The Gold Standard and the Great Depression: a Dynamic General Equilibrium Model*

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Preliminary version

Abstract

Was the Gold Standard a major determinant of the onset and the protracted character of the the Great Depression of the 1930s in the United States and Worldwide? In this paper, we model the 'Gold-Standard hypothesis' in a dynamic general equilibrium framework. We show that encompassing the international and monetary dimensions of the Great Depression is important to understand what happened in the 1930s, especially outside the United States. Contrary to what is often maintained in the literature, our results suggest that the vague of successive nominal exchange rate devaluations coupled with the monetary policy implemented in the United States did not act as a relief. On the contrary, they made the Depression worse.

Keywords: Gold Standard, Great Depression, Dynamic General Equilibrium

JEL Classification: N10, E13, N01

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1 Introduction

In this article, we introduce a two-country, dynamic general equilibrium model to study whether the Gold Standard was a major concomitant cause for the onset and the long duration of the Great Depression.

It is not too far fetched to claim that the Great Depression has always been on the frontier of research in macroeconomics, even before the 2008 recession called for obvious comparisons.

Traditional Keynesian explanations see the Great Depression as the epitome of market failures (Keynes (1936), Temin (1976)). Capitalist economies, the story goes, are chronically subject to depressions due to possible deficiencies in aggregate demand. This calls for systematic Government intervention in the form of public expenditures and expansionary monetary policy.

The alternative view runs under the banners of Monetarism. This view was put to the fore by Friedman and Schwartz (1963) and further elaborated by Mishkin (1978). According to the Monetarist explanation, the Great Depression was not a market failure, but actually a State failure. The fingers are pointed to the Federal Reserve (Fed), who failed to act as lender of last resorts. The consequent lack of liquidity in the market caused banking panics and debt-deflation, thereby prompting the worst Depression of American history.

Economic historians have blended the two theoretical approaches and widened the scope of the analysis from the United States to the rest of the World. The first remarkable analysis was that by Kindleberger (1973), who argues that the Depression was mostly induced by a lack of lender of last resort at the international level, with the Bank of England not capable to exert this role anymore, and the Fed not yet ready to accept the handover. Taking the reasoning one step further, Eichengreen (1992) argues that not only the Gold Standard did not work well because of a lack of hegemonic power, but the Gold Standard itself was at the heart of the trouble. The Gold Standard hypothesis was most notably supported by the work of Bernanke (1995), Bernanke and Carey (1996), Eichengreen and Irwin (2010), Eichengreen and Sachs (1985), Eichengreen and Temin (2000) and Temin (1989), among others.

At the end of the 1990s, a new strand of macroeconomic literature on the Great Depression saw the light of the day.[1] Using dynamic general equilibrium (DGE) models, these authors collectively claim that the De-

[1]See the articles in the collected volume by Kehoe and Prescott (2007), and Pensieroso (2007) for a critical survey.

pression was a 'normal' business cycle worsened by bad policy decisions. Their models are equilibrium models of the business cycle, in the sense of Lucas (1980). They point to a State failure, but they include Keynesian features in the form of frictions. Major contributions are Bordo et al. (2000), Cole and Ohanian (1999), Cole and Ohanian (2004), Weder (2006).

The emergence of DGE models of the Great Depression was a major breakthrough.[2] In particular, it allowed a reformulation of the Keynesian and Monetarist views of the Depression in terms of formal economic models geared towards a quantitative assessment of their relevance. Still, this research agenda raises as many questions as it answers, as recalled by Pensieroso (2011b) and Temin (2008). One obvious concern is its main focus on closed-economy models and idiosyncratic, country-specific shocks.[3] As the Great Depression was clearly a world-wide phenomenon, explanations based on idiosyncratic shocks hitting different countries at the same time are hardly compelling. Moreover, none of the model produced so far in the literature can help us to assess whether the Gold Standard hypothesis put to the fore by the historians hold good.

In this paper, we provide a DGE model of the Gold Standard and the Great Depression. To our knowledge, this is the first attempt to seriously consider the international dimension of the Great Depression in a full-fledged DGE model. The aim is to contribute to the historiography of the Great Depression, by assessing the qualitative adequacy and quantitative relevance of the Gold Standard hypothesis.

The scope of our analysis actually extends beyond the realm of history, and touches on current events. It has recently been argued that the Euro zone presents important analogies with the Gold Standard. In particular, Eichengreen and Temin (2010) have argued that the Europeans are chained by fetters of paper today, like the World was chained by fetters of gold during the Great Depression, with the implicit conclusion that exiting the Euro will help the recovery. Assessing whether the Gold Standard was a likely culprit for the Depression, and whether exiting the Gold Standard was therefore the way out of the Depression might indeed have important policy implications.

Our results show that it is important to encompass a proper international dimension in the model, in order to better understand what happened during the 1930s. Indeed, monetary shocks linked to the Gold Standard helps to account for the actual data, particularly in the rest of the

[2]See De Vroey and Pensieroso (2006).

[3]Closed-economy analyses include Beaudry and Portier (2002) for France, Cole and Ohanian (1999) for the United States, Cole and Ohanian (2002) for the United Kingdom, Fisher and Hornstein (2002) for Germany, Pensieroso (2011a) for Belgium.

World. However, if the Gold Standard provided a transmission mechanism of the shock from the United States to the rest of the World, exiting the Gold Standard in the way the policy was actually implemented was hardly the way out of the Depression. Our counterfactual analysis shows that, had the World economy gone back to the 1929 Gold Standard by 1932, with no additional monetary shock, the Depression would have been milder, especially in the rest of the World.

The paper is organized as follows. In Section 2, we review the historical narrative on the working of the Gold Standard and its possible role during the Great Depression. In Section 3, we present our model. We proceed to calibrate and simulate it in Section 4, where we also provide our counterfactual analysis. Section 5 concludes.

2 The Gold Standard

2.1 The working of the Gold Standard

The classical exposition of the working of the Gold Standard is to be found in Hume (1752).[4] Its mechanics is based on three pillars, money supply, the trade balance and gold flows. Money supply is linked to gold through the price of gold, the units of currency that must be given in exchange for a unit of gold. This price is fixed by the monetary authority. When two countries both abide by the Gold Standard, the nominal exchange rate between their currencies is fixed and equal to the relative price of gold in the two countries. In other words, the Gold Standard is a fixed exchange rate regime, in which relative gold parity regulates the nominal exchange rate. In this context, when the trade balance in the domestic economy is in deficit, the domestic currency cannot devaluate. Accordingly, like it happens in any instance in which prices are fixed, quantities must adjust, the quantity of gold in the case at hand. The country in deficit will experience a gold outflow, and consequently a deflation of monetary prices. By the same token, the country in surplus will experience a consequent increase in gold reserves. As the amount of gold increases, and given the gold content of the currency, the foreign country will witness an increase in money supply and therefore in monetary prices. Deflation in the domestic economy and inflation in the foreign economy will push the terms of trade in favour of the foreign economy. The latter will start importing more from, and exporting less to the domestic economy, thereby correcting the initial unbalance in

[4]Reprinted in Eichengreen, ed (1985).

the trade balance. This mechanism will work until the trade balance is in equilibrium.

If this is the backbone of the Gold Standard system, its actual working might be more complex, once we take into account the presence of banks and the financial system. As aptly noted by the Cunliffe Committee (1918),[5] capital movements (i.e. international lending and borrowing) add additional specific features to the system. If the trade balance is in deficit, the central bank of the deficit country can raise the discount rate to attract lending. In this way, the trade-balance deficit might be compensated by capital inflows (i.e. debt), with no or less gold outflows. This possibility introduces an element of arbitrariness in the working of an otherwise automatic mechanism. It follows that credible commitment to the Gold Standard and central bank cooperation becomes central features of the system. Notice that capital movements do not correct the disequilibrium of the trade balance, *per se*. Indeed, the inflows of capital, to be sustainable, cannot be perennial, while capital mobility will tend to equalise interest rates across countries. Therefore, eventually the real exchange rate must adjust to restore equilibrium. Again, in a fixed exchange rate context, it is the relative price index that must bear the brunt of adjustment. The higher interest rate in the deficit country will discourage investments, lower aggregate demand and therefore exert a deflationary pressure. The improvement of the real exchange rate will favour exports and depress imports, thereby contributing to restore the equilibrium of the trade balance. Notice the possible trade-off between the long-run objective of balance-of-payments stabilisation and the short-run objective of countercyclical monetary policy, a trait already highlighted by Keynes (1923), most notably.

