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Title: “International transmission of shocks under the classical Gold Standard (1880-1914): The role of Depositor Confidence as a source of amplification”

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International transmission of shocks under the classical Gold Standard (1880-1914): The role of Depositor Confidence as a source of amplification

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Abstract

The role of depositor confidence as a source of amplification and propagation of International Gold shocks is explored in this paper, focusing principally on the panics of 1893 and 1907. By obtaining dynamic responses for different points in time during the classical Gold Standard (1880-1914), in particular making the difference between 'calm' and 'panic' episodes, it is possible to characterize changes in the dynamic impact of these shocks, and this task is performed through an estimated Time-Varying FAVAR model. Besides, changes over time in volatilities of main factors are also analyzed in order to capture the dynamic changes in the information set of economic agents. Overall, the main lesson is that even in the classical Gold Standard era there were regime changes based on the flow of information, and this is useful to explain changes in the transmission mechanism of International Gold shocks.

I. Introduction

What is depositor confidence? Let's recall to the typical story of a Bank Run: If an agent believes that his savings or deposits are safe inside a financial institution, such as a bank, then he is not willing to withdraw them in the short run. However, every period this agent receives feedback of new information about the reputation or financial situation of this financial institution, either by newspapers or simply by rumors that are expanded along the market. For the sake of concreteness, if this information is favorable, he will keep his deposits in the same financial institution, otherwise he will withdraw them without being doubtful. Now imagine that many depositors imitate him, forthwith the financial institution will experience an enormous demand of deposit withdrawals that most likely will lead it to the bankruptcy. This is not the end of the story, in particular if we consider the network effects that this event generates. That is, the fact that there is a failing financial institution generates a flow of information to the rest of depositors that will de-stabilize the whole system. This chain-reaction effect is typically described as a bank panic which goes besides the bank run¹. Under normal conditions we think on the Central Bank that acts as a Lender of Last Resort during this type of episodes. However, given the absence of this type of institution during the national banking era in the United States (late nineteenth century), it is likely that this activity was performed, if any, by the Treasury with some difficulties².

There is a vast literature that documents that the National Banking Era in the United States was governed by various episodes of bank panics, especially under the period of the

¹ A departing point for a theoretical approach was described in first place by Diamond and Dybvig (1983).

² Even though the relevance of the creation of the Federal Reserve and the main causes that triggered it is also an interesting theme, it is beyond the scope of this paper and therefore it is not covered.

Classical Gold Standard (1880-1914)³, despite it is considered as an epoch of remarkable international monetary stability. Bordo (1981) describes that the Classical Gold Standard as the commitment of many countries to fix the prices of their currencies in terms of a specified amount of Gold. In practical an pedestrian terms it's a fixed exchange regime, which implies strong international interdependence across countries (i.e. domestic economies can be hit at anytime by external nominal shocks, especially through interest rates). In words of Eichengreen (1997), it was considered the as "*Gold Standard myth*". As a matter of fact, he states that "... *The gold standard did not prevent the international transmission of financial crises, nor did it preclude suspensions of convertibility. Discretionary actions by national authorities featured prominently in the gold standard's operation in both normal periods and times of crisis (pp.2)*". Therefore, major panic episodes within classical Gold Standard era are covered in this paper.

Which were the sources of Bank Panics during this period? It is often argued that besides the traditional monetary channel, based principally of shocks in the supply of Gold (that could come from abroad), there was a main event that characterizes each of these panics, the change in depositor and/or investor confidence (Wicker, 2000). As a result of this new state, the economy became more vulnerable to external shocks. The question that rises immediately is: can we measure the depositor confidence from the data we have available? Let's imagine that somehow the answer is yes, therefore we can extract this information and represent it through a reduced set of indicators. Then, it is likely that these set of indicators exhibit high volatility for some portion of the sample and low volatility or tranquility for some other portion. In particular, I'm going to explore whether these volatilities are relatively higher during bank panic episodes compared to a calm one. That

³ The most detailed description of these episodes are offered by Sprague (1910), Friedman and Schwartz (1963), Wicker (2000) among others.

raises the second question: If we claim that volatility changes across regimes, can we capture these dynamics from the data? If the answer is yes again, then we are done, in the sense that we are able to fully characterize both episodes of instability and tranquility. More interestingly, through this framework we can describe the transition between states, as it seems natural to think on panic episodes derived from the evolution of market expectations over time; i.e. the so-called depositor confidence.

Let's now think on the aggregate economy. On the basis of time varying market expectations, does the impact of international monetary shocks to the American economy changed over time conditional on the current state of depositor confidence? We could think on panic episodes as a source of amplification and propagation of this particular type of shocks to the economy, compared to the tranquility episode. Or even more, we can think on financial vulnerability as a source of amplification.

Recently Tallman and Moen (1998, 2008) characterized the transmission of unanticipated shocks the Gold stock to the American Economy, and their main finding is the so-called liquidity effect.⁴ In order to answer the questions described above, I take the latter approach and extend it in a twofold way. In first place, I take the Factor Augmenting VAR (henceforth FAVAR) approach from Bernanke, et al (2005). These authors argue that traditional VARs use a limited set of information and this restrict the analysis and main conclusions (or even more, this could generate a potential "*omitted variables bias*" and lead to the so-called puzzles). As a result, this approach allows us to exploit a large set of information and as a matter of fact, to analyze the response of all these variables after an identified shock, such as the gold ones (in this context it is interesting to explore the

⁴ The most plausible example that they provide to understand these unanticipated shocks is "*policy shocks from a foreign central bank*". Without loss of generality, we can think on actions taken by the Bank of England. Notice that we're disentangling predictable shocks from the unexpected ones.

response of stock prices, such as Railroads, as well as relevant commodity prices, such as wheat or corn, currency held by the public and even clearing operations). The second extension is to allow parameters to vary over time taking as a benchmark the approach of Primiceri (2005). Given that we have panic events within the sample of analysis, it is likely that we have structural breaks and instability periods⁵. Therefore, it sounds plausible to allow parameters related with the dynamics as well as variance ones to vary over time. Furthermore, Korobilis (2009) extends the approach of Primiceri (2005) to the FAVAR context. In this paper I closely follow both approaches in order to perform this task.

Regarding the FAVAR approach, I will extract a reduced set of factors from the data⁶. As non observable variables, we interpret these factors as representing changes in the information set of private agents; i.e. short run fluctuations in financial markets, which could also be associated with depositor confidence, as well as changes in long run trends. These factors will be extracted from a large set of data through the Principal Components analysis, and this is why the Factor augmenting approach is useful. Moreover, the exploration of the time-varying variances will exhibit relevant information, such as when did the expectation instability (or lack of credibility) started and how did it evolved during a panic episode.

Regarding the time-varying approach, I will explore the response of a set of relevant variables after Gold shocks in a similar but extended version of Tallman and Moen (1998, 2008). However, I will compare two scenarios. That is, do the responses of macroeconomic variables after Gold Shocks depend on whether the shocks were realized either in a panic or a tranquility episode? Are the differences significant? Fortunately, this

⁵ Tallman and Moen (1998, 2008) include bank panic dummy variables and argue that the differences between these two types of states are not very significant.

⁶ This approach is described in Section 4.

time-varying approach allows us to perform this task and to derive relevant conclusions regarding the importance of being in a particular state of the economy before examining the impact of shocks. This paper covers the period of the classical Gold Standard (1880-1914) and therefore focuses its attention into the panics of 1893 and 1907⁷. Furthermore, each of these episodes had a different impact on the aggregate economy and on particular economic sectors. Therefore, I will explore the transmission of these shocks to different macroeconomic variables conditional on being in a 'panic' or a 'calm' state of depositor confidence. The results are that under normal conditions the transmission mechanism of Gold shocks works perfectly, showing a liquidity effect together with the short run real effects on economic activity and as a consequence on output . Whereas, under financial instability the timing of this mechanism is altered, showing an even higher response of interest rates and stronger real effects on aggregate economy in the long run. The main explanation of this result is the credibility of the Gold Standard. That is, credibility of the monetary system generates room for real effects in the short run, but at the same time the effect in the long run is not as hard as if we were under episodes of financial stress. Moreover, financial stress acts as a source of amplification and propagation of gold shocks in the financial system, affecting currency held by the public and the dynamics of clearing operations. Besides, lost of confidence is observed through changes in volatilities of main factors, which coincide with dates of bank panics. The main lesson is that even in the classical Gold Standard era there were regime changes based on the flow of information from the depositor side, and this helps us to explain changes in the transmission mechanism of gold shocks.

⁷ Wicker (2000), among others, mention the panics of 1884 and 1890. He concludes that these two episodes were different because necessary measurements were taken in order to not alter depositor confidence, and indeed this was the case.

The document is organized as follows: Section 2 covers the literature review and states the research question. Sections 3 through 5 cover the empirical methodology, estimation and data sources, respectively. Section 6 describes the main findings and section 7 concludes.

II. Literature Review and Research Question

Gold standard as a monetary regime

Bordo (1981) describes the Classical Gold Standard as a commitment of many countries to fix the prices of their currencies in terms of a specified amount of Gold. Besides, he stresses the main properties of this commodity in order to justify its selection among others (in terms of durability, easy to recognize, etc.). In the context of open economies, and in practical and pedestrian terms, it was akin to a fix exchange rate regime. Therefore, the main objective of this framework was to ensure price stability among participant countries, and this was achieved through the *price-specie-flow* mechanism⁸. Thus, under normal conditions this was the mechanism that governed the Classical Gold Standard, ensuring price stability of each of the participants. Bordo (1984) also calls this adjustment process as the arbitrage in the Gold Market, but at the end of the day Gold stock fluctuations were predictable. In addition, Bordo (1981) argues that maintaining this regime in strict terms was very costly for all countries. Let's try to make the parallel with a Moral Hazard situation. Imagine a country which is experiencing a deficit in balance of payments and had the obligation, according to the 'rules of the game', to allow for Gold outflows in order to restore the purchasing power parity. Clearly this is in detriment of its domestic interest regarding economic activity. Therefore, it seems natural to think that every country had incentives to not follow the rules of the game to the letter, and thus we can think on an

⁸ See Bordo (1981) and Bordo and Schwartz (1999) for details.

additional room for Gold supply shocks very apart from the systematic description given above⁹.

The other aspect that should not be neglected is the role of the capital flows in this international adjustment process. Bordo (1984) mentions correctly that the movements in money supply generate interest rate fluctuations that may turn domestic capitals even more or less attractive, depending on whether the domestic interest rate is higher or lower, respectively. This additional demand is another source of fluctuations in Gold supply.

Furthermore, Friedman and Schwartz (1963) stress the influence of external shocks in the stock of money, and therefore the vulnerability of the domestic markets, especially if the relative influence of the country is low¹⁰: *“Under a gold standard with fixed exchange rates, on the other hand, the stock of money is ultimately a dependent factor controlled primarily by external influences—at least for a country which is an economically minor part of the gold-standard world (pp.89).”*

On the other hand, Eichengreen (2008) highlights the importance of international solidarity under the classical Gold Standard. That is, due to the fact that movements in discount rates produce opposite effects across countries, the necessity of policy coordination matters. As a result, it could be the case that at some point in time one country is experiencing a trade deficit and hence needs to attract gold in detriment of its neighbors. According to the described solidarity, at some other point in time the favor should be paid.

Panic of 1893

⁹ As a matter of fact, this clearly opens the room for a relevant role of the Central Bank in each country. Bordo argues that under normal conditions it could be the case that the Gold Standard works perfectly, even with the lack of a Central Bank.

