(0)/I(1)	I(0)	I(0)
CA/GDP	I(0)/I(1)	I(0)/I(1)	I(1)
CA/GDP	I(1)	I(1)	I(0)
Δ (CA/GDP)	I(0)	I(0)	I(0)
Current Account: 1929-2000, N = 72. Istat-Bank of Italy series			
CA/GDP	I(0)	I(0)	I(0)
CA/GDP	I(0)	I(0)	I(1)/I(0)
CA/GDP	I(0)/I(1)	I(0)/I(1)	I(0)
Current Account: 1948-2000, N = 55. Bank of Italy series			
CA/GDP	I(0)	I(0)	I(0)
CA/GDP	I(0)	I(1)/I(0)	I(0)
CA/GDP	I(0)	I(0)	I(0)
Other variables: 1861-1913, N = 52.			
ε	I(1)	I(1)	I(1)
ε	I(1)	I(1)	I(1)
ε	I(1)	I(1)	I(1)
$\Delta\,\varepsilon$	I(0)	I(0)	I(0)
LrealGDP	I(1)	I(1)	I(1)
LrealGDP	I(1)	I(1)	I(1)
LrealGDP	I(1)	I(1)	I(1)
Δ LrealGDP	I(0)	I(0)	I(0)
Lreal K	I(1)/I(2)	I(1)	I(1)
Lreal K	I(1)/I(0)	I(1)/I(0)	I(1)
Lreal K	I(1)/I(0)	I(1)	I(1)
Δ Lreal K	I(1)/I(0)	I(0)	I(0)
Lreal KE	I(1)/I(2)	I(1)/I(2)	I(1)
Lreal KE	I(1)/I(2)	I(1)/I(0)	I(1)
Lreal KE	I(1)/I(2)	I(1)/I(2)	I(1)
Δ Lreal KE	I(1)/I(0)	I(1)	I(0)

Table 7. … to be continued

Lreal I	I(1)	I(1)	I(1)
Lreal I	I(1)/I(0)	I(1)/I(0)	I(1)
Lreal I	I(1)	I(1)/(I(0)	I(1)
Δ Lreal I	I(0)	I(0)	I(0)
Lreal IE	I(1)	I(1)	I(1)
Lreal IE	I(1)	I(1)	I(1)
Lreal IE	I(1)	I(1)	I(1)
Δ Lreal IE	I(0)	I(0)	I(0)

Notes: I(0) means stationary series (no unit root is present). I(1) means non stationary series (i.e presence of at least one unit root).

Table 8. Long run comovements (common trends) among current account to GDP ratio, real exchange rate and real GDP (logs) - Engle and Granger cointegration analysis - 1861-1913

Engle – Granger long run regression: $CA/GDP_t = \alpha + \beta_1\varepsilon + \beta_2 LrealGDP_t + \eta_t$	
Variables	H_0 **: unit root in** η_t **(no cointegration, i.e no common trends)**
CA/GDP (ISTAT), ε	Test = - 1.90, p- value = 0.57, does not reject H_0, NO COINTEGRATION
CA/GDP (Morjs), ε	Test = - 2.65, p- value = 0.23, does not reject H_0, NO COINTEGRATION
CA/GDP (ISTAT), ε, LrealGDP	Test = - 3.33, p- value = 0.16, does not reject H_0, NO COINTEGRATION
CA/GDP (Morjs), ε, LrealGDP	Test = - 2.53, p- value = 0.47, does not reject H_0, NO COINTEGRATION
CA/GDP (ISTAT), ε, LrealK(Total)	Test = - 2.15, p- value = 0.67, does not reject H_0, NO COINTEGRATION
CA/GDP (ISTAT), ε, LrealK(Machinery and equipment)	Test = - 2.24, p- value = 0.62, does not reject H_0, NO COINTEGRATION
CA/GDP (Morjs), ε, LrealK(Total)	Test = - 3.27, p- value = 0.17, does not reject H_0, NO COINTEGRATION
CA/GDP (Morjs), ε, LrealK(Machinery and equipment)	Test = - 3.42, p- value = 0.13, does not reject H_0, NO COINTEGRATION
CA/GDP (ISTAT), ε, LrealI(Total)	Test = -1.80, p- value = 0.81, does not reject H_0, NO COINTEGRATION
CA/GDP (ISTAT), ε, LrealI(Machinery and equipment)	Test = - 1.20, p- value = 0.94, does not reject H_0, NO COINTEGRATION
CA/GDP (Morjs), ε, LrealI(Total)	Test = - 2.84, p- value = 0.33, does not reject H_0, NO COINTEGRATION
CA/GDP (Morjs), ε, LrealI(Machinery and equipment)	Test = - 3.00, p- value = 0.27, does not reject H_0, NO COINTEGRATION

Notes: 5% critical values fot the Engle – Granger ADF test for cointegration: -3.80 (two regressors included) -4.16 (three regressors included) see Philips – Ouliaris (1990). P-values in Mac Kinnon (1996). The no cointegration result is also obtained with DOLS and Johansen cointegration procedure. For DOLS see Stock and Watson (1993) while for Johansen procedure see Johansen (1991).