2.2 The Gold Standard and the Great Depression

The most complete account of the Gold Standard hypothesis for the Great Depression is to be found in Eichengreen (1992). Like Friedman and Schwartz (1963), Eichengreen attributes the onset of the Great Depression to the restrictive monetary policy implemented by the Fed in 1927-1928, in the attempt to avoid the bursting of a speculative bubble. However, differently from Friedman and Schwartz (1963), Eichengreen looks at this factor from an international perspective. Higher interest rates in the United States implied less lending from the United States to the rest of the World. This was a problem for many countries, and in particular for the European countries, who were still recovering from World War I, and witnessed

[5] Reprinted in Eichengreen, ed (1985).

heavy current account deficits. Absent American lending, the rest of the World was forced to recur to restrictive fiscal and monetary policy in order to keep gold parity and prevent gold outflows. If bad monetary policy in the United States was the impulse mechanism determining the onset of the Great Depression, the transmission mechanism from money to the real world passed through wage and price rigidity in the United States and elsewhere, and through the lack of international cooperation. Eichengreen attributes the strong non-neutrality of money necessary to explain why monetary policy had such devastating effects on real output and employment to nominal stickiness, including wages, rents and mortgages. In fact, the evidence suggests that real wages were increasing more for countries belonging to the Gold Standard. Moreover, they started to decrease almost everywhere when the Gold Standard was abandoned. In the international context, monetary tensions were worsened by issues like war repayments and war debts, which led to freeze any coordinated action by the main central banks to provide liquidity to the economy without incurring in losses of gold. The Depression was further worsened because of the financial crises that hit the United States and other countries (Austria and Germany, most notably). Eichengreen points to the trade-off between financial stability and nominal exchange rate pegging. In case of liquidity problem in the banking system, liquidity provisions by central banks might increase the perceived risk of currency devaluation, thereby increasing deposit withdrawals and inducing capital (and gold) outflows. According to Eichengreen, far from acting as a stabiliser, the Gold Standard was actually fostering financial instability and banking crises.

These dramatic events unfolded in what was to become the worst crisis in the history of Capitalism, until one by one countries started exiting the Gold Standard, or imposing strict capital controls. This is, according to Eichengreen, the main policy decision driving the World economy out of the Depression. Indeed, the evidence shows that countries exiting the Gold Standard earlier, recovered earlier and faster. Absent the external constraint, fiscal and monetary expansion became possible, until the approach of World War II swept the Depression away, and the drama precipitated into tragedy.

3 The model

3.1 Key features and notation

The theoretical reasoning underpinning the literature on the Gold Standard and the Great Depression is based on many elements: exchange rate pegging, monetary and real shocks, money non-neutrality induced by nominal rigidities, financial instability and banking crises, trade and capital movements.

Our model features many of those elements, but not all of them. We shall have exchange rate pegging, monetary and real shocks, nominal wage rigidity and international trade. Capital movements are not included as deemed to be minor in the 1930s.[6] We do not model the use of reserve currency because the issue is irrelevant in a two-country model. Financial sector and banking crises are included in reduced form.[7]

The model features two symmetric countries, the United States (*US*) and the 'Rest of the World' (*RW*). Each country produces one country-specific good, that can be traded internationally. We assume that both labour and capital are not mobile internationally. Population is assumed to be constant in both countries.

A key ingredient of this model is the presence of money in the sense of cash balances whose quantity is linked to the quantity of gold and to monetary policy.

Nominal wages are assumed to witness some degree of rigidity in both countries.

Before proceeding to illustrate the model, some explanation about notation is in order, for the model features two countries, two currencies and four price indices, all of which makes notation quite cumbersome.

Variables referring to the Rest of the World are denoted by a 'star', X^*. Variables referring to the United States bear no superscript. Nominal variables in local currency are denoted by an superscript 'tilde', $\tilde{X}$. Real variables bear no superscript if deflated by the consumption price index. They are instead denoted by a superscript 'hat', $\hat{X}$, if they are physical

[6]According to Eichengreen (1992), capital outflows from Europe to the United States at the end of the 1920s are the transmission mechanism of the monetary shock from the United States to the Rest of the World, as they forced the European central banks to increase their policy rates, in order to avoid major outflows of gold. In the model, absent capital mobility, we will treat monetary shocks in the Rest of the World as exogenous, but it must be understood by the reader that those shocks are linked to the Gold Standard, and we shall consider them as such.

[7]We discuss the issue at length in Section 3.6.

$\tilde{C}$	nominal consumption (in dollars)
$C \equiv \tilde{C}/P^c$	real consumption (deflated by CPI)
$c \equiv C/N$	real consumption per capita
$\hat{c}^{US}$	US real per-capita consumption of US good
$\hat{c}^{RW}$	US real per-capita consumption of RW good.

Table 1: Notation: US variables

$\tilde{C}^*$	nominal consumption (in RW currency)
$C^* \equiv \tilde{C}^*/P^{*,c}$	real consumption (deflated by CPI)
$c^* \equiv C^*/N^*$	real consumption per capita
$\hat{c}^{US*}$	RW real per-capita consumption of US good
$\hat{c}^{RW*}$	RW real per-capita consumption of RW good

Table 2: Notation: RW variables

quantities of good. Lower-case variables stand for per-capita, i.e. aggregate variables divided by the population, N and N^* for the USA and the Rest of the World, respectively. We denote by n the ratio N^*/N. A *US* or *RW* superscript denotes the origin of the good (i.e. where the good has been produced).

To ease the task for the reader, notation is reported in Tables 1 and 2.

In what follows we will focus the exposition on the United States. Given the symmetry between the two countries, the model for the Rest of the World is analogous. We will spell out the equations for the Rest of the World only when there is some difference with respect to the US economy.

3.2 The US aggregate consumption

Real per-capita aggregate consumption in the United States, c, is made of consumption of both the domestic and the foreign good. As standard in the international trade literature, we shall use a CES aggregator, where ϕ stands for the elasticity of substitution between the two goods.

$$c = \left[\omega^{\frac{1}{\phi}} \left(\hat{c}^{US}\right)^{\frac{\phi-1}{\phi}} + (1-\omega)^{\frac{1}{\phi}} \left(\hat{c}^{RW}\right)^{\frac{\phi-1}{\phi}}\right]^{\frac{\phi}{\phi-1}}, \tag{1}$$

In view of the importance attributed to the Hawley-Smoot Act of 1931 by the literature (see Crucini and Kahn (1996) and Crucini and Kahn (2003)), we allow for the presence of tariffs on US imports. Tariffs on the dollar value of imports are denoted by τ. Calling P^* the price in foreign currency of US imports from the Rest of the World, $\hat{c}^{RW}$, and e the nominal exchange rate expressed as the amount of dollars for 1 unit of international currency, expenditure minimization by the representative household gives:

$$\hat{c}^{US} = \omega \left(\frac{P}{P^c}\right)^{-\phi} c, \tag{2}$$

$$\hat{c}^{RW} = (1-\omega)\left(\frac{(1+\tau)eP^*}{P^c}\right)^{-\phi} c, \tag{3}$$

$$P^c = \left[\omega P^{1-\phi} + (1-\omega)\left((1+\tau)eP^*\right)^{1-\phi}\right]^{\frac{1}{1-\phi}}, \tag{4}$$

Two features are noteworthy. First, tariffs impact demand directly. Second, we ought to distinguish between the GDP deflator, P, and the CPI price index, P^c.

3.3 The US aggregate production

We assume that there is a representative firm that uses labour, L, and capital, K, to produce the US output, Y, by means of a constant return to scale technology:

$$\hat{y}_t = \exp(\hat{s}_t)\hat{k}_t^{\alpha}(\hat{x}_t l_t)^{1-\alpha}. \tag{5}$$

We assume that total factor productivity, A, can be decomposed in two components, a stochastic one, given by $\exp(s)$, and a deterministic one, x.

$$\hat{A}_t \equiv \underbrace{\exp(\hat{s}_t)}_{\text{stochastic}} \overbrace{(\hat{x}_t)^{1-\alpha}}^{\text{trend}}. \tag{6}$$

The stochastic component will give us the TFP shock, while x stands for the labour-augmenting technical progress that drives the economy along a balanced-growth path.