¹⁰ These authors point out that this was the case at the time of the resumption.

Sprague (1910) provides a very detailed version and sequence of events that occurred during the panics in National Banking Era. He focuses his attention on events that occurred in New York and dedicates special attention to the panics of 1893 and 1907; in particular the author stresses the prominent role of depositor confidence. In the same line, Wicker (2000) refers to the panics of 1893 and 1907, especially the former one, as the most important during the classical Gold Standard¹¹. Besides, he refers to the panics of 1884 and 1890 as minor ones, in the sense that depositor confidence was not significantly altered, or at least it was rapidly restored and also because succeeded measures were undertaken in order to prevent the propagation of a bank panic. Regarding the panic of 1893, he describes it as an episode of *“widespread distrust of the banks in the interior (pp.81)”*. Tons of details, dates of banking suspensions and/or resumptions and sequence of events are offered with the aim to describe the panic at a state level, which also filled the gap left by Sprague (1910), as the author claims. His main aim was to reinforce the argument that the panic was not initiated in New York, and in fact, stress the fact that this episode was akin to the Great Depression, in the sense that events in the periphery were largely neglected by the central money market (in this case, New York). Another important detail is the asymmetry of information across banks. This is observed through the fact that actually most of the banks were solvent at the time of the suspension, and that is why they resumed their activities very quickly (on average after three months).

Carlson (2005) studies the causes of bank suspension in the panic of 1893, examining the *“importance of liquidity, real economic shocks and depositors’ actions in triggering a panic”*. The author performs the analysis the national, state and local levels. His main conclusion is that real shocks play a relevant role in determining a panic episode. In

¹¹ This author also describes the panic of 1873. However, since this paper is focused on the period after the resumption, I do not cover this panic episode.

addition, he finds that both liquidity and solvency concerns are important in generating panics (i.e. in a similar fashion of the fall in depositor confidence), but their observation depends crucially on data aggregation levels. He left the window open for further research regarding the role networks in spreading panics over the financial system (contagion).

Dupont (2007) argues that asymmetries of information across banks were a source of propagation of bank runs during the panic of 1893, despite the “information bank-rich environment”. He claims that contagion should not occur if bank-specific information is provided to the depositors. Besides, he claims that contagious runs in 1893 occurred even though bank-specific information was regularly provided to the public, meaning that this was a necessary but not sufficient condition. He performs the analysis for Kansas through Probit regressions¹² in order to reach this conclusion. On the other hand, he stresses the role of bank types (i.e. national and private). In order to understand this argument, we need to recall that the frequency of information dissemination was different across bank types. Therefore, we can conclude that depositor confidence was bank-type dependent.

Ramírez (2009) examines the effect of bank disintermediation in 1893 on long run economic growth. He focuses his argument on the causality of financial intermediation to growth, i.e. the long-lasting effects of the panic. One of the most important pillars of financial disintermediation is the reduction in public confidence, and he claims that there was minimum government intervention to restore it. As a result, among different features, the latter one was the most important in order to choose it for the study. Regarding the consequences, he performs convergence regressions across states, including a banking instability indicator¹³ that he founds negatively significant.

¹² See Dupont (2007) for details.

¹³ See Ramírez (2009) for details. The idea is that it represents a proxy for depositor confidence.

Panic of 1907

Tallman and Moen (1990, 1992) present some lessons that can be derived from the panic of 1907, stressing the importance of trust companies (particularly in New York) acting as financial intermediaries. They find evidence of concentration of riskier assets in less regulated entities, such as these trust companies. As a consequence, this lack of diversification and uneven regulation were enough ingredients to unleash a bank run. Once there was a confidence reduction in Trust companies, this gave free rein to a bank panic. The sequence of events that they describe is as follows. In first place, there was a stimulus to the imports of gold in the US in the spring of 1906 through financial bills. The Bank of England responded by increasing its interest rate, protecting its domestic financial market. Financial bills in the US were suspended in 1907, and despite the relatively high interest rates, the US exported large amounts of Gold to London. Henceforth, the lack of liquidity increased the vulnerability of the financial system to any shock. Unfortunately, this shock actually occurred when Heintze's Copper Company failed in October. This shock, together with the described lack of liquidity and uneven regulation prompted the bank panic. As a matter of fact, the authors argue that this would have occurred even with the access of a lender of last resort, because "companies would have had the incentives to maintain portfolios with profitable but risky assets".

A more detailed description of the panic of 1907 can be found on Wicker (2000) and Bruner (2007). In particular, the former devotes most of the time in describing the events step by step, together with data and concrete facts; whereas, the latter presents a very pleasant narrative that helps one to place into the described context very quickly.

Structural Vector Auto-regressions and the classical Gold Standard

Calomiris & Hubbard (1987, 1998) had as their main objective to identify the importance of domestic and external shocks in the US economy, and especially determine the degree of

interrelation between UK and US economies during the classical Gold Standard episode. The identification of this relationship was useful for characterizing the process of adjustment and they advocate for a relevant importance of close linkages across these two economies in the process of adjustment ('internationalist' view). This conclusion is achieved after exploring the contribution in the response of different macroeconomic variables of domestic and external shocks, in the short and long run. In particular, they claim that interest rates were determined in the international markets, and in particular they describe the role of a well developed forward and future market.

In a document with a similar approach, Calomiris & Hubbard (1989) estimate a model for the period 1894-1909, with the main aim of explaining the real output dynamics and their link with financial markets. That is, they claim that the vision of price rigidities as the main source that leads real output to fluctuate is incorrect, and in fact he presents empirical evidence supporting rapid price adjustment after nominal shocks. On the other hand, they advocate for an active role of credit availability shocks as the ones that contributed to real output and financial variables fluctuations. Moreover, their mechanism is referred to normal times, and they mention that 'panic' episodes should be studied as "*extreme examples (pp.446)*". This raises the question of whether these dynamic effects are amplified or dampened under extreme conditions.

Canova (1992) explores the changes in the dynamic effects and transmission of demand and supply currency shocks due to the creation of the Federal Reserve. He estimates the model for two subsamples (1891:7-1913:7 and 1924:1-1937:1), comparing the impulse responses for both cases. Regarding the pre-World War I period, he describes different major and minor crisis episodes, where the most important were the ones of 1893 and 1907. In particular, he argues that external shocks to the money supply "*were indeed significant in those years (pp.706)*". Besides, he states that "*only in 1901 did the collapse of the stock market seem to be generated entirely by internal conditions in the U.S*

(pp.706).”, stressing in this way the relevant role of external shocks to gold flows for different points in time in the pre WWI epoch, and enlightening the idea that financial crisis in the U.S. occurred due to the interaction between international shocks and seasonal movements in the financial markets. The latter was caused by the strong link between financial market fluctuations and crop movements across seasons for relevant commodities (Tallman and Moen, 1990). A more detailed characterization of the co-movements between American and British economies can be found in Cha (2003).

Jeanne (1995) identifies the transmission mechanism of external monetary disturbances (which take the form of gold outflows) for the period 1893-1914, but for the British economy. His main finding is the positive reaction of interest rates after unanticipated gold outflows, which is akin to the so-called liquidity effect. In fact, he stresses the active role of market expectations for reinforcing this mechanism. Besides, the fact that interest rates could react more during an international crisis episode is captured using dummy variables for the case of 1907, but overall the author left the window open for additional research regarding the role of market expectations in this mechanism.

Tallman and Moen (1998, 2008) characterize the transmission mechanism of Gold shocks during the classical Gold Standard. They conclude that Gold shocks generate large and persistent effects on the real economy and on prices and interest rates (the so-called liquidity effect). To be concrete, they interpret unanticipated positive International Gold shocks work in a similar way of expansionary monetary policy shocks. Besides, given the Gold standard context, it sounds natural to understand them as shocks that can be derived from external circumstances, such as actions from foreign Central Banks.

Vector Auto-regressions, time-varying parameters and Factor-Augmented Models

The structural Vector Auto-regressions approach (henceforth VAR) to model the transmission of shocks in macroeconomic variables has been widely disseminated in the last two decades. In particular, this method has been used to identify monetary policy shocks. Articles such as Bernanke and Blinder (1992), Blanchard and Quah (1989), Sims (1992), Leeper, Sims and Zha (1996), Bernanke and Mihov (1998), Galí (1999), Christiano, et al (2000), among others in the literature are useful to illustrate how to identify monetary policy shocks¹⁴.

Furthermore, recent developments in this methodology, such as the one described by Bernanke, et al (2005) allow us to include additional information in this type of system of equations. The factor-augmented structural VAR model (henceforth FAVAR) facilitates the possibility to exploit a large set of additional information besides the series included in the model. Moreover, it is realistic to consider that agents actually observe and use more information than the reduced set of time series included in the VAR model. In short, the methodology extracts the relevant information from a large set of variables¹⁵, summarizes it into a reduced set of 'non-observable' variables, and uses them to augment the standard VAR model. The key feature of this approach is that it permits the observation of the response of many more variables after the occurrence of an identified structural shock, as if they were all included in the VAR system. A recent application to this procedure to the context of the American Great Depression of 1929 is performed by Ahmadi and Ritschl (2009). Nevertheless, they use sign restrictions¹⁶ in order to identify monetary policy shocks, which is beyond the scope of this paper. Furthermore, for more details regarding

¹⁴ Nevertheless, in this paper we are willing to identify external disturbances rather than domestic monetary policy shocks.

¹⁵ Bernanke et al (2005) use more than 100 variables in their exercise. See the reference for details.

¹⁶ A recent approach introduced in the VAR literature. As a main reference these authors quote Ahmadi and Uhlig (2008).

this literature, a self-contained survey regarding factor models was recently written by Stock and Watson (2010), where a particular section is dedicated to FAVAR models.

Recently VAR models have also been extended to allow parameters vary over time, henceforth TVP approach (Primiceri, 2005). This feature is crucial for avoiding problems such as structural breaks in the time series, as well as changes in the covariance matrix of identified disturbances. The paper develops a Markov-Chain Monte Carlo method to perform this task. One interesting aspect of this approach is its flexibility, because it permits us to explore the responses of variables conditional on whether a shock was realized in one particular epoch or in another. In this paper, we compare episodes of 'calm' against 'panic' ones and explore the differences in the dynamics. Even more recently, Korobilis (2009) has taken Primiceri's approach to the context of FAVARs, exploiting both features of data-rich environment and changes in the dynamics over time. That is, he implements the TVP-FAVAR approach in order to analyze changes in the monetary transmission mechanism over time.

What is missing?

To conclude, given the current state of the literature, and given the tools that now we have available, the range of directions to be taken is wide enough, and in this paper I will take a particular one. The aim of this paper is to explore the transmission mechanism of International Gold shocks to the classical Gold-Standard-American-Economy and how it differs conditional on being in an episode of 'calm' compared to an episode of 'panic'. This is achieved using the TVP approach of Primiceri (2005). Besides, I want to explore a large set of data in order to extract relevant information using the FAVAR approach of Bernake et al (2005). In particular, it might be the case that using all this information we are allowed to extract non observable indicators that can summarize depositor confidence, because they are based principally on financial market variables, as well as much more information

available. The motivation to do that is that, as many authors have mentioned it, panics were strongly related with changes in this confidence, especially in its volatility¹⁷. Thus, the best way to perform this task is to follow Korobilis (2009). The departing point or benchmark specification will be the Tallman and Moen (1998, 2008) model and I will merge it with the Korobilis' approach. That is, the new model will nest this benchmark specification. Once I have estimated this model, I will be able to answer questions such as:

- How larger were the differences in reaction function of core variables conditional on being in a 'panic' episode? In particular, how different is the liquidity effect conditional on being in a more vulnerable state of the economy?
- If we compare the reaction functions and evolution of volatility previous and after the Sherman Silver Purchase Act establishment in 1890, do we observe a significant role of the Silver in increasing vulnerability and confidence debilitation? Can we do the same for the case of the panic of 1907 and therefore stress the role of trust companies?
- Can we observe the role of flow of information in the evolution of the volatility of factors as a proxy of changes in depositor confidence? In other words, when do we observe that the confidence volatility starts to fluctuate very much? How many periods before the panic episode?