Table 9 Italian current account to GDP ratio and real exchange rate - Granger causality - 1861-1913 – Istat series

$$\Delta CA/GDP_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \eta_t$$				
	H_0: the past of the exchange rate does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0: \delta_1 = 0$	p-value = 0.007	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0: \delta_1 = \delta_2 = 0$	p-value = 0.000	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(3,3)	$H_0: \delta_1 = \delta_2 = \delta_3 = 0$	p-value = 0.000	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(4,4)	$H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$	p-value = 0.000	Reject H_0	Changes in exchange rate *cause* CA/GDP variations

$$\Delta \varepsilon_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \eta_t$$				
	H_0: the past of the current account does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0: \beta_1 = 0$	p-value = 0.63	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(2,2)	$H_0: \beta_1 = \beta_2 = 0$	p-value = 0.98	Fail to reject H_0	Changes in exchange rate *do not cause* CA/GDP variations
ADL(3,3)	$H_0: \beta_1 = \beta_2 = \beta_3 = 0$	p-value = 0.89	Fail to reject H_0	Changes in exchange rate *do not cause* CA/GDP variations
ADL(4,4)	$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$	p-value = 0.14	Fail to reject H_0	Changes in exchange *do not rate cause* CA/GDP variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 10. Italian current account to GDP ratio and real exchange rate - Granger causality - 1861-1913 – Morys series

$\Delta CA/GDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \eta_t$				
	H_0: the past of the exchange rate does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.04	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.02	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(3,3)	$H_0 : \delta_1 = \delta_2 = \delta_3 = 0$	p-value = 0.00	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(4,4)	$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$	p-value = 0.00	Reject H_0	Changes in exchange rate *cause* CA/GDP variations

$\Delta\varepsilon_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \eta_t$				
	H_0: the past of the current account does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.77	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.99	Fail to reject H_0	Changes in exchange rate *do not cause* CA/GDP variations
ADL(3,3)	$H_0 : \beta_1 = \beta_2 = \beta_3 = 0$	p-value = 0.71	Fail to reject H_0	Changes in exchange rate *do not cause* CA/GDP variations
ADL(4,4)	$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$	p-value = 0.15	Fail to reject H_0	Changes in exchange rate *do not cause* CA/GDP variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 11. Current account to GDP ratio, real exchange rate and real GDP growth - Granger causality - 1861-1913 – Istat series

$\Delta CA/GDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealGDP_{t-1} + ... + \eta_t$				
	H_0 : the past does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.21	Fail to reject H_0	Changes in GDP growth *do not cause* CA/GDP variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.85	Fail to reject H_0	Changes in GDP growth *do not cause* CA/GDP variations
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.000	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.000	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
$\Delta LrealGDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealGDP_{t-1} + ... + \eta_t$				
	H_0 : the past does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.80	Fail to reject H_0	Changes in CA/GDP *do not cause* GDP growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.90	Fail to reject H_0	Changes in CA/GDP GDP growth *do not cause* GDP growth
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 034	Fail to reject H_0	Changes in exchange rate *do not cause* GDP growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.28	Fail to reject H_0	Changes in exchange rate *do not cause* GDP growth

$\Delta\varepsilon_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealGDP_{t-1} + ... + \eta_t$				
	H_0 : the past of the current account does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.87	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations variations
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.91	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.30	Fail to reject H_0	Changes in GDP growth *do not cause* exchange rate variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.44	Fail to reject H_0	Changes in GDP growth *do not cause* exchange rate variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 12. Current account to GDP ratio, real exchange rate and real GDP growth - Granger causality - 1861-1913 – Morys series