Calling W the wage of labour, and R the interest rate, profit maximisation by the representative firm leads to labour and capital demand:

$$\tilde{w}_t = (1-\alpha)P_t \exp(\hat{s}_t)\hat{x}_t\hat{k}_t^{\alpha}(\hat{x}_t l_t)^{-\alpha}; \tag{7}$$

$$\tilde{r}_t = \alpha P_t \exp(\hat{s}_t)\hat{k}_t^{\alpha-1}(\hat{x}_t l_t)^{1-\alpha}. \tag{8}$$

Notice that both labour and capital demand are expressed in nominal terms.

3.4 The US household dynamic problem

The representative household draws utility from consumption, c_t, real cash balances, $m_t \equiv \tilde{M}_t/P_t^c$, and leisure. We normalise the total household's time endowment to 1, so that leisure per capita can be expressed as $1 - l_t$. The problem of the household reads:

$$\max_{\{c_t,k_{t+1},l_t,m_{t+1}\}} \sum_{t=0}^{\infty} \beta^t \left[\ln c_t + \zeta \ln(1-l_t) + \chi \ln m_t\right], \tag{9}$$

subject to

$$\hat{k}_{t+1} = (1-\delta)\hat{k}_t + \hat{\imath}_t; \tag{10}$$

$$m_t + \frac{\tilde{w}_t}{P_t^c} l_t + \frac{\tilde{r}_t}{P_t^c}\hat{k}_t + tr_t = c_t + \frac{P_t}{P_t^c}\hat{\imath}_t + m_{t+1}(1+\pi_{t+1}^c), \tag{11}$$

where I stands for investments, $\beta \in [0,1]$ denotes the consumer's discount rate, ζ and χ are positive scaling parameters, $(1+\pi_{t+1}^c)$ is the CPI inflation factor (i.e. P_{t+1}^c/P_t^c), and tr stands for transfers from the Government, that are taken as given by the household.[8]

The first order conditions of the problem are:

$$\frac{c_{t+1}}{c_t} = \beta\frac{(1+\pi_{t+1})}{(1+\pi_{t+1}^c)}\left[(1-\delta) + \frac{\tilde{r}_{t+1}}{P_{t+1}}\right]. \tag{12}$$

$$m_t = \chi\frac{c_t}{\iota_t}. \tag{13}$$

$$(1+\iota_t) \equiv (1+\pi_t)(1+\frac{\tilde{r}_t}{P_t} - \delta). \tag{14}$$

$$\zeta\frac{c_t}{(1-l_t)} = w_t. \tag{15}$$

Equation (12) is the Euler equation ruling savings. Notice that savings now depends also on how the CPI evolves compared to the GDP deflator. For the remuneration of capital investment in physical terms has more or less impact on utility depending on how it does translate into aggregate consumption. Equation (13) is the standard money demand as a function of current consumption and the nominal interest rate. Equation (14) is the definition of the nominal interest rate in terms of the Fisher equation. Finally, Equation (15) is the labour supply.

[8]For the sake of simplicity, we have assumed that investments are made of domestic good only.

3.5 The Gold Standard

We model the Gold Standard as an automatic rule linking the monetary base, $\tilde{M}^B$, to the price and quantity of gold, P^g and $\hat{G}$, respectively.[9] Calling η the statutory gold-backing ratio of the currency, the expressions for the monetary base $\tilde{M}^B$ in both countries will be

$$\tilde{M}_t^B = \left(\frac{1}{\eta_t(1+\lambda_t)}\right) P_t^g \hat{g}_t; \tag{16}$$

$$\tilde{M}_t^{B*} = \left(\frac{1}{\eta_t^*}\right) P_t^{g*} \hat{g}_t^*. \tag{17}$$

Notice the asymmetry between the two countries. While we assume that the Rest of the World mechanically sticks to the Gold Standard, so that, absent changes in the price of gold, any inflow or outflow of gold will affect the stock of the monetary base, we allow the Gold-Standard constraint to be non-binding for the United States. The implication of this assumption is that the US monetary authorities can sterilise gold inflows and outflows, by acting on the parameter λ. This is in accordance with the historical evidence from Bordo et al. (2002), who maintain that the US Federal Reserve could have undertaken a more expansionary monetary policy in the 1930s, for it was actually not constrained by the amount of gold.

It is assumed that gold can freely and costlessly move between countries. In this context, the nominal exchange rate is simply the ratio between the statutory price of gold in both countries, that is the ratio between the gold content of the two currencies.

$$e_t = \frac{P_t^g}{P_t^{g*}}. \tag{18}$$

We assume that all existing gold is used for monetary purposes.

3.6 Inside money

As explained above, the historical literature on the Gold Standard and the Great Depression focuses on the link between the Gold Standard and the financial system in order to account for the depth of the Great Depression. Unfortunately, modern DGE macroeconomics have long overlooked the issue of financial stability, so that we lack tools to properly model this claim

[9] A similar rule was first proposed by Barro (1979).

about the Great Depression. Much research effort is currently devoted to understanding the link between the banking system and real recessions, like in Boissay et al. (forthcoming), while a model of financial accelerator has been developed by Bernanke et al. (1996). Adapting these models to the case of the Depression, in order to ascertain to what extent the interaction between the banking crises in the United States (and elsewhere) and the Gold Standard is responsible for the Depression is an interesting but daunting task that we leave to future research.[10] In this article, we shall content ourselves with having a kind of 'reduced form' formulation for the banking sector. In particular, we shall assume that cash balances, $\tilde{M}$, are a multiple of the monetary base by an exogenous money multiplier, $1/\mu$.

$$\tilde{M}_t = \frac{1}{\mu}\tilde{M}_t^B; \tag{19}$$

$$\tilde{M}_t^* = \frac{1}{\mu^*}\tilde{M}_t^{B*}; \tag{20}$$

This formulation allows us to interpret exogenous variations in the money multiplier as banking shocks. While this is admittedly an oversimplified representation of the banking system, it has the advantage of being simple and tractable. Moreover, we can back up the shock directly from the data, which makes us confident that, for all the limitations of our approach, we are still considering the quantitative relevance of banking shocks in our Gold Standard model.

3.7 Equilibrium conditions

In a Gold-Standard system, the equilibrium of the balance of payments ensures that any surplus or deficit of the trade balance is compensated by a flow of gold from the deficit to the surplus country. Accordingly, we shall have

$$\overbrace{(1+\pi_{t+1}^c)\left(\frac{P_{t+1}^g}{P_{t+1}^c}\right)\hat{g}_{t+1} - \left(\frac{P_t^g}{P_t^c}\right)\hat{g}_t}^{\Delta \text{ gold}} = \underbrace{\left(\frac{P_t}{P_t^c}\right)n\hat{c}_t^{US*} - \left(\frac{e_t P_t^*}{P_t^c}\right)\hat{c}_t^{RW}}_{\text{trade balance}}. \tag{21}$$

[10]Some effort in this direction has been made by Christiano et al. (2003), in the context of a closed-economy model with no Gold Standard.

In our model, the Government collects revenue from three sources: seignorage, the flow of gold due to the surplus of the current account (if any) and tariffs. We assume that the Government rebates these resources to the household via lump-sum transfers.

$$tr_t = \left[(1+\pi^c_{t+1})m_{t+1} - m_t\right] - \left[(1+\pi^c_{t+1})\left(\frac{P^g_{t+1}}{P^c_{t+1}}\right)\hat{g}_{t+1} - \left(\frac{P^g_t}{P^c_t}\right)\hat{g}_t\right] + \tau_t \frac{e_t P^*_t}{P^c_t}\hat{c}^{RW}_t. \quad (22)$$

Finally we shall impose several equilibrium conditions, to ensure market clearing.

$$P_t \hat{y}_t = \tilde{w}_t l_t + \tilde{r}_t \hat{k}_t. \quad (23)$$

$$P_t \hat{y}_t = P^c_t c_t + P_t \hat{i}_t - \tau e_t P^*_t \hat{c}^{RW}_t + \underbrace{P_t n \hat{c}^{US*}_t - e_t P^*_t \hat{c}^{RW}_t}_{\text{trade balance}}. \quad (24)$$

$$\bar{g}_t = \hat{g}_t + n\hat{g}^*_t. \quad (25)$$

Equation (23) states that the value of revenue must be equal to the value of production. Equation (24) states that value of aggregate demand must be equal to the value of aggregate supply. Equation (25) guarantees that the sum of the stock of gold in the two countries is equal to the worldwide gold reserves.