III. Empirical methodology

The Model

In this section I closely follow the specification and notation from Bernanke, et al (2005), Primiceri (2005) and Korobilis (2009)¹⁸. The time varying structural factor augmented VAR

¹⁷ As a matter of fact, an interesting chart will be the evolution of the volatility of these filtered indicators. See Figure 7.

¹⁸ I acknowledge the availability of MATLAB codes by Gary Koop and Dimitris Korobilis through their website section "MATLAB Code for Bayesian Inference in VARs, TVP-VARs and TVP-FAVARs."

with stochastic volatility model is a particular case of a State-space model. The specification is as follows:

Factor observation equation:

$$\begin{bmatrix} X_t \\ g_t \end{bmatrix} = L_t \begin{bmatrix} F_t \\ g_t \end{bmatrix} + e_t$$

VAR (state) equation:

$$\begin{bmatrix} F_t \\ g_t \end{bmatrix} = B_t \begin{bmatrix} F_{t-1} \\ g_{t-1} \end{bmatrix} + u_t$$

Where X_t is $(N \times 1)$, Y_t is $(M \times 1)$, F_t is $(K \times 1)$, g_t is gold holdings and $t = 1, \dots, T$. The distribution for the error terms are:

$$e_t \sim N(0, H_t); u_t \sim N(0, \Omega_t)$$

The elements of the vector F_t are not directly observable and therefore are extracted from the data. Notice also that the number of factors extracted is relatively low compared to the number of original observed series included in the model. In other words, $K \ll N$. In our particular case we have $(M = 1)$ because we only include gold stocks as directly observable, and every other type of information is going to be summarized by the vector F_t .

The matrix of loadings can be disentangled as follows: $L_t = \begin{bmatrix} \lambda_t^f & \lambda_t^g \\ 0 & 1 \end{bmatrix}$. Besides, the full

vector of observed series as $x_t' = [X_t', g_t']$ and the full vector of series that enter into the

VAR as $y_t' = [F_t', g_t']$. Henceforth, the system can be re-expressed as follows:

http://personal.strath.ac.uk/gary.koop/bayes_matlab_code_by_koop_and_korobilis.html

In particular I have used a modified version of the file **TVP_FAVAR_FULL.m**.

$$X_t = \lambda_t^f F_t + \lambda_t^g g_t + e_t$$

$$y_t = b_{1,t} y_{t-1} + \dots + b_{p,t} y_{t-p} + u_t$$

Where we have disentangled the vector $B_t = (b'_{1,t}, \dots, b'_{p,t})$. Denote $P = K + M$. Then the covariance matrix is Ω_t is $(P \times P)$ for each period $t = 1, 2, \dots, T$. Moreover, we assume that the covariance matrix of the observation equation H_t is diagonal, such that:

$$H_t = \text{diag}(\exp(h_{1,t}), \dots, \exp(h_{n,t}), 0)$$

Besides, the error terms are i.i.d, which implies that $E(e_{i,t} F_t) = 0$, $E(e_{i,t} e_{j,s}) = 0$ for all $i, j = 1, \dots, n$ and $t, s = 1, \dots, T$, $i \neq j$ and $t \neq s$. This assumption permits the estimation of the factor observation block equation by equation:

$$X_{i,t} = \lambda_{i,t}^f F_t + \lambda_{i,t}^g g_t + e_{i,t}$$

Where

$$e_{i,t} \sim N(0, \exp(h_{i,t}))$$

On the other hand, the reduced form of the state equation (VAR) can be estimated by Ordinary Least Squares, which is widely used in the literature¹⁹. Then, the matrix of contemporaneous relationships A_t is assumed to be lower-triangular with ones in the diagonal. This assumption allows us to recover it using the Cholesky Factorization²⁰. That is, the mapping between reduced-form and structural shocks is $u_t = A_t^{-1} \Sigma_t \varepsilon_t$, with the structural shocks distributed as $\varepsilon_t \sim N(0, I_p)$. As a result of taking variances to both sides:

$$A_t \Omega_t A_t' = \Sigma_t \Sigma_t' \Leftrightarrow \Omega_t = A_t^{-1} \Sigma_t \Sigma_t' (A_t^{-1})'$$

Where

¹⁹ See Hamilton (1994).

²⁰ Here I take the same Identification process of Tallman and Moen (1998, 2008), in order to recover Gold shocks and nest their approach through this more general specification.

$$A_t = \begin{bmatrix} 1 & 0 & \dots & 0 \\ a_{2,t} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ a_{(K+1)1,t} & \dots & a_{(K+1)K,t} & 1 \end{bmatrix}$$

As a result from the Cholesky Factorization the structural shocks are orthogonal. Henceforth, the specified matrix of standard deviations is diagonal,

$$\Sigma_t = \text{diag}(\sigma_{1,t}, \dots, \sigma_{k+1,t})$$

Furthermore, we assume that each set of parameters follows a Random-Walk process:

$$\lambda_{i,t} = \lambda_{i,t-1} + \eta_t^\lambda$$

$$h_{i,t} = h_{i,t-1} + \eta_t^h$$

$$B_t = B_{t-1} + v_t$$

$$\alpha_t = \alpha_{t-1} + \zeta_t$$

$$\log(\sigma_t) = \log(\sigma_{t-1}) + \eta_t^\sigma$$

The column vector α_t contains the parameters of the matrix A_t . Following Primiceri (2005), we assume that all these innovations are jointly normally distributed with variance taking the following form,

$$V = \text{Var} \left(\begin{bmatrix} \varepsilon_t \\ v_t \\ \zeta_t \\ \eta_t^\sigma \end{bmatrix} \right) = \begin{bmatrix} I_P & 0 & 0 & 0 \\ 0 & Q & 0 & 0 \\ 0 & 0 & S & 0 \\ 0 & 0 & 0 & W \end{bmatrix}$$

The assumption of independence among error terms is justified by Primiceri (2005) in the sense that we interpret each of them as structural innovation, and any correlation will distort the analysis. Overall, this flexible framework allows us to explore changes in both dynamics and volatility departing from the data. Moreover, here I adopt the approach of Bernanke et al (2005), in the sense that I separate slow from fast variables and then

compute the factors for the model discussed above. This approach is described in the next section.

IV. Identification and Estimation

1st stage: Principal components approach

In this model we assume time-varying parameters. However, we estimate the factors by a principal component approach. That is, parameters are estimated in a second stage conditional on observing the factors, following closely Korobilis (2009). The first step is to find the K principal components for the information set matrix X_t ²¹. It is assumed that raw data was standardized in first place, in order to avoid problems related with scale units. I denote these principal components as $\hat{C}(F_t, g_t)$, following the notation provided by Bernanke, et al (2005). In order to find the part that is not spanned by g_t I follow their identification procedure, such that rotational indeterminacy is avoided²². Moreover, given that the VAR is identified via Cholesky, implicitly we're assuming that the factors react to gold shocks with one lag. Nevertheless, we could think of variables in the financial markets that can react contemporaneously to the unanticipated shock. Therefore, I take the approach of "slow vs. fast" classification from the same authors. As a result, fast variables react contemporaneously to unanticipated shocks. The classification codes are included in the Appendix II.

²¹ That is, we need to find the eigenvectors associated with the K largest eigenvalues of the matrix $X_t'X_t$, which we denote as \hat{Z} , following Bernanke et al (2005).

²² That is, I use the normalization assumption $C'C/T = I$, which implies that $\hat{C} = \sqrt{T}\hat{Z}$. For a detailed discussion see Bernanke et al (2005).

The number of factors is selected in first place using the scree plot (see Figure 1)²³. There are also more formal procedures to determine the optimal number of factors in a dynamic factor model, such as the suggested by Bai and Ng (2002)²⁴. On the other hand, Bernanke et al (2005) argue that *“this does not necessarily address the question of how many factors should be included in the VAR (pp.407)”*. In this model, I chose four factors, such that they are capable to explain the 40% of the total variance of the information dataset²⁵. Once we have estimated the underlying factors, the next step is to estimate the time-varying parameters.

2nd stage: Bayesian Estimation

Prior specification

I set the priors for each of the group of parameters as conjugated ones, i.e. given the normality assumption of the error terms, each of the priors are set such that posterior distribution of parameters is normal as well for each of the subgroups of them.

• $B_0 \sim N(\hat{B}, 4V(\hat{B}))$	• $A_0 \sim N(\hat{A}, 4V(\hat{A}))$
• $\log(\sigma_0) \sim N(\log(\hat{\sigma}), I_n)$	• $L_0 \sim N(\hat{L}, 4V(\hat{L}))$
• $h_{i,0} \sim IG(0.01, 0.01); i = 1, \dots, n$	• $Q \sim IW(k_Q^2 \cdot 40 \cdot V(\hat{B}), 40)$
• $W \sim IW(k_W^2 \cdot 4 \cdot I_n, 4)$	• $S_1 \sim IW(k_S^2 \cdot 2 \cdot V(\hat{A}_1), 2)$
• $S_2 \sim IW(k_S^2 \cdot 3 \cdot V(\hat{A}_2), 3)$	

²³ The first paper cited in the literature regarding the scree plot was published by Cattell (1966): “The scree test for the number of factors.” *Multivariate Behavioral Research*, 1, 245-276. I do not include it in the references because this is beyond the scope of this paper.

²⁴Bai, J. and Ng, S. (2002). "Determining the Number of Factors in Approximate Factor Models," *Econometrica*, Econometric Society, vol. 70(1), pages 191-221, January.

²⁵ As a robustness exercise, and as suggested by Bernanke et al (2005), I estimated the model both with 3 and 5 factors and check whether if the results change dramatically or not (see Figures 8 and 9).

In particular, it is worth to mention that the matrix S is block-diagonal and that the prior is calibrated as follows: $k_{\rho} = 0.01$, $k_s = 0.1$, $k_w = 0.01$. Both latter assumptions were made following Primiceri (2005). In particular, this author argues that setting these values for the previous hyper-parameters ensure that “*the priors are not flat, but still diffuse and uninformative (pp. 831)*”.

Given the limitations of data availability, I cannot estimate the model for a sufficiently large training sample (i.e. a considerable number of observations previous to 1882 for all variables would be needed in order to perform this task). Therefore, I calibrate the priors for remaining parameters such that they are diffuse and uninformative as well. That is, for the rest of parameters I set:

$$\hat{B} = 0, V(\hat{B}) = I, \hat{A} = 0, V(\hat{A}) = I, \hat{L} = 0, V(\hat{L}) = I, \hat{\sigma} = 1_{n \times 1}$$

In short, the major information comes from the data, and not from an *ad hoc* and/or arbitrary calibration of the prior.