$\Delta CA/GDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealGDP_{t-1} + ... + \eta_t$				
	H_0 : the past does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.13	Fail to reject H_0	Changes in GDP growth *do not cause* CA/GDP variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.42	Fail to reject H_0	Changes in GDP growth *do not cause* CA/GDP variations
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.01	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.00	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
$\Delta LrealGDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealGDP_{t-1} + ... + \eta_t$				
	H_0 : the past does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.74	Fail to reject H_0	Changes in CA/GDP *do not cause* GDP growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.73	Fail to reject H_0	Changes in CA/GDP GDP growth *do not cause* GDP growth
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.30	Fail to reject H_0	Changes in exchange rate *do not cause* GDP growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.25	Fail to reject H_0	Changes in exchange rate *do not cause* GDP growth

$\Delta\varepsilon_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealGDP_{t-1} + ... + \eta_t$				
	H_0 : the past of the current account does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.84	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.80	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.31	Fail to reject H_0	Changes in GDP growth *do not cause* exchange rate variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.41	Fail to reject H_0	Changes in GDP growth *do not cause* exchange rate variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 13. Current account to GDP ratio, real exchange rate and real capital (machinery and equipment) - Granger causality - 1861-1913 – Istat series

$\Delta CA/GDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealKE_{t-1} + ... + \eta_t$				
	H_0 : the past does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.23	Fail to reject H_0	Changes in KE growth *do not cause* CA/GDP variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.61	Fail to reject H_0	Changes in KE growth *do not cause* CA/GDP variations
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.02	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.03	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
$\Delta LrealKE_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealKE_{t-1} + ... + \eta_t$				
	H_0 : the past does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.16	Fail to reject H_0	Changes in CA/GDP *do not cause* KE growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.04	Reject H_0	Changes in CA/GDP *cause* K growth
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.51	Fail to reject H_0	Changes in exchange rate *do not cause* KE growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.91	Fail to reject H_0	Changes in exchange rate *do not cause* KE growth

$\Delta\varepsilon_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealKE_{t-1} + ... + \eta_t$				
	H_0 : the past of the current account does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.80	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.99	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.25	Fail to reject H_0	Changes in KE growth *do not cause* exchange rate variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.87	Fail to reject H_0	Changes in KE growth *do not cause* exchange rate

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 14. Current account to GDP ratio, real exchange rate and real capital (machinery and equipment)….- Granger causality - 1861-1913 –Morys series

$\Delta CA/GDP_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealKE_{t-1} + ... + \eta_t$				
	H_0: the past does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0: \gamma_1 = 0$	p-value = 0.29	Fail to reject H_0	Changes in KE growth *do not cause* CA/GDP variations
ADL(2,2)	$H_0: \gamma_1 = \gamma_2 = 0$	p-value = 0.57	Fail to reject H_0	Changes in KE growth *do not cause* CA/GDP variations
ADL(1,1)	$H_0: \delta_1 = 0$	p-value = 0.10	Reject H_0 (10%)	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0: \delta_1 = \delta_2 = 0$	p-value = 0.07	Reject H_0 (10%)	Changes in exchange rate *cause* CA/GDP variations
$\Delta LrealKE_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealKE_{t-1} + ... + \eta_t$				
	H_0: the past does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0: \beta_1 = 0$	p-value = 0.08	Reject H_0 (10%)	Changes in CA/GDP *cause* KE growth
ADL(2,2)	$H_0: \beta_1 = \beta_2 = 0$	p-value = 0.00	Reject H_0	Changes in CA/GDP *cause* KE growth
ADL(1,1)	$H_0: \delta_1 = 0$	p-value = 0.50	Fail to reject H_0	Changes in exchange rate *do not cause* KE growth
ADL(2,2)	$H_0: \delta_1 = \delta_2 = 0$	p-value = 0.63	Fail to reject H_0	Changes in exchange rate *do not cause* KE growth

$\Delta \varepsilon_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealKE_{t-1} + ... + \eta_t$				
	H_0: the past of the current account does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0: \beta_1 = 0$	p-value = 0.72	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(2,2)	$H_0: \beta_1 = \beta_2 = 0$	p-value = 0.99	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(1,1)	$H_0: \gamma_1 = 0$	p-value = 0.24	Fail to reject H_0	Changes in KE growth *do not cause* exchange rate variations
ADL(2,2)	$H_0: \gamma_1 = \gamma_2 = 0$	p-value = 0.87	Fail to reject H_0	Changes in KE growth *do not cause* exchange rate variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 15. Current account to GDP ratio, real exchange rate and real capital (total)- Granger causality - 1861-1913 – Istat series

$$\Delta CA/GDP_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealK_{t-1} + ... + \eta_t$$

	H_0 : the past does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.08	Fail to reject H_0	Changes in K growth *do not cause* CA/GDP
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.19	Fail to reject H_0	Changes in K growth *do not cause* CA/GDP variations
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.06	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.01	Reject H_0	Changes in exchange rate *cause* CA/GDP variations

$$\Delta LrealK_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealK_{t-1} + ... + \eta_t$$