3.8 Frictions

From a methodological point of view, our standpoint favours the simplest possible model to make the point we want to make, i.e. understanding whether the Gold Standard was an important determinant of the Great Depression. Accordingly, we have refrained from introducing too many frictions, and we have tried to minimise the number of free parameters. This notwithstanding, we cannot ignore that economic historians have put to the fore two main frictions linked to the Gold Standard, namely tariffs and nominal wage rigidity.

The case for tariffs as a major determinant of the Great Depression was put to the fore by Meltzer (1976), and more recently by Crucini and Kahn (1996) and Crucini and Kahn (2003). Interestingly, Eichengreen and Irwin (2010) argue that countries sticking to the Gold Standard longer were also experiencing deeper slides toward protectionism.

A glance at Figure 1 suggests that the case for tariffs is compelling and uncontroversial. Measured tariffs were indeed increasing at the onset of the Great Depression, both for the United States and, to different degrees,

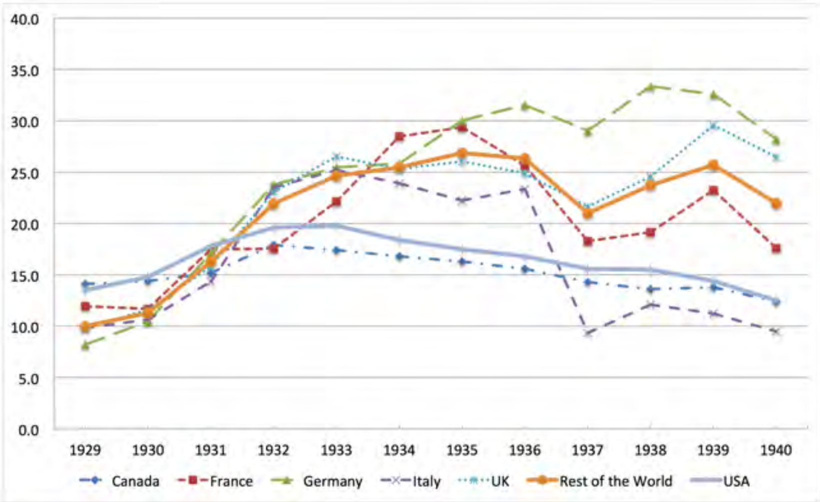
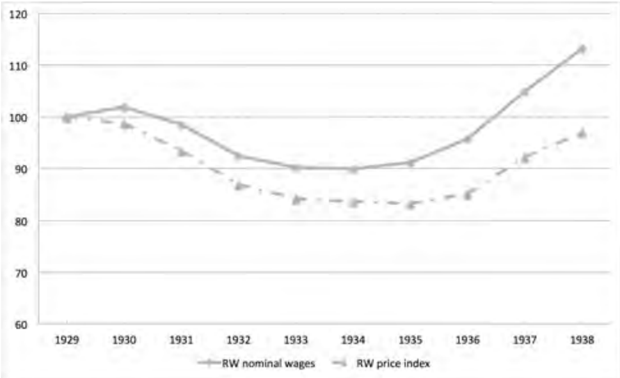


Figure 1: Tariffs. Source: Crucini and Kahn (2003). Customs revenue over total imports

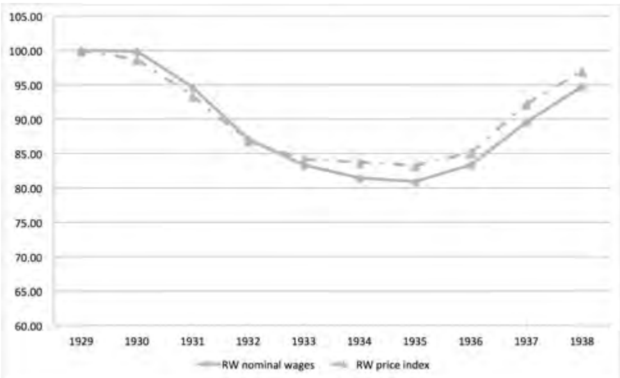
for the bunch of countries we will include in our definition of the Rest of the World. We shall use measured average tariffs for the United States and the Rest of the World as shocks.

The case for nominal wage rigidity is less immediate. Convincing direct evidence (surveys) for the United States is provided by Bordo et al. (2000). Indirect evidence for the United States and a bunch of other countries is discussed by Eichengreen and Sachs (1985), Bernanke (1995) and Bernanke and Carey (1996). Their empirical strategy consists in estimating the shape of the short-run aggregate supply curve (AS). In the short run, real wages make the bulk of marginal costs. A positively shaped AS is interpreted as evidence of nominal wage stickiness. The argument is that if supply increases with prices, it must be that nominal wages are not keeping up with prices. Otherwise, the real wage would be constant and the AS vertical. Bernanke and Carey (1996) go one step further, and also estimate the degree of nominal wage stickiness directly by using one-period lagged nominal wages in the supply equation. They conclude that the data suggest a sizeable degree of nominal wage stickiness.

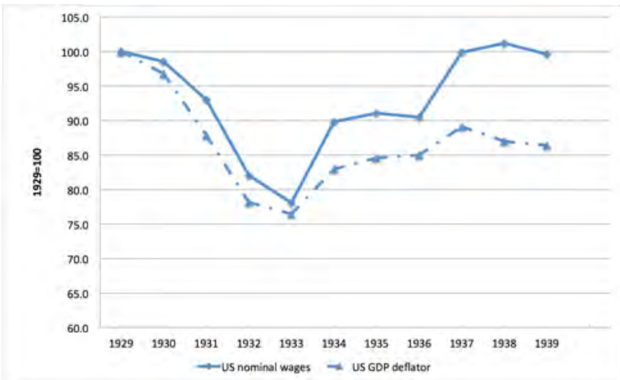
A way to visualise the kind of argument advanced by these papers is to compare nominal wages with prices. Whenever the former increases more (or decreases less) than the latter, their argument leads to attributing a major part of the resulting change in real wages to nominal wage stickiness. Figure 2a illustrates the point for the Rest of the World: as the gap between nominal wages and prices increased during the Depression, we could



(a) Rest of the World. Undetrended data.



(b) Rest of the World. Detrended data.



(c) United States. Detrended data. Manufacturing.

Figure 2: Nominal wages and prices. Source: our elaboration on Kehoe and Prescott (2007).

conclude that real wages were increasing due to some sort of nominal wage stickiness.

One possible issue with this conclusion is that the data in Figure 2a have not been detrended. Now, the relevant measure for our purposes is detrended wages, for we have assumed that in the long run both economies grow along a balanced growth path, which implies that wages will exhibit a trend. Using a deterministic trend of 2% like in Cole and Ohanian (1999), and assuming that the trend is common to both countries, the picture we get is rather different, as can be seen from Figures 2b (the Rest of the World) and 2c (the United States).

In detrended terms, real wages in the United States were increasing during the Depression, slightly so from 1929 to 1933, more markedly thereafter. On the contrary, in the Rest of the World we cannot distinguish any clear trend.

In a nutshell, the evidence on nominal wage rigidity holds good for the United States, but is mixed for the Rest of the World. Accordingly, instead of specifying a model of wage staggering like Calvo (1983) or Taylor (1980), we have opted to use a rather 'agnostic' model, like the one proposed by Blanchard and Galì (2007). In our terms, this implies

$$\tilde{w}_t = \kappa \tilde{w}_{t-1} + (1 - \kappa) P_t^c \frac{U'_{1-l_t}}{U'_{c_t}}. \tag{26}$$

This formulation states that absent nominal rigidities (i.e. for $\kappa = 0$), nominal wages should be equal to the value of the marginal rate of substitution between consumption and leisure. In this way, we can calibrate the extent of nominal wage rigidity (i.e. κ) directly from the data, without imposing any restriction on the average length of job contracts.