Gibbs sampling algorithm

The estimation procedure is described in the following steps²⁶²⁷. For each iteration j :

Factor (measurement) equation

²⁶ I have performed 10 000 simulations and eliminated the first 5 000. Since we’re estimating the posterior distribution directly from the algorithm, it seems natural to think that these first draws do not precisely belong to the limiting distribution. Therefore, as Kim and Nelson (1999) among many authors suggest, I eliminate the first portion of draws such that we can ensure that the error bands for the impulse responses belong to the limiting distribution case.

²⁷ A more detailed version of this algorithm can be found in the appendix A of Primiceri (2005), especially the sections A5-A6.

1. Draw factor loadings L_t from the posterior distribution (prior specification plus data information) and conditional on the previous iteration. That is, draw L_t from

$$p(L_{t(j)} | L_{t(j-1)}, R_{t(j-1)}).$$

2. Conditional on L_t derive the error term covariance matrix R_t from

$$p(R_{t(j)} | L_{t(j)}, R_{t(j-1)})$$

VAR (state) equation

Step I – Block (B_t, Q_t)

3. Using the Carter and Kohn algorithm (1994)²⁸, henceforth CK, draw B_t from

$$p(B_{t(j)} | B_{t(j-1)}, Q_{t(j-1)}, \alpha_{t(j-1)}, S_{t(j-1)}, \log(\sigma_{t(j-1)}), W_{t(j-1)}).$$

4. Using the random walk definition of B_t (taking first differences), draw the covariance matrix Q_t from

$$p(Q_{t(j)} | B_{t(j)}, Q_{t(j-1)}, \alpha_{t(j-1)}, S_{t(j-1)}, \log(\sigma_{t(j-1)}), W_{t(j-1)}).$$

Step II – Block (α_t, S_t)

5. Using the CK algorithm again, draw the contemporaneous relationships matrix parameters α_t from

$$p(\alpha_{t(j)} | B_{t(j)}, Q_{t(j)}, \alpha_{t(j-1)}, S_{t(j-1)}, \log(\sigma_{t(j-1)}), W_{t(j-1)}).$$

6. Using the random walk definition of α_t (taking first differences), draw the covariance matrix S_t from

$$p(S_{t(j)} | B_{t(j)}, Q_{t(j-1)}, \alpha_{t(j)}, S_{t(j-1)}, \log(\sigma_{t(j-1)}), W_{t(j-1)}).$$

Step III – Block $(\log(\sigma_t), W_t)$

7. Given that each element of $\log(\sigma_t)$ has a normal distribution, and they are independent each other, we need to draw each element of σ_t from a log-normal

²⁸ In short, this routine performs the Gibbs sampling for state space models, which is implementing both Kalman Filter and Smoothing processes (updating draws by iterating backwards once we have observed the full sample). A nice textbook that surveys this process is offered by Kim and Nelson (1999).

distribution. In other words, we are required to draw each element from a $\chi_{(1)}^2$ distribution. To achieve this task, Primiceri (2005) performs the seven-component mixture approach, following Kim et al (1998)²⁹. In this paper I take this approach as a benchmark. In short, using the CK algorithm draw $\log(\sigma_t)$ from $p(\log(\sigma_{t(j)}) | B_{t(j)}, Q_{t(j-1)}, \alpha_{t(j)}, S_{t(j)}, \log(\sigma_{t(j-1)}), W_{t(j-1)})$.

8. Using the random walk definition of $\log(\sigma_t)$ (taking first differences), draw the covariance matrix W_t from $p(W_{t(j)} | B_{t(j)}, Q_{t(j-1)}, \alpha_{t(j)}, S_{t(j)}, \log(\sigma_{t(j)}), W_{t(j-1)})$.

Impulse response characterization

From the state space form of the model, the dynamic multipliers for the matrix of variables $x_t' = [X_t', g_t']$ are characterized as follows:

$$\frac{\partial x_{t+s}}{\partial \varepsilon_t} = L_t B_t^s A_t^{-1} \Sigma_t; s = 0, 1, \dots$$

In particular, because of the recursive ordering, the last row of this matrix is the set of responses of all variables to gold shocks after s periods. Notice that the responses are time-dependent since the matrices L_t, B_t, A_t and Σ_t are not constant over time. This means that the date of shock occurrence matters for its resulting impact in short and long run. As a consequence, this flexible approach allows us to explore whether if the impact of gold shocks differ conditional on being in a panic or tranquility episode. We will explore it in a more detailed way in section 6.

V. Data sources

²⁹ See Appendix A.7 in p.847 in Primiceri (2005).

I have used the NBER MacroHistory Database³⁰ time series in order to perform this task. This is a wide enough database that contains huge economic information regarding economic activity, prices, interest rates, stock markets and so on. Given its coverage and because it has many variables in monthly frequency, it fits perfectly with the empirical approach proposed for this paper. Besides, the availability of information for the target period of the classical Gold Standard makes it suitable for the proposed exercise³¹.

The sample period covers the interval 1882.01-1913.12 (monthly frequency). In the Appendix I indicate the data transformation used for each of the series included. Despite the limitation of the time horizon for many interesting variables I have included 61 series³² in the information set, such that underlying common factors are captured using all the available information.

VI. Results

Impulse responses after Gold Outflows

In this section I explore the change in the transmission mechanism of Gold shocks. Since we know that these reaction functions are time-dependent, I take dates such that they are known as 'panic' or 'calm' episodes. According to the NBER³³, there was a period of expansion between May 1885 and March 1887. Using this information, together with the fact that this episode does not cover a significant panic episode (according to Sprague (1910) and Wicker (2000) among others), it seems natural to consider this episode as a calm one. Therefore, I take the midpoint of March 1886 for analyzing the impulse

³⁰ This database is publicly available at <http://www.nber.org/macroeconomy/>.

³¹ A previous exercise using this Database and FAVAR models can be found in Ahmadi and Ritschl (2009). They perform the analysis for the Great Depression of 1929.

³² See Appendix II for references regarding data description and transformations.

³³ "Business Cycle Expansions and Contractions": <http://www.nber.org/cycles.html>

responses. On the other hand, I'll compare this result with the ones related with the date of panic of 1893. Since the period of high stress covers from May to August (Wicker, 2000), I take June 1893 as a date of low Depositor confidence or panic. Furthermore, the comparison between these two dates allows us to explore the role of loosing depositor confidence as a source of amplification. In particular, we need to recall the establishment of the Silver Sherman Act in 1890 as a factor that destabilized the credibility in the Gold Standard regime. As Sprague (1910, p.156) argues, "... *the deterioration in the quality of money in the country through the loss of gold was intensified by additional amounts of every other kind of money of which the circulating medium was composed*".

I apply the same logic in order to analyze the panic of 1907. This time I will compare March 1901 against October 1907, the date when panic started. However, this time we attribute the amplification role to the Trust companies, as Tallman and Moen (1990, 1992) argue that they were crucial in generating the panic and the consequent loss of confidence.

Economic activity and prices³⁴ – Gold shocks generate short run effects either under 'calm' or the 'panic' episodes, which is consistent with Tallman and Moen (1998, 2008) (see Figures 2 and 3). However, these effects are on average larger for the panic state (except for the industrial production in 1901), meaning that the cumulative effect in the long run are higher as well under the panic state; this result stresses the increase in the vulnerability of the American Economy to external shocks under this particular state. On the other hand, these differences seem to not be significantly different from zero once we take into account standard errors (following Primiceri, 2005), as Figures 2b and 3b show. In the same line, under a panic episode, following Friedman and Schwartz (1963) who refers in particular to the panic of 1893: "*The panic had important effects on the banking*

³⁴ I have selected U.S. Index of Industrial Activity and U.S. Index of the General Price Level (series m12002a and m04051, respectively). For the Gold stock series, following Tallman and Moen (2008), I have selected the series m14076a.

structure ... and it undoubtedly affected the detailed timing, form and impact of the economic adjustment". In addition, the extent of real effects of Gold shocks is conditional on the credibility of the Gold Standard. Therefore, under a 'panic' episode there was a reduction in confidence, which obviously affected the resulting real effects in the long run. In particular, the reduction in confidence in 1893 was mainly driven by the existence of the Silver Sherman Act, which was released in 1890, as Friedman and Schwartz (1963) pointed out. Finally, these results seem to match better the panic of 1893, but as the results suggest, there was no significant difference for the panic of 1907 (recall the industrial production effect in 1901). The most plausible explanation that these authors provide is that this time there were not beliefs in favor of an eventual abandonment of the Gold Standard, and hence the real effects remain unchanged. If we wanted to connect these results with the ones by Calomiris and Hubbard (1989), we can say that there is evidence of rapid adjustment in the short run under normal conditions, either for prices or output. Whereas, under a panic episode we have larger long run effects, meaning that the adjustment mechanism is altered and therefore the economy was more vulnerable to external shocks.

Interest rates and financial markets (Liquidity effect) – We observe that the increase in interest rates (especially the Call Rate) was higher for the panic episode than for the 'calm' episode (see Figures 4 and 5). Again, the results seem to match better the panic of 1893 relative to the panic of 1907. That is, the increased uncertainty is captured in the behavior of interest rates, with larger and more persistent dynamics. We can also observe a similar pattern for some other interest rates and stock yields, such as Railroads. As a matter of fact, the counterpart of this analysis is the larger fall in stock prices (such as Railroads again) relative to the 'calm' episode. All these previous results are consistent with a fall in depositor confidence.

Currency held by the public - Under the panic episode there is an increase in the demand of Currency held by the public, as Wicker (2000) describes in a very detailed way. This effect can also be observed in the National Banknotes Outstanding outside the Treasury, as well as a fall in Currency held by the Treasury. Here we can paraphrase Friedman & Schwartz (1963), in the sense that *“The run on banks reinforced the effect of the gold outflow on the stock of money by leading the public to desire a higher ratio of currency to deposits”*. Moreover, the graph suggests that this effect was harder in the panic of 1893 than in 1907, relative to an episode of cyclical expansion.

Commodity prices – There is also an amplification effect in the fall of prices for the main commodities. The results follow the fall in general price index (recall figures 2 and 3).

Trade effects – Gold outflows seem to not generate results significantly different to Trade variables. Here the most plausible explanation is that we may think on Trade shocks affecting gold outflows and not the opposite. Therefore, in the light of this statement, gold shock should not generate additional fluctuation in trade variables.

Clearing operations – There is also an amplification effect in the dynamics of clearing operations conditional on being in a panic episode, which is related with credit availability, and it take the form of a monetary contraction.

Time varying volatilities

Given the presence of both panic and calm episodes within the sample period of the classical Gold Standard, it seems natural to think on these episodes as ones with high and low volatility, respectively. The framework of stochastic volatility adopted in this paper allows us to explore dates of regime changes. Moreover, it also sounds plausible to associate the evolution of this volatility to the flows of new information, since it is often argued that there was a reduction in confidence during panic episodes.

We first observe that the volatility of Gold shocks is relatively higher for panic episodes than for calm ones (see Figure 6, where dotted line represent panic episodes). In short, we

can interpret this graph in the following way. Episodes of higher volatility of Gold shocks simply mean that the frequency of occurrence of Gold shocks is higher. For example, between 1891 and 1893 there were unusually large outflows of Gold in April of 1891 but also there were higher inflows in the second half of 1892 (Sprague, 1910).

On the other hand, it is interesting to explore the evolution of volatilities of unobservable factor equations (see Figure 7), since these indicators summarize all the information contained in the data set. In particular, if we observe the magnitudes of standard deviations, factors two and three seem to be capturing most of the increase in volatility derived from the change in depositor confidence (given the dates of panics of 1893 and 1907 and their adjacent dates). However, factor 4 seems to be capturing some of the turbulence generated in the panic of 1907. Moreover, it seems to be that factor one is capturing the evolution of long run trends, and therefore it is not very sensitive to being in a panic episode. As I said previously, these factors summarize the information available for economic agents, but still with this approach we're not able to disentangle depositor confidence entirely, and this opens the window for additional related research.