	H_0 : the past does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.24	Fail to reject H_0	Changes in CA/GDP *do not cause* K growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.05	Reject H_0	Changes in CA/GDP *cause* K growth
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.92	Fail to reject H_0	Changes in exchange rate *do not cause* K growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.95	Fail to reject H_0	Changes in exchange rate *do not cause* K growth

$$\Delta \varepsilon_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealK_{t-1} + ... + \eta_t$$

	H_0 : the past of the current account does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.84	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.94	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.36	Fail to reject H_0	Changes in GDP growth *do not cause* exchange rate variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.55	Fail to reject H_0	Changes in GDP growth *do not cause* exchange rate variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation

Table 16. Current account to GDP ratio, real exchange rate and real capital (total)- Granger causality - 1861-1913 – Morys series

$\Delta CA/GDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealK_{t-1} + ... + \eta_t$				
	H_0 **: the past does not matter**	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.14	Fail to reject H_0	Changes in K growth *do not cause* CA/GDP variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.52	Fail to reject H_0	Changes in K growth *do not cause* CA/GDP variations
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.21	Fail to reject H_0	Changes in exchange rate *do not cause* CA/GDP variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.15	Fail to reject H_0	Changes in exchange rate *do not cause* CA/GDP variations
$\Delta LrealK_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealK_{t-1} + ... + \eta_t$				
	H_0 **: the past does not matter**	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.13	Fail to reject H_0	Changes in CA/GDP *do not cause* K growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.00	Reject H_0	Changes in CA/GDP *cause* K growth
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.91	Fail to reject H_0	Changes in exchange rate *do not cause* K growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.68	Fail to reject H_0	Changes in exchange rate *do not cause* K growth

$\Delta\varepsilon_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealK_{t-1} + ... + \eta_t$				
	H_0 **: the past of the current account does not matter**	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.74	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.95	Fail to reject H_0	Changes in CA/GDP *do not cause* exchange rate variations
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.34	Fail to reject H_0	Changes in K growth *do not cause* exchange rate variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.58	Fail to reject H_0	Changes in K growth *do not cause* exchange rate variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 17. Current account to GDP ratio, real exchange rate and real investment (machinery and equipment) - Granger causality - 1861-1913 – Istat series

$$\Delta CA/GDP_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealIE_{t-1} + ... + \eta_t$$

	H_0 : the past does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.34	Fail to reject H_0	Changes in IE growth do not cause CA/GDP variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.61	Fail to reject H_0	Changes in IE growth do not cause CA/GDP variations
ADL(1,1)	$H_0 : \delta_1 = 0$	*p-value = 0.01*	*Reject* H_0	*Changes in exchange rate cause CA/GDP* variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	*p-value = 0.00*	*Reject* H_0	*Changes in exchange rate cause CA/GDP* variations

$$\Delta LrealIE_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealIE_{t-1} + ... + \eta_t$$

	H_0 : the past does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.04	*Reject* H_0	Changes in CA/GDP cause IE growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.04	*Reject* H_0	*Changes in CA/GDP cause IE growth*
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.54	Fail to reject H_0	Changes in exchange rate do not cause IE growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.86	Fail to reject H_0	Changes in exchange rate do not cause IE growth

$$\Delta \varepsilon_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealIE_{t-1} + ... + \eta_t$$

	H_0 : the past of the current account does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.83	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.79	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate variations
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.95	Fail to reject H_0	Changes in IE growth *do not cause* exchange rate variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.75	Fail to reject H_0	Changes in IE growth *do not cause* exchange rate variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 18. Current account to GDP ratio, real exchange rate and real investment (machinery and equipment)….- Granger causality - 1861-1913 –Morys series

$\Delta CA/GDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealIE_{t-1} + ... + \eta_t$				
	H_0 : **the past does not matter**	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.04	Reject H_0	Changes in K growth *cause* CA/GDP
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.36	Fail to reject H_0	Changes in K growth *do not cause* CA/GDP
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.06	Reject H_0 (6%)	Changes in exchange rate *cause* CA/GDP
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.04	Reject H_0	Changes in exchange rate *cause* CA/GDP
$\Delta LrealIE_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealIE_{t-1} + ... + \eta_t$				
	H_0 : **the past does not matter**	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.30	Fail to reject H_0	Changes in CA/GDP *do not cause* I growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.08	Reject H_0 (8%)	Changes in CA/GDP *cause* I growth
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.16	Fail to reject H_0	Changes in exchange rate *do not cause* I growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.05	Fail to reject H_0	Changes in exchange rate *do not cause* I growth