4 Numerical Analysis

4.1 The Rest of the World

Before getting to the numerical analysis, we need to specify the empirical counterpart to the country labelled the 'Rest of the World' in our model. We have chosen a GDP weighted average of Canada, France, Italy, Germany and the United Kingdom. The weights are reported in Table 3. Together, those countries amounted to 56% of US exports and to 31% of US imports. Together, they were quite similar to the United States in terms of both degree of development and dimension, which ensures that our symmetric-countries assumption holds in the simulations: they amounted to 116% of

Country	Weight
Canada	0.052
France	0.205
Germany	0.301
Italy	0.145
United Kingdom	0.297

Table 3: Average on 1920-1939. Source: Maddison (2011)

the US GDP (in PPP) and to 166% of the US population. On top of that, they are made of both representative of the 'Gold Bloc' and the 'Sterling Bloc', so that we are sure we have not introduced any arbitrary bias linked to monetary regimes.

4.2 Shocks

There are five shocks in our model, two real shocks and three monetary shocks. All shocks are temporary.

Real shocks are TFP and tariff shock. Detrended TFP in both countries is assumed to follow an AR(1) process:

$$\hat{s}_t = \rho \hat{s}_{t-1} + \nu_t; \tag{27}$$

$$\hat{s}^*_t = \rho^* \hat{s}^*_{t-1} + \nu^*_t. \tag{28}$$

Tariff shocks are directly measured from the data. We normalise tariffs in 1929 to zero in both countries and assume this corresponds to the steady state.

$$\tau_{29} = \tau_{ss} = 0; \tag{29}$$

$$\tau^*_{29} = \tau^*_{ss} = 0. \tag{30}$$

Monetary shocks concern the US gold backing ratio, the US and RW money multiplier and the bilateral nominal exchange rate. The US gold backing ratio shock is measured from the data.

$$\lambda = \frac{P^g \hat{g}}{\tilde{M}^B} \frac{1}{\eta} - 1. \tag{31}$$

It is a measure of the sterilisation policy implemented by the Fed. The US and RW money multipliers are also taken from the data:

$$\mu = \frac{\tilde{M}^B}{\tilde{M}1}. \tag{32}$$

$$\mu^* = \frac{\tilde{M}^{B*}}{\tilde{M}1^*}. \tag{33}$$

It is a reduced form representation for banking shocks. For what concerns the nominal exchange rate shock, we model it as follows:

$$e_t = (1-\rho_e)\frac{P^g}{P^{g*}} + \rho_e e_{t-1} + \varepsilon_t; \tag{34a}$$

$$P_t^g = (1-\rho_p)P^g + \rho_p P_{t-1}^g + \vartheta_t; \tag{34b}$$

$$P_t^g = P_t^{g*} e_t. \tag{34c}$$

This formulation implies that the actual nominal exchange rate might diverge from its natural level, that is from the ratio between gold content of the two currencies, but this divergence follows an AR(1) process. The same is true for the price of gold in the United States. The last Equation ensure that the price of gold in the Rest of the World is such that the model is always consistent with the observed pattern of the nominal exchange rate. Notice that this way the shocks on the nominal exchange rate in the two countries are interdependent.

4.3 Calibration

The model is calibrated on yearly data and our reference period for the calibration corresponds to 1929. Some parameters values can be taken directly from the data, but others like ζ, ζ^*, χ, χ^* together with ω and ω^* need to be endogenously calibrated to fit a set of aggregate ratios in both countries. To capture the key properties of the RW economy, the RW ratios are constructed by averaging Canada, France, Germany, Italy and UK ratios weighted by each country's GDP share in the group's total GDP (see the weights reported in Table 3).

On the household side, the benchmark calibration assumes that, in both countries, the discount factor is set to 0.979 to ensure annual real interest rates r and r^* equal to 4% in the deterministic steady-state. The preferences (9) are characterized by scaling parameters ζ and χ for the US and ζ^* and χ^* for the RW. We choose ζ and ζ^* so that hours worked is one third in the steady-state. The resulting values are $\zeta = 1.859$ and $\zeta^* = 1.860$. The parameters χ and χ^* are set to 0.015 and 0.024 respectively to target a ratio money over GDP ($\tilde{M}/\tilde{Y}$ and $\tilde{M}^*/\tilde{Y}^*$ respectively) of 0.253 in the US and 0.431 in the RW.[11] Following Chari et al. (2002), the elasticity of substitution

[11]The money stock M refers to M1 which is currency and notes in circulation plus commercial bank deposits. The sources are Bernanke (2000) for the US, Amaral and

between domestic and foreign goods is set to 1.50 in each economy. The weight of consumption in domestic goods ω (ω^* resp.) in the US (RW resp.) is computed so that the home goods share in consumption, α_C (α_C^* resp.), targets the value found in the data, 93.8% (75.1% resp.).[12] Therefore, ω and ω^* are fixed to 0.974 and 0.455 respectively.

We now describe the calibration of production-side parameters. For the US, the parameters δ, $1-\alpha$ and γ are fixed accordingly as in Cole and Ohanian (1999): the labor share in production, $1-\alpha$, has a standard value of 2/3, the depreciation rate, δ, is chosen to be 0.10 and the deterministic growth rate is 0.02 implying that $\gamma = 1.02$. In the RW economy, we assume that physical capital depreciates at the same rate of $\delta^* = 0.10$ and we let per capita variables grow by the factor $\gamma = 1.02^*$. The RW share of labor income in output, $1-\alpha^*$, is the GDP weighted average of labor share in Canada (0.70), France (0.66), Germany (0.75), Italy (0.55) and UK (0.70). Such values give an aggregate labor income share of $1-\alpha^* = 0.685$.[13] The persistence of the process of US technology, ρ, is estimated by regressing the logarithm of the detrended TFP s_t as an AR(1) process on the period 1929-1938. Undetrended TFP $\hat{A}_t$ is extracted from the empirical Solow residual defined as output over inputs, where the different inputs are weighted by their factor shares. Then detrended TFP $\hat{s}_t$ is obtained by using the formula $\hat{s}_t = \hat{A}_t/(\gamma^{t-t_0})$ where $t_0 = 1929$. The resulting point estimate is $\rho = 0.852$ in the US. The same procedure was followed for obtaining the technology persistence in the RW, this gives $\rho^* = 0.895$.

Turning to the labor and monetary markets, the degrees of nominal wage rigidities κ and κ^* are obtained by running AR(1) processes (with a drift) on the nominal wage in both countries. This yields the following estimates: $\kappa = 0.572$ for the US and $\kappa^* = 0.720$ for the RW. The backing ratio

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MacGee (2002) for Canada, Beaudry and Portier (2002) for France, Perri and Quadrini (2002) and Fratianni and Spinelli **XX** for Italy, Hetzel **XX** and Fisher and Hornstein (2002) for Germany and Cole and Ohanian (2002) for the UK.

[12] To obtain $\alpha_C = 0.938$ and $\alpha_C^* = 0.751$, we proceed as follows. For each country α_C is computed as the ratio of the share of imports in GDP to the share of consumption in GDP (both evaluated in 1929). Notice that this calculation implicitly assumes that all imports are made of consumption goods only. According to League of Nations international trade database, the share of imports of capital goods in total imports in 1936 (no data were available for 1929) amounts to only 1% in the US (for France and UK the respective values are 5.9% and 3.4%). Given these numbers, our assumption is unlikely to affect our results in a quantitatively important way. Once all individual α_C are obtained, α_C^* is computed as the GDP weighted average of home goods share in consumption across Canada, France, Germany, Italy and UK.