VII. Conclusion

I have explored the classical Gold Standard Era (1880-1913) and the possible regime changes that might have occurred during this epoch; strictly speaking, changes related with the occurrence of bank panics. Under normal conditions the transmission mechanism of Gold shocks works perfectly, showing a liquidity effect together with the short run real effects on economic activity and as a consequence on output³⁵. Whereas, under an episode of low depositor confidence and the consequent financial instability, the timing of this mechanism is altered in such a way that shows an even higher response of interest

³⁵ This particular case replicates the Tallman and Moen (1998, 2008)'s result.

rates, together with a higher response of output and prices in the short and long run. The main explanation of this result is the credibility of the Gold standard. That is, credibility of the monetary system generates room for real effects in the short run, but the effect vanishes more rapidly compared with episodes of financial stress. In other words, cumulative effects are higher under the latter state. Moreover, financial stress acts as a source of amplification and propagation of gold shocks in the financial system, affecting interest rates, stock prices and yields, currency held by the public and the dynamics of clearing operations.

I have said that one of the principal sources of financial instability is the fall in confidence of individual agents, either depositors or investors. In the same line, these agents condition their behavior on the information that they have available. In episodes of tranquility, the information set of agents, summarized by non observable factors, exhibits low volatility. On the other hand, under episodes of financial stress these factors exhibit large volatility, reflecting the fact that new information has arrived and therefore they have learned that something important is coming. Thus, they modify their portfolio decisions, generating additional fluctuations in interest rates and financial market variables in general.

Yet this is not the end of the story. This empirical evidence opens the room for additional research, pointing to the characterization of private agents' behavior and their process of learning about the financial markets as new information arrives. Overall, the main lesson is that even in the classical Gold Standard era there were regime changes based on the flow of information, and this helps us to explain changes in the transmission mechanism of international gold shocks.

VIII. References

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IX. Appendix I – Figures

Figure 1 – Scree plot (sorted eigenvalues)

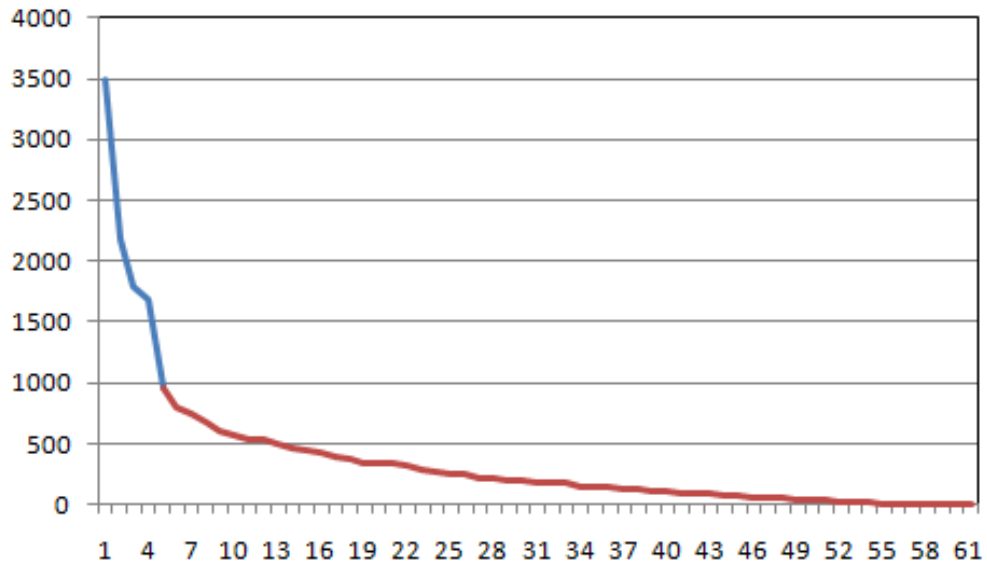


Figure 2a – Responses of Ind. production and Prices (March 1886 vs. June 1893)³⁶

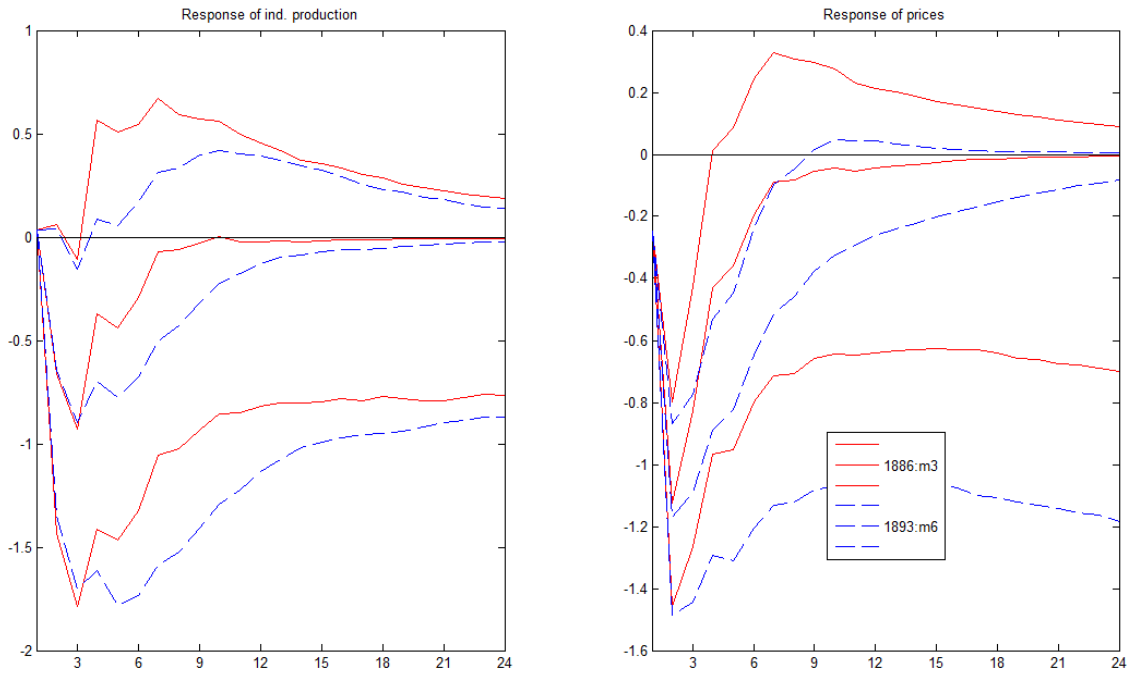
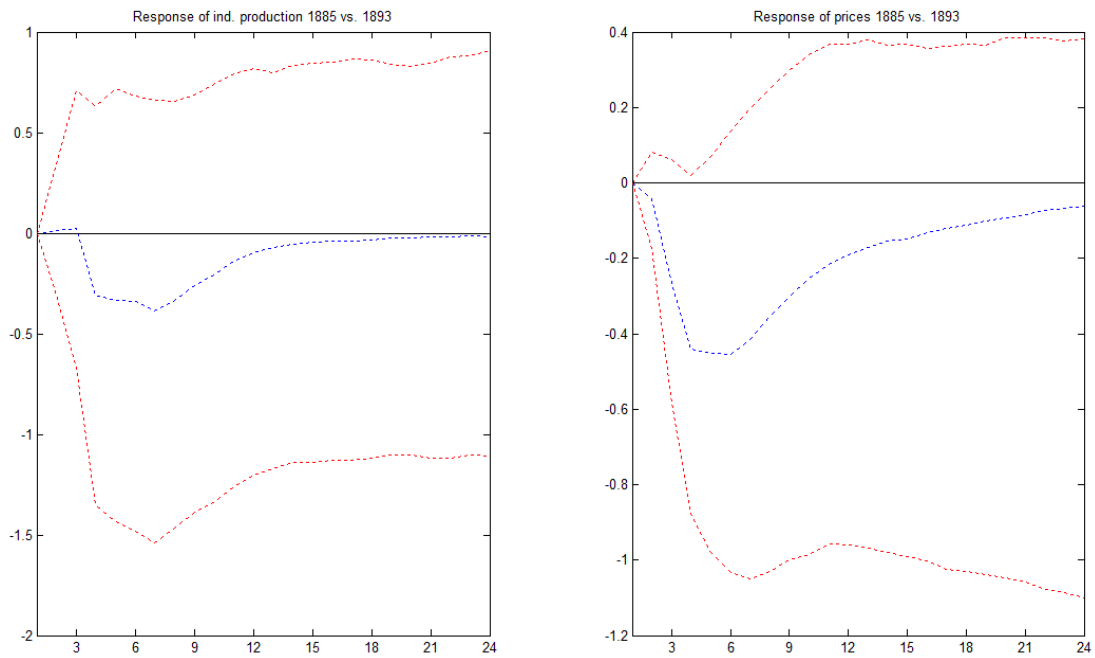


Figure 2b – Differences in Responses (March 1886 vs. June 1893)



³⁶ Error bands for figures 2 and 3 represent 16th and 84th percentiles, whereas the middle line represents 50th percentile.

Figure 3a – Responses of Ind. production and Prices (March 1901 vs. October 1907)

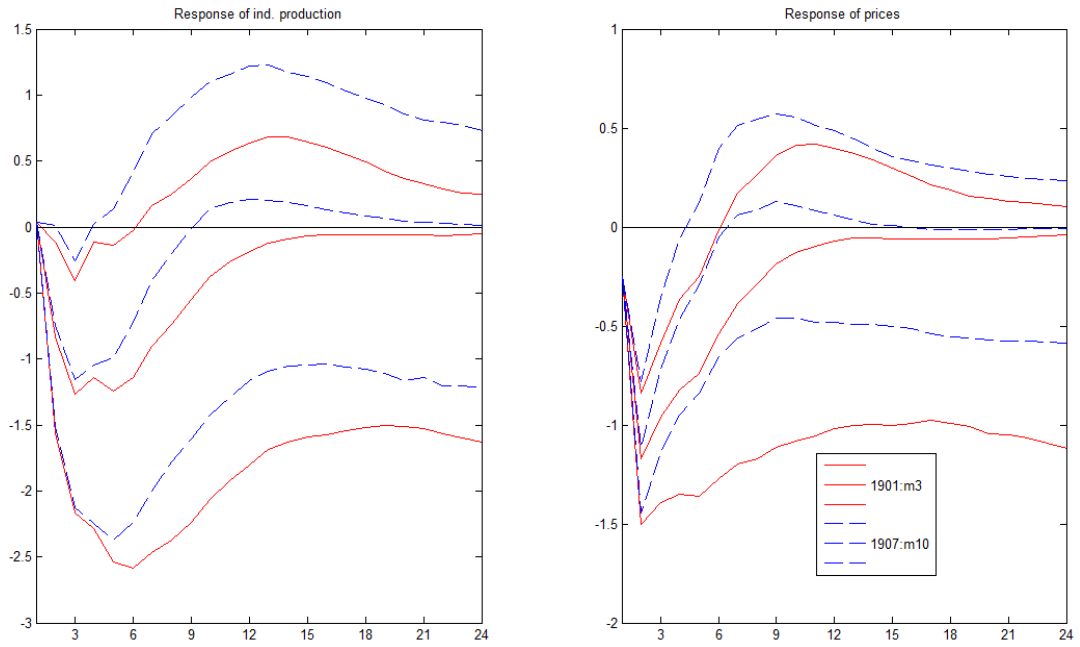


Figure 3b – Differences in Responses (March 1901 vs. October 1907)