$\Delta\varepsilon_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealIE_{t-1} + ... + \eta_t$				
	H_0 : **the past of the current account does not matter**	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.81	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.89	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.66	Fail to reject H_0	Changes in I growth *do not cause* exchange rate
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.29	Fail to reject H_0	Changes in I growth *do not cause* exchange rate

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 19. Current account to GDP ratio, real exchange rate and real investment (total)- Granger causality - 1861-1913 – Istat series

$\Delta CA/GDP_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealI_{t-1} + ... + \eta_t$				
	H_0 : the past does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.03	Reject H_0	Changes in I growth *cause* CA/GDP variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.28	Fail to reject H_0	Changes in I growth *do not cause* CA/GDP variations
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.01	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.00	Reject H_0	Changes in exchange rate *cause* CA/GDP variations
$\Delta LrealI_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealI_{t-1} + ... + \eta_t$				
	H_0 : the past does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.12	Fail to reject H_0	Changes in CA/GDP *do not cause* I growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.01	Reject H_0	Changes in CA/GDP *cause* I growth
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.09	Fail to reject H_0	Changes in exchange rate *do not cause* I growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.00	Reject H_0	Changes in exchange rate *cause* I growth

$\Delta \varepsilon_t = \alpha + \beta_1 \Delta (CA/GDP)_{t-1} + ... + \delta_1 \Delta \varepsilon_{t-1} + ... + \gamma_1 \Delta LrealI_{t-1} + ... + \eta_t$				
	H_0 : the past of the current account does not matter	**F test – p-value**	**Outcome**	**Causality Conclusion**
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.89	Fail to reject H_0	Changes in CA/GDP *do not cause* exchange rate variations
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.90	Fail to reject H_0	Changes in CA/GDP *do not cause* exchange rate variations
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.65	Fail to reject H_0	Changes in I growth *do not cause* exchange rate variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.31	Fail to reject H_0	Changes in I growth *do not cause* exchange rate variations

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.

Table 20. Current account to GDP ratio, real exchange rate and real investment (total)- Granger causality - 1861-1913 – Morys series

$$\Delta CA/GDP_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealI_{t-1} + ... + \eta_t$$

	H_0 : the past does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.04	Reject H_0	Changes in I growth *cause* CA/GDP variations
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.36	Fail to reject H_0	Changes in I growth *do not cause* CA/GDP variations
ADL(1,1)	$H_0 : \delta_1 = 0$	*p-value = 0.06*	Reject H_0 (6%)	Changes in exchange rate *cause* CA/GDP variations
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	*p-value = 0.05*	Reject H_0	Changes in exchange rate *cause* CA/GDP variations

$$\Delta LrealI_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealI_{t-1} + ... + \eta_t$$

	H_0 : the past does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.30	Fail to reject H_0	Changes in CA/GDP *do not cause* I growth
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.08	Reject H_0 (8%)	Changes in CA/GDP *cause* I growth
ADL(1,1)	$H_0 : \delta_1 = 0$	p-value = 0.16	Fail to reject H_0	Changes in exchange rate *do not cause* I growth
ADL(2,2)	$H_0 : \delta_1 = \delta_2 = 0$	p-value = 0.68	Fail to reject H_0	Changes in exchange rate *do not cause* I growth

$$\Delta\varepsilon_t = \alpha + \beta_1 \Delta(CA/GDP)_{t-1} + ... + \delta_1 \Delta\varepsilon_{t-1} + ... + \gamma_1 \Delta LrealI_{t-1} + ... + \eta_t$$

	H_0 : the past of the current account does not matter	F test – p-value	Outcome	Causality Conclusion
ADL(1,1)	$H_0 : \beta_1 = 0$	p-value = 0.81	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate
ADL(2,2)	$H_0 : \beta_1 = \beta_2 = 0$	p-value = 0.89	Fail to reject H_0	Changes in CA/GDP *does not cause* exchange rate
ADL(1,1)	$H_0 : \gamma_1 = 0$	p-value = 0.66	Fail to reject H_0	Changes in I growth *do not cause* exchange rate
ADL(2,2)	$H_0 : \gamma_1 = \gamma_2 = 0$	p-value = 0.29	Fail to reject H_0	Changes in I growth *do not cause* exchange rate

Notes: The no cointegration result implies we estimate an ADL models instead of an ECM models. Robust standard errors estimation.