[13] The sources for these countries' labor share are Amaral and MacGee (2002) for Canada, Beaudry and Portier (2002) for France, Perri and Quadrini (2002) for Italy, Fisher and Hornstein (2002) for Germany and Cole and Ohanian (2002) for the UK.

in the US is set to 0.40, value consistent with the legal reserve requirement (i.e. liabilities against which gold must be held) in 1929, see Bernanke (1995). For the RW, the cross-country average of backing ratios in Canada, France, Germany, Italy and UK gives $\eta^* = 0.511$.[14]. Finally, persistence parameters of the nominal exchange rate and the price of gold in the US, ρ_e and ρ_g are obtained by estimating equations (34a) and (34b) over the period 1929-1938. In doing so, we used in the AR(1) process for e_t the nominal effective exchange rate of the US at time t constructed as the GDP weighted average of the nominal bilateral exchange rates vis-a-vis Canada, France, Germany, Italy and the UK (source: League of Nations **XX**). The estimated value for ρ_e is found to be 0.786. Using data from Bernanke (1995) for the price of gold in the US, our estimate of the autoregressive parameter ρ_g is 0.858.

4.4 Simulations

The model period is one year. All variables are assumed to be at their steady state level in 1929. All shocks are temporary, i.e., we assume that the economy will eventually step back to the initial steady state. We assume perfect foresight of the shock.[15]

Figure 3 shows the pattern of the shocks. TFP shocks were negative in both countries till 1932, to become positive after 1934. Tariffs increased in both countries, more markedly so in the Rest of the World. In accordance with the thesis of Eichengreen and Irwin (2010), tariffs in the United States start to decline after 1933, the year of the devaluation of the dollar.

[14]The backing ratios in France, Italy and Germany correspond to the official legal reserve requirements and are 0.35, 0.40 and 0.40 in 1929 respectively (source: Federal Reserve Board (1930)). No information for Canada is provided by Federal Reserve Board (1930), we thus assign to this country the value of 0.383 which corresponds to the mean value of η in France, Italy and Germany. In the UK, only issues in excess of £ 260 millions had to be fully backed by gold. In order to obtain a value of the backing ratio that applies to the entire monetary base, η in the UK is computed according to: $\eta = 0.383 \times 260 + 1.00 \times$ (Monetary base in excess of £260m) where we apply again the mean value of η in France, Italy and Germany to the monetary base below the official threshold of £ 260 millions

[15]While this is a common assumption in the literature, there is little consensus over the correct way of modeling expectations in the analysis of the Great Depression. See Kehoe and Prescott (2008) for a discussion about rational expectations *vs* perfect foresight in the analysis of the Great Depression. Eggertsson (2008) provides a model highlighting the role of expectations in driving the American economy out of the Great Depression of the 1930s. Aguilar Garcìa and Pensieroso (2017) are currently further exploring the expectations hypothesis, by introducing adaptive learning in a DGE model of the Great Depression.

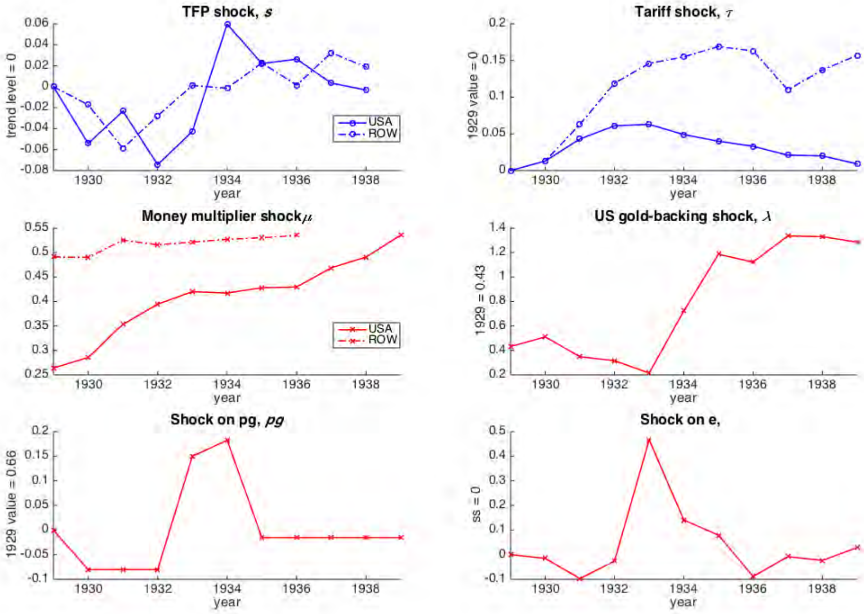

Figure 3: Shocks used in the simulations

The US money multiplier ($1/\mu$) was decreasing all over the decade, particularly from 1930 to 1932, and from 1936 to 1938. This suggests that banking problems were important, a finding consistent with Friedman and Schwartz (1963). On the other hand, the Fed acted in an expansionary way from 1930 to 1933 on the exchange market, accepting lower backing ratios than normal. This pattern reverted after the dollar devaluation, with the Fed seemingly engaging in some form of sterilisation policy. The money multiplier in the Rest of the World ($1/\mu^*$) decreased only slightly between 1929 and 1931, to stay roughly constant thereafter.

The shocks on the nominal exchange rate and the price of gold reflect actual changes in the exchange rate policy implemented by the countries considered here, as reported in Table 4.

We have run three different simulations, one with real shocks only, one with monetary shocks only, and one with all shocks confounded.

We shall judge the data mimicking ability of the model along several dimensions. First, in Table 5, we compare the steady state of the model with the data in 1929. We find that the model fit is remarkably good, with the exception of the Gold-to-GDP ratio in the Rest of the World.[16]

[16]The model also overestimates the ratio of investment to GDP, most likely because of

Country	Suspension of GS	Exchange contr.	Devaluation
Canada	Oct. 1931	–	Sept. 1931
France	–	–	Oct. 1936
Germany	–	Jul. 1931	–
Italy	–	May 1934	Oct. 1936
United Kingdom	Sep. 1931	–	Sep. 1931
United States	March 1933	March 1933	April 1933

Table 4: Source: Bernanke and James (1991) reprinted in Bernanke (2000)

Main ratios, Data vs Model, 1929

	United States		Rest of the World	
	Data	Model	Data	Model
Consumption (% of GDP)	0.695	0.717	0.776	0.737
Investment (% of GDP)	0.178	0.282	0.156	0.266
Trade balance (% of GDP)	0.007	0.001	−0.013	−0.003
Exports (% of GDP)	0.050	0.045	0.180	0.180
Imports (% of GDP)	0.043	0.045	0.193	0.183
Real cash balances (% of GDP)	0.253	0.253	0.431	0.431
Gold (% of GDP)	0.038	0.038	0.048	0.108
Real cash balance/Gold	6.615	6.614	8.954	3.984

Table 5: Model fit: steady state compared with actual data in 1929.

Second, in Table 6 - panel (a), we report the cross-correlation with GDP of several aggregate variables in the United States, for the period 1929-1938. We do the same for the Rest of the World in Table 6 - panel (b). For both the United States and the Rest of the World, results show that the model economy simulated with the whole set of shocks matches reasonably well the available evidence. Notice how nominal shocks helps to get the price level right. The correlation between real wages and real GDP is negative, but not significant in the US data, low and positive, but again not significant in the RW data. Notice again how the presence of monetary shocks helps the model to reduce the excessive co-movement in real wages that one gets because of the real shocks. Finally, gold and real cash balances do not show any appreciable correlation with real GDP in the data.

the absence of public expenditures.

(a) Correlation with real GDP, United States

Variable	Data	Real shocks	Nominal shocks	All shocks
Consumption	+0.98***	+0.73**	+0.49	+0.67**
Investment	+0.97***	+0.97***	+0.97***	+0.98***
Hours worked	+0.98***	+0.91***	+0.99***	+0.81***
Real wages	−0.40	+0.84***	−0.95***	+0.23
CPI	+0.95***	−0.86***	+0.68**	+0.72**
Gold	−0.06	−0.64**	+0.16	+0.76**
Real cash balances	+0.25	−0.37	−0.30	+0.16

(b) Correlation with real GDP, Rest of the World

Variable	Data	Real shocks	Nominal shocks	All shocks
Consumption	+0.66**	+0.72**	+0.60*	+0.74**
Investment	+0.86***	+0.96***	+0.86***	+0.88***
Hours worked	+0.96***	+0.92***	+0.98***	+0.91***
Real wages	+0.22	+0.82***	−0.81***	-0.03
GDP deflator	+0.83***	−0.61*	+0.30	+0.44
Gold		+0.61	−0.57	−0.67
Real cash balances		+0.80	−0.57	−0.60

Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 6: Correlation of selected aggregate variables with real GDP: 1929-1928, (a) the United States, (b) the Rest of the World. Comparison between the data, the model with real shocks only, the model with nominal shocks only and the model with all shocks confounded.