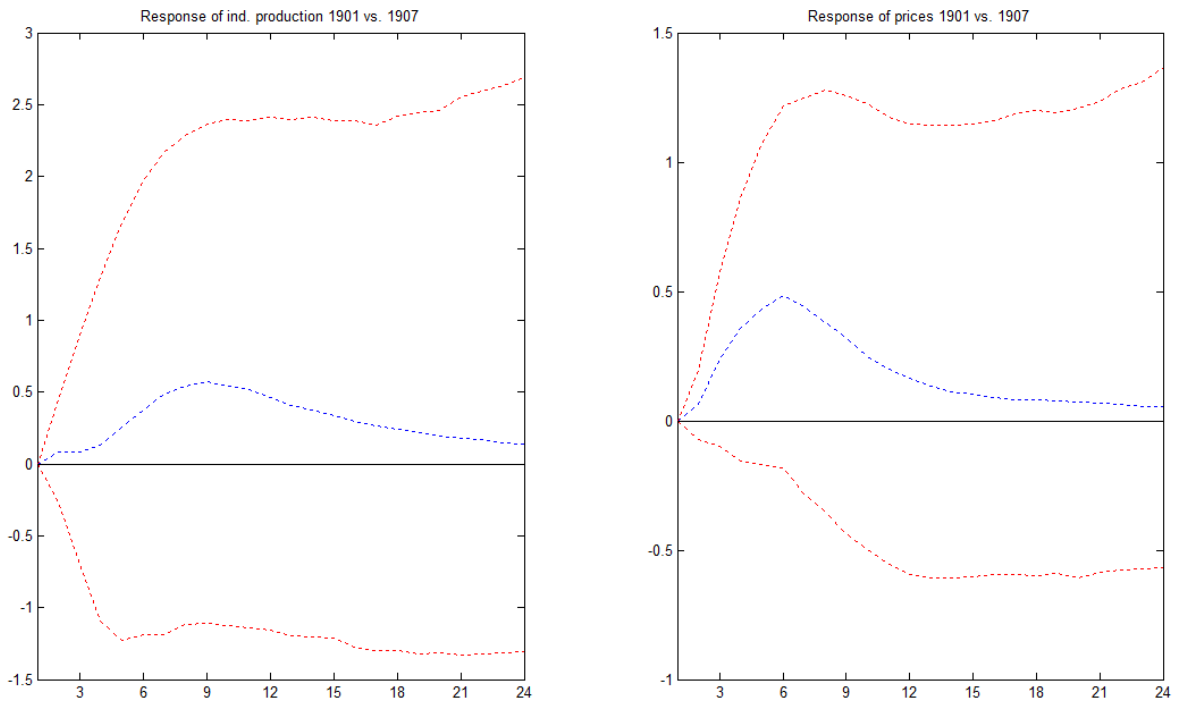


Figure 4 – Responses of several variables (March 1886 vs. June 1893)

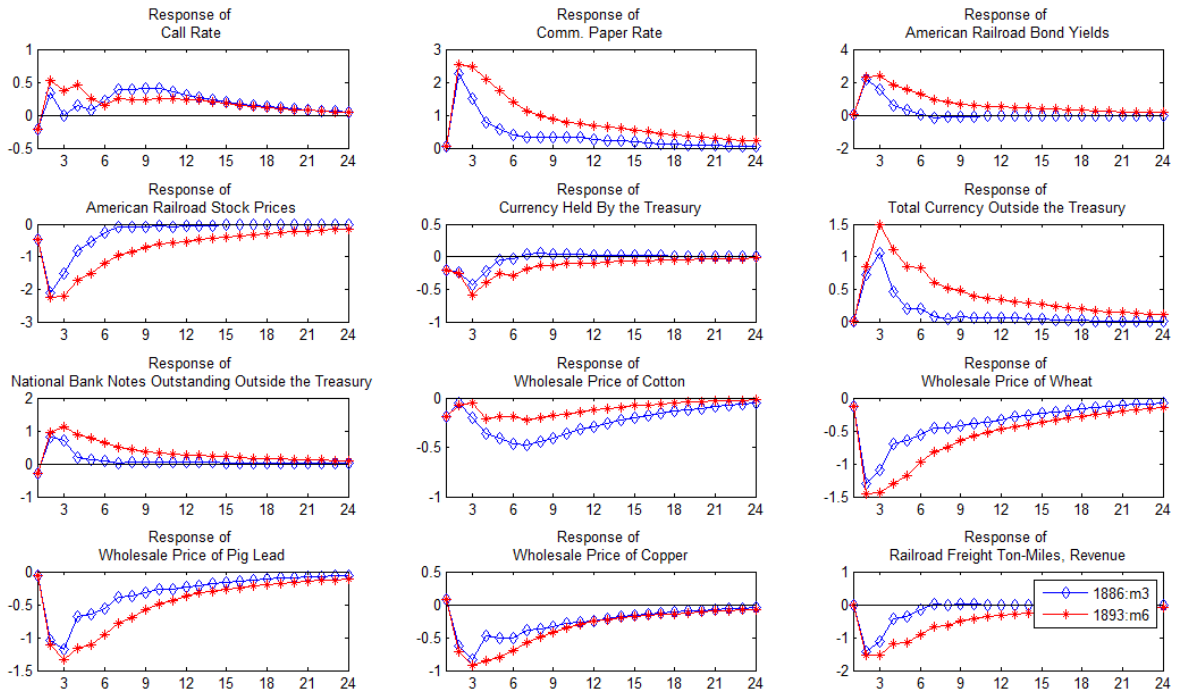


Figure 4 (cont.) – Responses of several variables (March 1886 vs. June 1893)

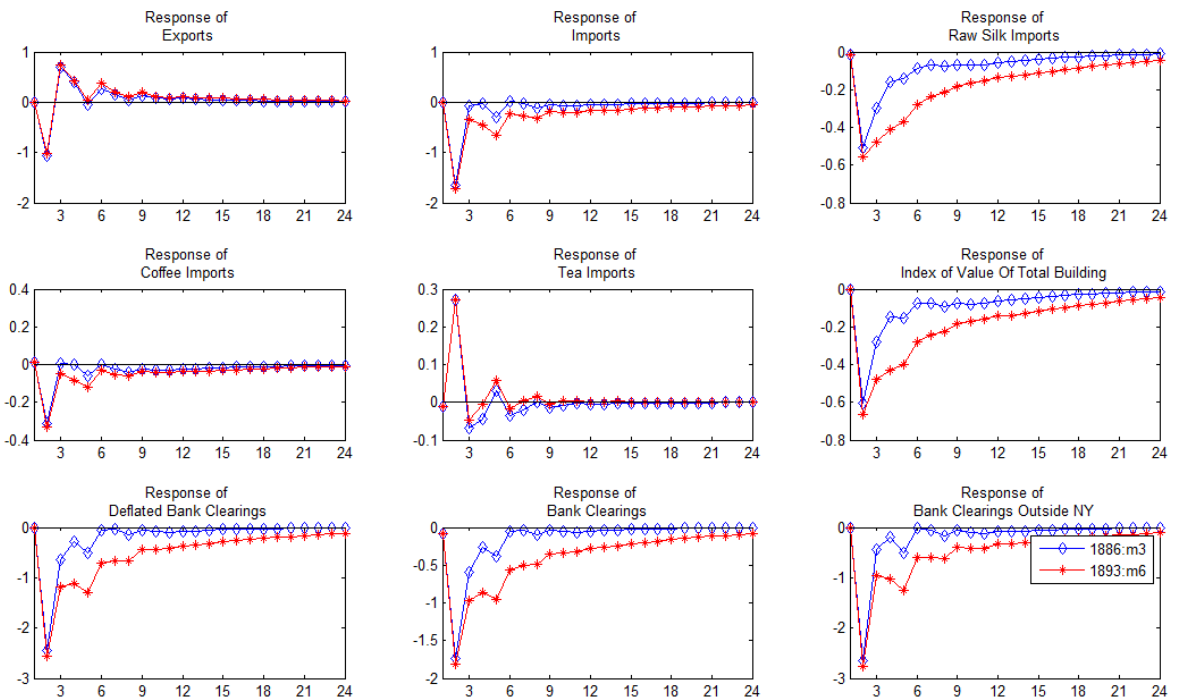


Figure 5 – Responses of several variables (March 1901 vs. October 1907)

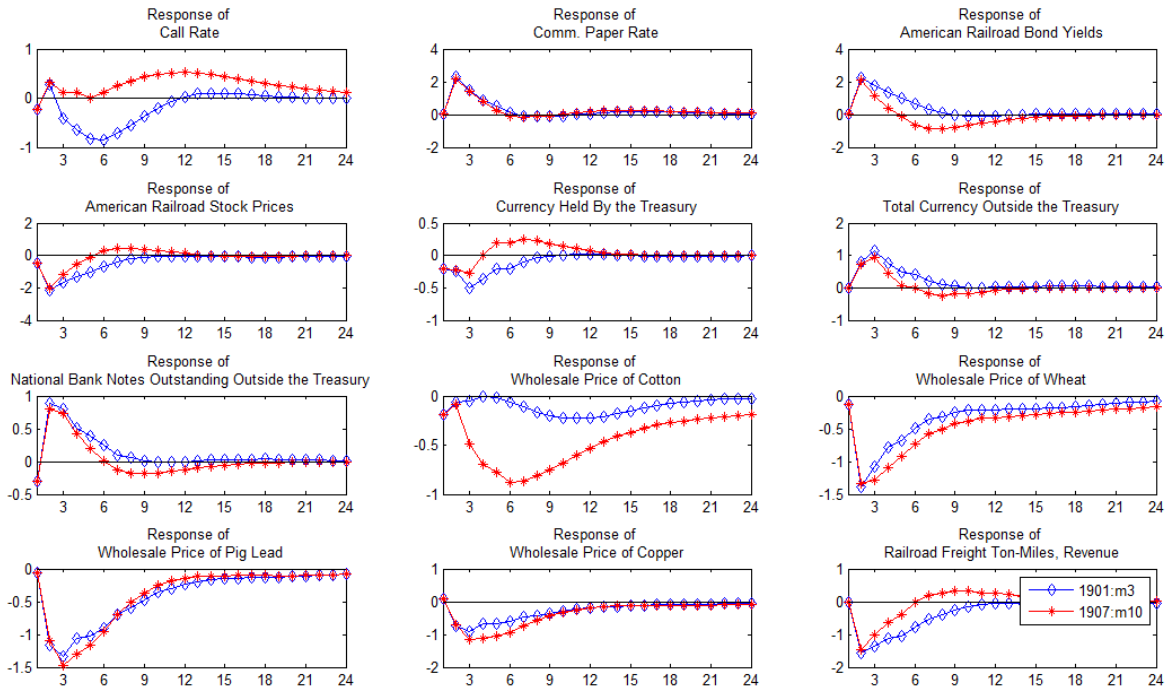


Figure 5 (cont.) – Responses of several variables (March 1901 vs. October 1907)

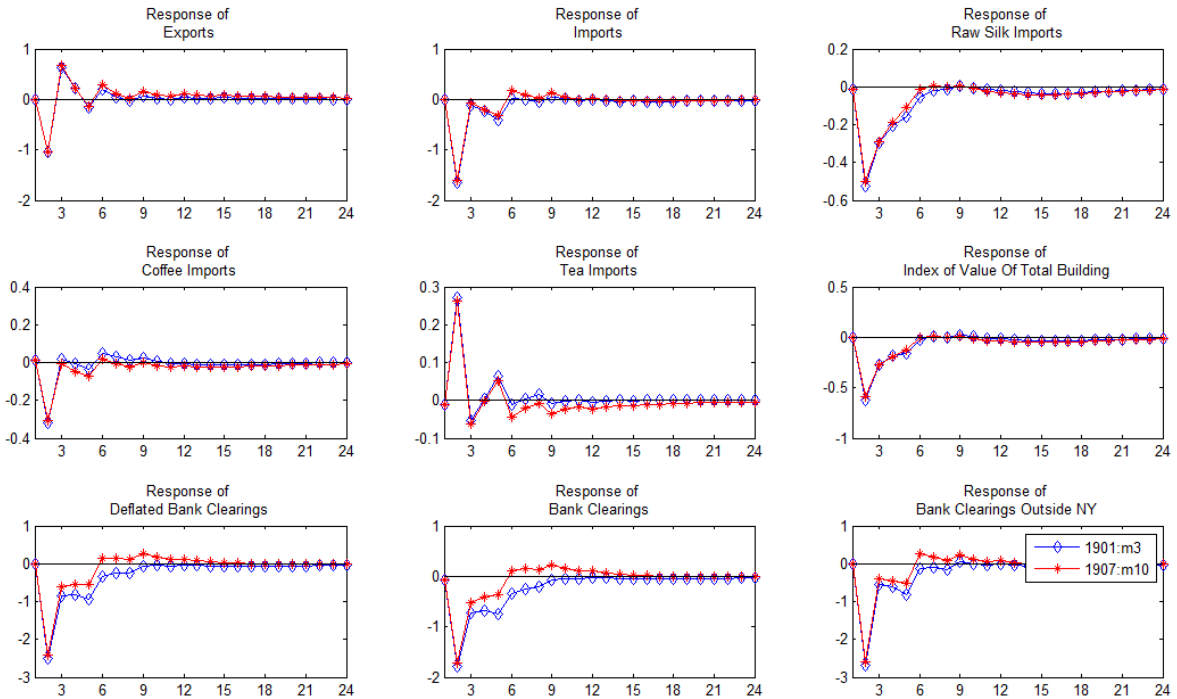


Figure 6 – Standard deviation of Gold Shocks

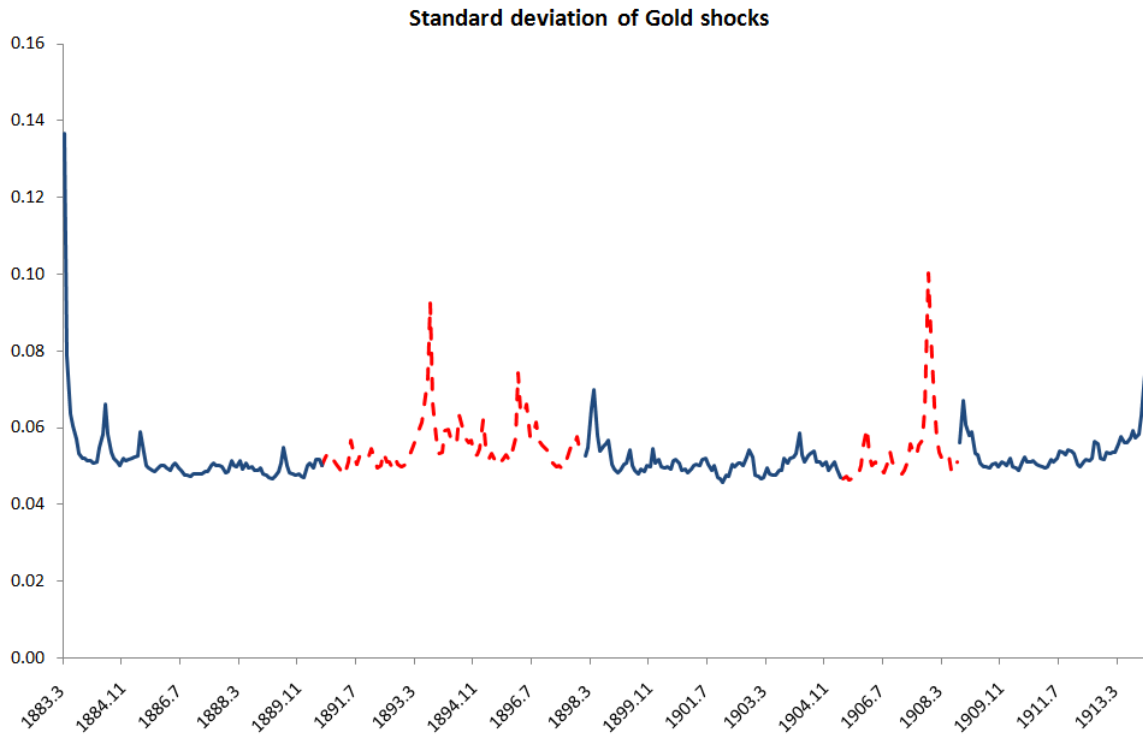


Figure 7 – Standard deviation of Factors

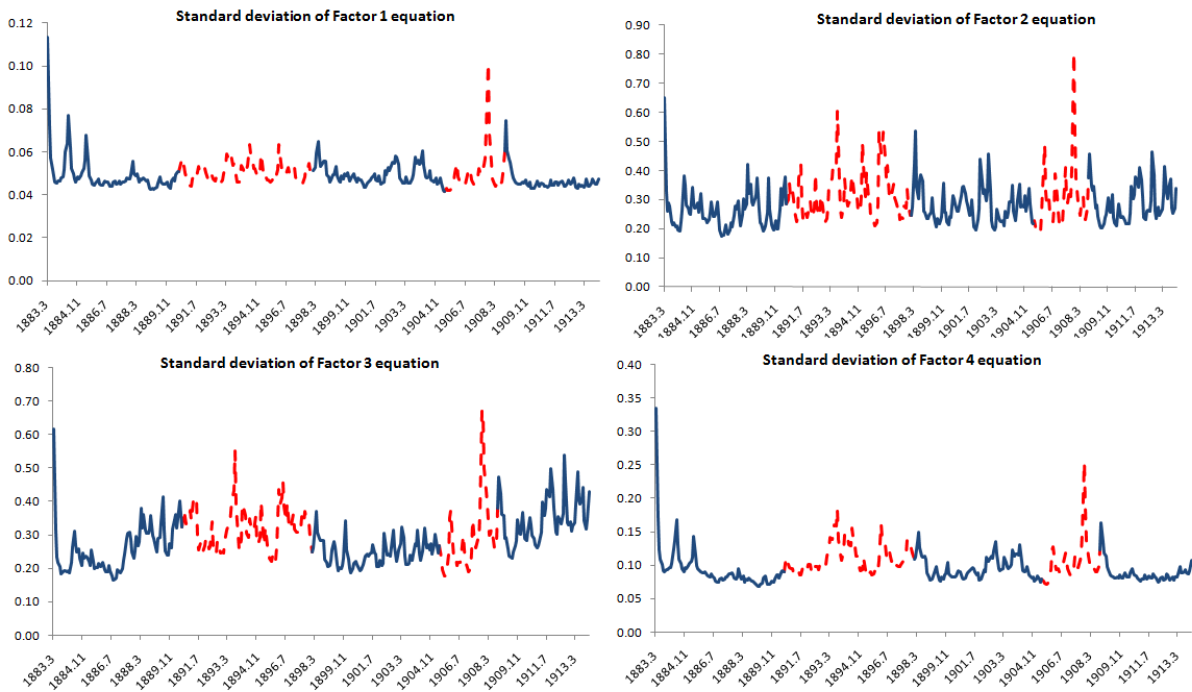


Figure 8 – Responses for the model with 3 factors

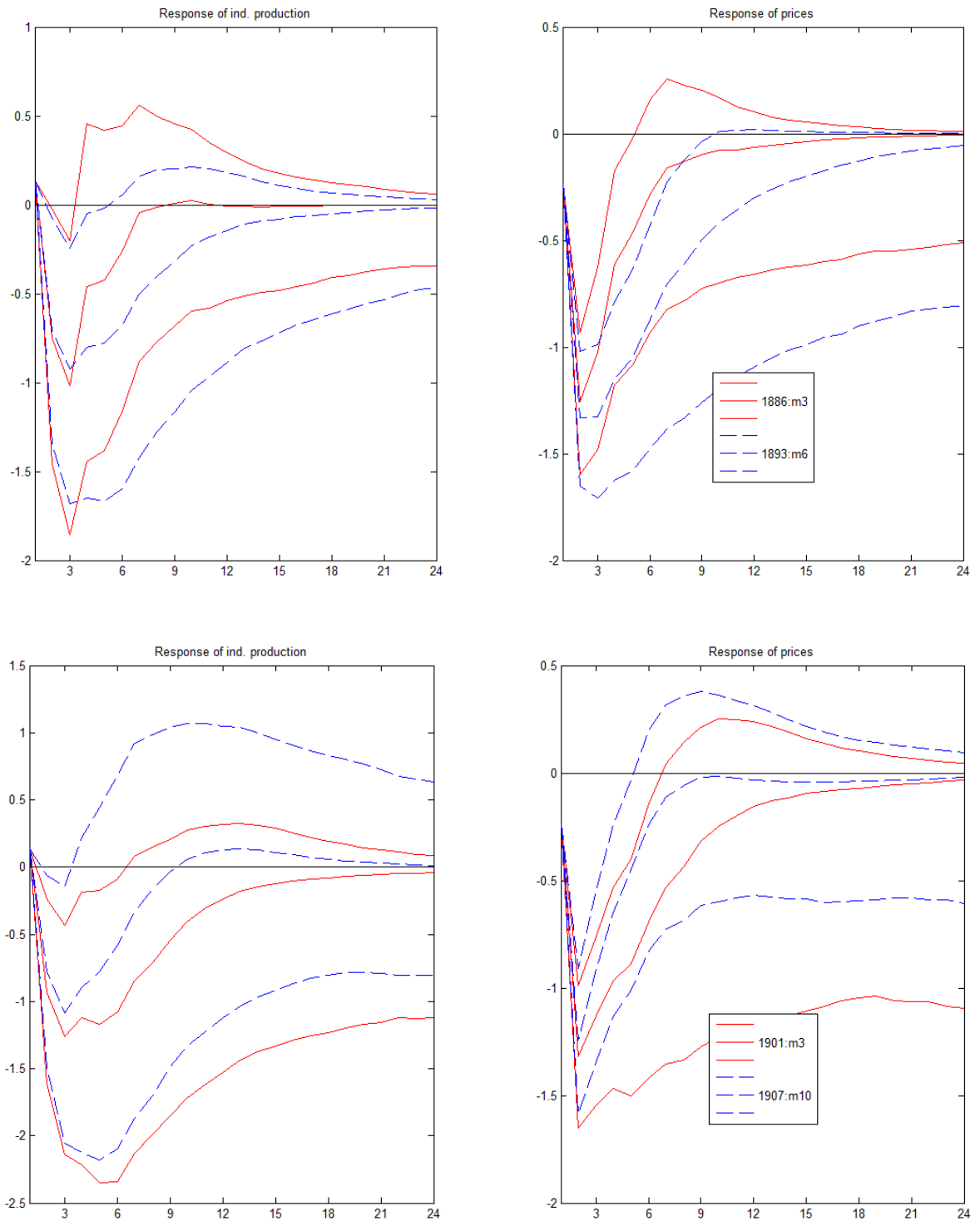
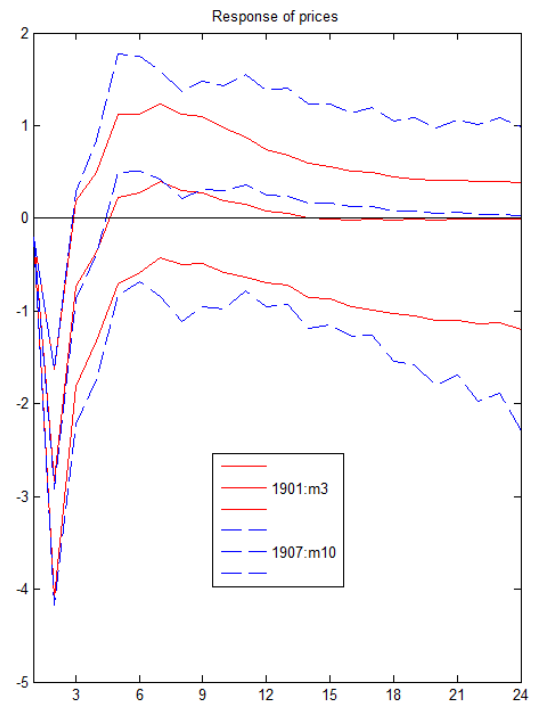
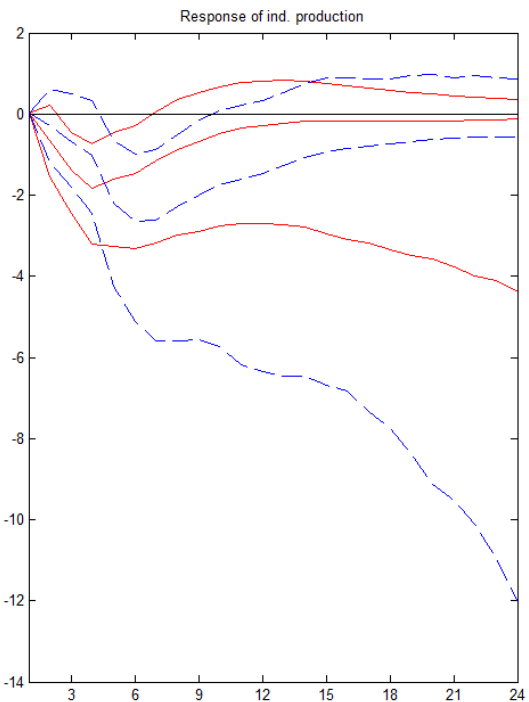
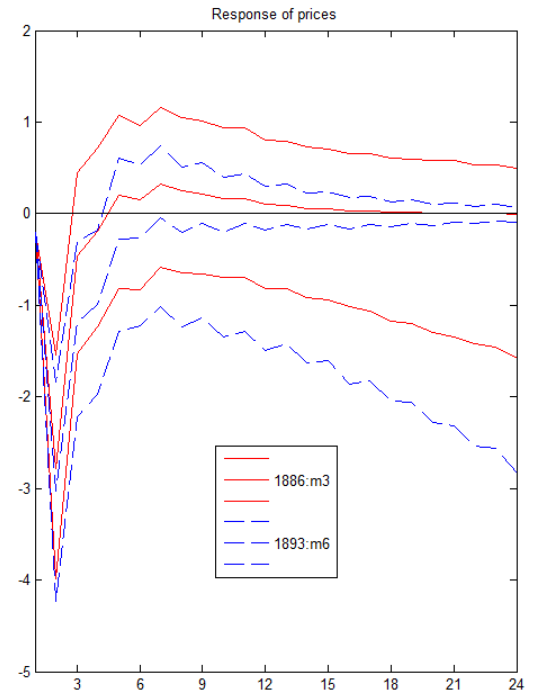
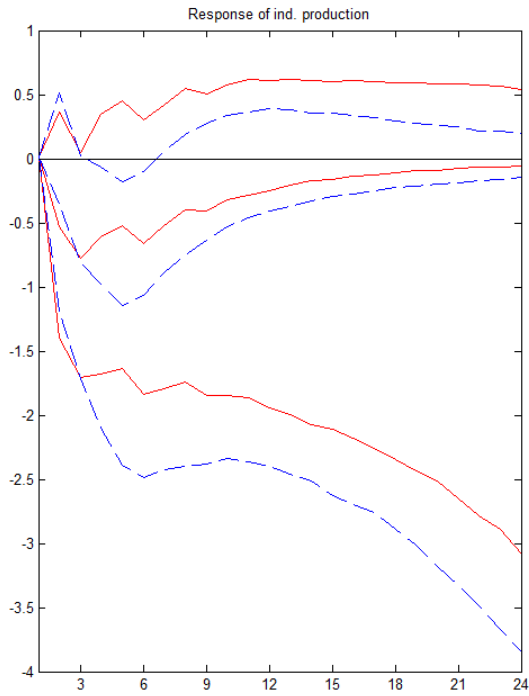


Figure 9 – Responses for the model with 5 factors



X. Appendix II – Data transformation

In the following table I present the series included in the information set for the factor model, together with the transformation code for each one.

Code	Series	Transformation code	Slow code
m12004a	U.S. Index of Industrial Production and Trade, Seasonally Adjusted 1/1875-12/1915	4	1
m12005a	U.S. Index of Trade and Industrial Activity, Seasonally Adjusted 01/1879-12/1930	4	1
m12008a	U.S. Index of Deposits Activity, Seasonally Adjusted 02/1875-12/1919	4	1
m12018a	U.S. Deflated Bank Clearings, Seasonally Adjusted 01/1875-12/1919	5	0
m12018aa	U.S. Deflated Bank Clearings Outside New York City, Seasonally Adjusted 01/1875-12/1919	5	0
m12018ba	U.S. Deflated Bank Clearings 01/1875-01/1936	4	0
m12020a	U.S. Clearings Index of Business, Seasonally Adjusted 03/1875-12/1929	4	0
m01046	U.S. Sheep Receipts, Chicago, Seasonally Adjusted 04/1866-12/1929	5	0
m04001a	U.S. Wholesale Price of Wheat, Chicago, Six Markets 07/1841-07/1944	4	0
m04005	U.S. Wholesale Price of Corn, Chicago 01/1860-12/1951	1	0
m04006a	U.S. Wholesale Price of Cotton, New York; 10 Markets 09/1870-12/1945	1	0
m04011a	U.S. Prices of No. 1 Anthracite Foundry Pig Iron in Philadelphia 05/1842-12/1842, 01/1844-09/1914	1	1
m04015a	U.S. Wholesale Price of Copper, Lake, New York City 01/1860-12/1912	1	0
m04017	U.S. Wholesale Price of Pig Lead, New York 01/1870-07/1955	1	0
m04102	Great Britain Index of Import Prices, Total, A.G. Silverman 01/1880-12/1913	4	1
m04107	Great Britain Metals, Imports, Prices 01/1880-12/1913	5	1
m04112	Great Britain Iron and Steel Exports Prices 01/1880-12/1913	4	1
m04113	Great Britain Index of Export Prices, Non-Ferrous Metals, Silverman 01/1880-12/1913	4	1
m04114	Great Britain Chemical Exports, Prices 01/1880-12/1913	4	1
m14080a	U.S. Currency Held By the Treasury, Middle of The Month, Seasonally Adjusted 07/1878-01/1915	5	0
m14112	U.S. NBER Series: 14112 01/1867-12/1914	1	0
m14124b	U.S. National Bank Notes Outstanding Outside the Treasury, End of Month 01/1874-12/1919	5	0
m14136a	U.S. Other Currency Outside the Treasury, End of Month 06/1878-12/1914	5	1
m14137a	U.S. Gold Held in the Treasury and Federal Reserve Banks, End of Month 06/1878-12/1914	5	1