As a third quantitative test, in Table 7 we study the synchronisation of the Great Depression between the United States and the Rest of the World, by looking at the co-movement of variables across the two countries. Results show a high degree of synchronisation, in full accordance with both the historical narrative and the data.

As a fourth metrics to evaluate the quantitative fit of the model, we studied the standard deviation of several aggregate variables relative to GDP in both countries. Results are reported in Table 8, panel (a) and (b) for the United States and the Rest of the World, respectively. In the data, consumption, hours worked, real wages and monetary prices are less volatile than output, while investment more. The model reproduces this key feature of the data, with the exception of hours worked in the Rest of the World, that move too much with respect to GDP.

Correlations United States - Rest of the World

Variable	Data	Real shocks	Nominal shocks	All shocks
GDP	+0.94***	+0.81***	+0.72**	+0.88***
Consumption	+0.92***	+0.95***	+0.50	+0.68**
Investment	+0.80***	+0.76**	+0.79***	+0.83***
Hours worked	+0.85***	+0.71**	+0.77***	+0.84***
Real wages	+0.31	+0.15	+0.45	+0.63**
GDP deflator	+0.84***	+0.79***	+0.55*	+0.51
Significance levels: *** p<0.01, ** p<0.05, * p<0.1				

Table 7: Correlation of selected aggregate variables between the United States and the Rest of the World, 1929-1928. Comparison between the data, the model with real shocks only, the model with nominal shocks only and the model with all shocks confounded.

Finally, we may want to be more demanding, check the pattern of the model on a year-by-year basis, and compare it with the data. In Figure 4, we report the results of our simulations for output, consumption, investment, hours worked, nominal wages and the GDP deflator in the United States. In Figure 5 we do the same for the Rest of the World. The black solid line depicts the behaviour of the model economy when hit by all the shocks, whereas the black dotted line depicts the behaviour of the detrended data. The blue and the red line depict the behaviour of the model economy when hit by the real-only or the monetary-only shocks, respectively. Figures 4 and 5 show that the model does a relatively good job to reproduce the qualitative and quantitative behaviour of the data, particularly for what concerns the Rest of World. This is a remarkable feature, in view of the stylised nature of the model.

In order to provide an even clearer quantitative assessment of the role of the Gold Standard as impulse and propagation mechanism of the Great Depression, we represent in Table 9 - panel (a) the percentage of the cumulative drop in the data explained by the model, for the United States. We do this exercise for the cumulative drop between 1929 and 1932, and for the cumulative drop between 1929-1936. The former will give us a sense of the impact of the shocks on the onset of the Depression, the latter on its long duration. Table 9 - panel (b) repeats this exercise for the Rest of the World.

Results from our simulations show that in the United States, monetary shocks linked to the Gold Standard contribute to explaining the onset of

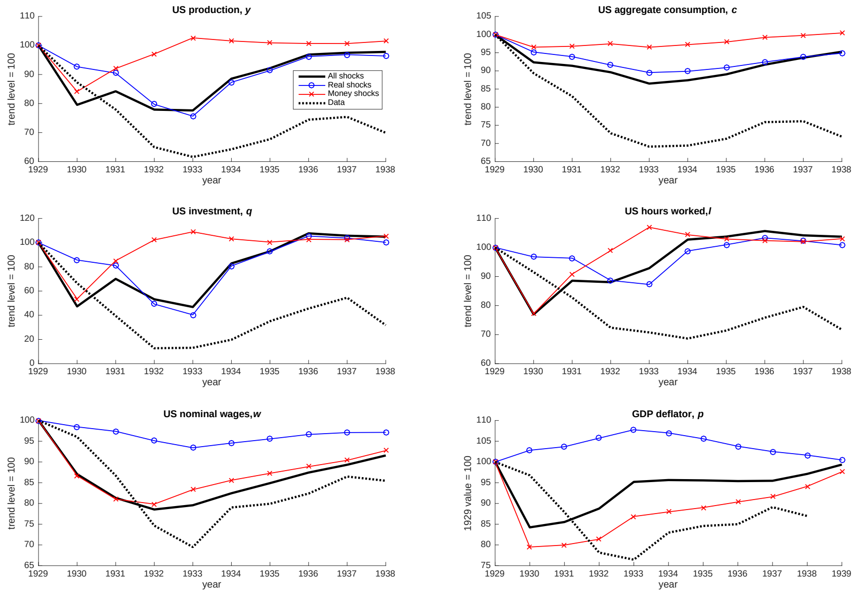

Figure 4: Simulations for the United States

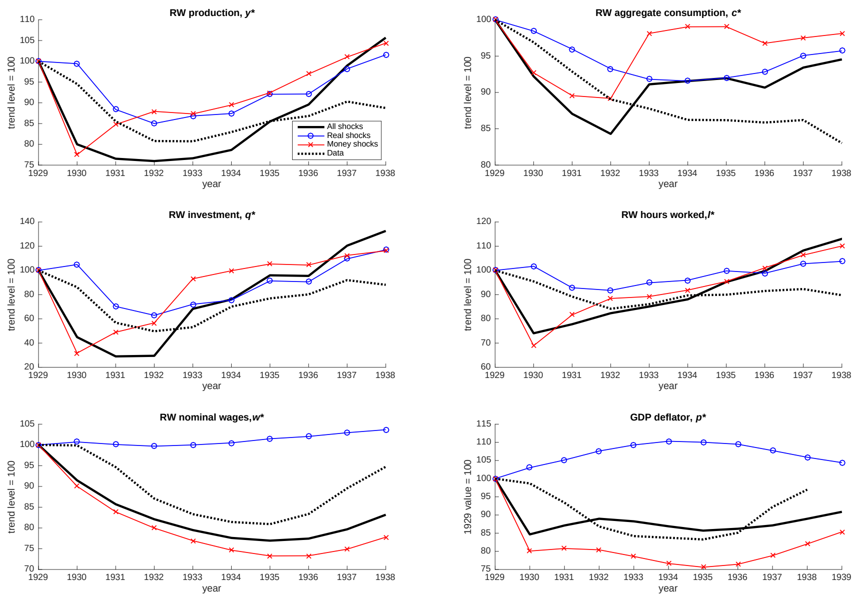

Figure 5: Simulations for the Rest of the World

(a) Standard deviation relative to real GDP, United States

Variable	Data	Real shocks	Nominal shocks	All shocks
Consumption	0.850	0.397	0.264	0.450
Investment	2.272	2.889	2.819	2.816
Hours worked	0.870	0.704	1.511	1.082
Real wages	0.460	0.527	0.690	0.747
GDP deflator	0.622	0.314	1.127	0.590
Gold				
Real cash balances				

(b) Standard deviation relative to real GDP, Rest of the World

Variable	Data	Real shocks	Nominal shocks	All shocks
Consumption	0.894	0.468	0.480	0.375
Investment	2.846	2.987	3.546	3.240
Hours worked	0.736	0.672	1.454	1.161
Real wages	0.277	0.631	0.629	0.526
GDP deflator	1.081	0.542	0.838	0.385
Gold				
Real cash balances				

Table 8: Standard deviation of 'Variable' relative to GDP: 1929-1938, the United States (a), the Rest of the World (b). Comparison between the data, the model with real shocks only, the model with nominal shocks only and the model with all shocks confounded.

the Great Depression, especially up to 1930, but have little to say about its long duration. Moreover, the model with monetary shocks account qualitatively well for the behaviour of the price indices. None of the models considered here fully account for the onset and, in particular, for the long duration of the Great Depression. As already pointed out by Cole and Ohanian (1999), Cole and Ohanian (2004) and Prescott (1999), this suggests that we need some additional shock or a stronger propagation mechanism to account for the protracted character of the Depression.

For what concerns the Rest of the World, monetary shocks linked to the Gold Standard significantly contribute to explaining the onset of the Great Depression, and also have some significant impact on its long duration. Moreover, the model with monetary shocks accounts qualitatively well for the behaviour of the GDP deflator.

While our model suggests that the Gold Standard was a powerful trans-

% of the cumulative drop in the data explained by the model

(a) United States

Variable	**Real shocks**		**Nominal shocks**		**All shocks**	
	1932	1936	1932	1936	1932	1936
GDP	58	35	8	-4	63	32
Consumption	31	33	9	9	38	41
Investment	58	24	-3	-4	54	21
Hours worked	41	4	3	-14	43	-9
CPI	-28	-40	87	57	52	14

(b) Rest of the World

Variable	**Real shocks**		**Nominal shocks**		**All shocks**	
	1932	1936	1932	1936	1932	1936
GDP	78	74	63	62	125	125
Consumption	62	61	99	7	143	61
Investment	74	82	86	1	140	80
Hours worked	52	39	73	79	112	116
GDP deflator	-58	-63	82	144	84	81

Table 9: A quantitative assessment: the United States (a), the Rest of the World (b).

mission mechanism of the Depression from the epicentre of the crisis, the United States, to the Rest of the World, thus giving credit to the analysis by Romer (1993) and Temin (1993), its parsimonious nature implies an imperfect data mimicking ability. In particular, the model witnesses excess volatility of gold and real cash balances, especially in the Rest of World. This is not surprising, given the absence of capital adjustment costs, or gold shipping costs. Somewhat more surprisingly, the model significantly and consistently underestimates real wages for the United States, implying that additional frictions on the labour market would be needed to improve the quantitative matching with the data. Furthermore, the model does not account well for the behaviour of the trade balance. These drawbacks of the model are not entirely unexpected, given that we have refrained from gearing the model towards full data mimicking, which could have been done by adding enough shocks and frictions in reduced form, in the spirit of Smets and Wouters (2003). Our aim here was more limited: we wanted to evaluate whether the Gold Standard story holds good qualitatively in a DGE model, and is not negligible quantitatively. Results do comfort our feeling that a simple model strongly disciplined by the data and with a minimum number of free parameters already provides interesting answers to those questions.

4.5 Counterfactual: back to gold

We have shown so far that monetary shocks linked to the Gold Standard have (slightly) worsened the Depression and favoured its transmission from the United States to the Rest of the World. Accordingly, one would expect that absent of the Gold Standard, the situation would have been much rosier. To test this hypothesis, we proceed the other way round. We run a counterfactual with the full set of real shocks for the whole decade, but with monetary shocks limited to 1930-1932. In other words, we study what would have happened to our model economy, had the World resorted the 1929 Gold Standard already in 1933. This allows us to test two competing stories, the one by Eichengreen (1992), who maintains that exiting the Gold Standard was the way out of the Depression, and a possible alternative story, according to which successive waves of competitive devaluations were essentially beggar-thy-neighbour policies that disrupted global stability.

In Table 10 - panel (a), we compare the percentage of the cumulative drop in the US data explained by the model in the benchmark simulations with all the shocks, with the percentage of the cumulative drop in US data explained in our counterfactual exercise. If the counterfactual explains more (less) of the actual drop, it means that returning to the 1929 Gold Standard would have worsened (improved) the Depression. Table 10 - panel (b) does the same for the Rest of the World.

Results from our counterfactual show that in the model economy, a return to the 1929 Gold Standard with no monetary shock after 1932 would have had expansionary effects with respect to the benchmark (i.e. with respect to the actual monetary shocks). The effects are minor for the United States, but are strong for the Rest of the World. In Table 11, we do the same exercise, but without shutting down the money multiplier shocks after 1932. This means assuming that banking shocks were present all over the decade, somewhat independently of the monetary regime, which is unlikely. Be that as it may, results do not change appreciably with respect to our first counterfactual. The only exception is the price level, that is now better explained than in the benchmark simulations.

This counterfactual analysis suggests that exiting the Gold Standard in

% of the cumulative drop in the data explained by the model

(a) United States		
Variable	Benchmark	Counterfactual
GDP	32	35
Consumption	41	35
Investment	21	21
Hours worked	-9	-1
CPI	14	2
(b) Rest of the World		
Variable	Benchmark	Counterfactual
GDP	125	68
Consumption	61	63
Investment	80	67
Hours worked	116	15
CPI	81	-59

Table 10: Back-to-gold counterfactual: 1936, the United States (a), the Rest of the World (b).

the way the policy was actually implemented in the 1930s, far from being a key recovery factor from the Depression, actually worsened it. Particularly so for the Rest of the World.

5 Conclusions

In this paper, we have built a dynamic general equilibrium model to assess whether the Gold Standard was the main contributing factor explaining the Great Depression of the 1930s, as claimed most notably by Eichengreen (1992).

Broadly speaking, our results suggest that encompassing the international and monetary dimensions of the Great Depression is important to understand what happened in the 1930s, especially outside the United States.

We have shown that monetary shocks linked to the Gold Standard matters to account for the onset of the Great Depression in both the United States and the Rest of the World, particularly for the latter. However, they have little to say about the long duration of the Great Depression in the

% of the cumulative drop in the data explained by the model

(a) United States		
Variable	Benchmark	Counterfactual
GDP	32	36
Consumption	41	39
Investment	22	20
Hours worked	-9	-3
CPI	11	44

(b) Rest of the World		
Variable	Benchmark	Counterfactual
GDP	125	75
Consumption	61	69
Investment	80	63
Hours worked	116	15
CPI	81	-17

Table 11: Back-to-gold plus banking shocks counterfactual: 1936, the United States (a), the Rest of the World (b).

United States, whereas they did contribute to output stagnation in the Rest of the World.

Contrary to what is often maintained in the literature, our results suggest that the vague of successive nominal exchange rate devaluations coupled with the monetary policy implemented in the United States did not act as a relief. On the contrary, they made the Depression worse.

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6 Appendix

6.1 Other counterfactuals

We run a third counterfactual with only shocks to the TFP in the United States. The counterfactual hypothesis is that the Great Depression was a real phenomenon, originated in the United States. This allows us to test of the Gold Standard as a mere transmission mechanism. Results are shown in Table 12.

% of the cumulative drop in the data explained by the model

(a) United States		
Variable	1932	1936
GDP	57	34
Consumption	28	30
Investment	58	23
Hours worked	39	2
CPI	-30	-44
(b) Rest of the World		
Variable	1932	1936
GDP	-5	-3
Consumption	8	9
Investment	-4	1
Hours worked	-6	-4
CPI	-12	-11

Table 12: US TFP shock counterfactual: the United States (a), the Rest of the World (b).

Overall, our analysis suggests that the monetary shocks linked to the Gold Standard plus other real shocks in the Rest of the World are important to account for the data in the Rest of the World. Withouth them, there is some transmission of the shock from the United States to the Rest of the World, and some minor feedback on the United States, but the effects are minor. Results also confirm the importance of TFP shocks in the United States, with numbers that are not far from Cole and Ohanian (1999).

We run a fourth counterfactual with only shocks to tariffs in both the United States and the Rest of the World. Here, the counterfactual hypothesis is that the Great Depression was due to the disruption of global trade induced by a wave of protectionism. The exercise allows us to assess the role of tariffs independently on other shocks, and to test again the Gold Standard as a mere transmission mechanism. Results are shown in Table 13.

% of the cumulative drop in the data explained by the model

(a) United States		
Variable	1932	1936
GDP	2	2
Consumption	3	3
Investment	1	1
Hours worked	3	2
CPI	7	12
(b) Rest of the World		
Variable	1932	1936
GDP	4	1
Consumption	6	7
Investment	-1	-10
Hours worked	4	1
CPI	-6	-12

Table 13: Tariffs shock counterfactual: the United States

Overall, our analysis shows that tariffs did have some effect, especially in the Rest of the World. But again, those effects are small, suggesting that eventually other shocks, like TFP and the monetary shocks linked to the Gold Standard must have been the major cause behind the onset and the long duration of the Great Depression.