m03003	U.S. Railroad Freight Ton-Miles, Revenue, Seasonally Adjusted 08/1866-12/1922	5	1
m03015a	U.S. Railroad Gross Earnings, Seasonally Adjusted 01/1866-12/1914	5	1
m03024	Great Britain Tonnage Cleared, British and Foreign 01/1846-08/1939	17	1
m03025	Great Britain Tonnage Entered, British and Foreign 01/1846-08/1939	4	1
m07006a	Great Britain Value of Exports Of Foodstuff 01/1882-12/1901	17	1
m07007a	U.K. Exports of Raw Materials, Value 01/1882-12/1902	17	1
m07008a	Great Britain Value of Exports Of Finished Goods 01/1882-12/1902	17	1
m07017a	Great Britain Imports of Foodstuffs, Value 01/1882-12/1902	17	1
m07019a	Great Britain Value of Imports Of Finished Goods 01/1882-12/1902	17	1
m07023	U.S. Total Exports 07/1866-10/1969	17	1
m07024	Great Britain Total Exports of Produce and Manufactures 12/1854-12/1953	17	1
m07028	U.S. Total Imports 07/1866-10/1969	17	1
m07029	Great Britain Total Imports, Value 01/1856-12/1950	17	1
m07034	Great Britain Total Exports of Cotton Yarn 12/1851-06/1937	17	1
m07035	Great Britain Total Exports of Linen Piece Goods 01/1854-12/1933	17	1
m07036a	Great Britain Total Exports of Cotton Piece Goods 01/1851-12/1921	17	1
m07037a	U.S. Raw Silk Imports 01/1867-12/1886	17	1
m07038	U.S. Coffee Imports 01/1867-06/1941	17	1
m07040	U.S. Tea Imports 01/1867-09/1941	17	1
m11005a	U.S. American Railroad Stock Prices 01/1857-12/1929	5	0
m11025a	U.S. Index of All Common Stock Prices, Cowles Commission and Standard And Poor's Corporation 01/1871-07/1914, 12/1914-12/1956	5	0
m02004	U.S. Index of Value Of Total Building, Original Data, Long 1868-1939 01/1882-12/1917	17	1
m13001	U.S. Call Money Rates, Mixed Collateral 01/1857-11/1970	18	0
m13002	U.S. Commercial Paper Rates, New York City 01/1857-12/1971	18	0
m13016	Great Britain Open Market Rates of Discount, London 01/1824-11/1939	18	0
m13018a	U.S. Excess of New York Commercial Paper Rates Over London Discount Rates On Three Month Bank Bills 01/1876-11/1939	18	0
m13019	U.S. American Railroad Bond Yields, High Grade 01/1857-01/1937	18	0
m13019a	U.S. Railroad Bond Yields Index 01/1857-12/1934	18	0
m13019b	U.S. Index of Railroad Bond Yields 01/1857-07/1914; 12/1914-01/1934	18	0
m13040	U.S. Excess of New York Call Money Rate Over London Open Market Discount Rate 01/1876-12/1914; 01/1925-12/1938	18	0
m13046a	U.S. Dividend Yield of Common Stocks On the New York Stock Exchange 01/1871-12/1938	18	0
m12002a	U.S. Index of Industrial Activity 1/1877-12/1961	4	1
m04051	U.S. Index of the General Price Level 01/1860-11/1939	5	1
m13001a	U.S. Call Money Rates 01/1857-04/1934	18	0
m12013	U.S. Bank Clearings, Daily Average 01/1875-09/1943	5	1
m12014	U.S. Bank Clearings Outside New York City 01/1875-02/1964	17	1
m14135a	U.S. Total Currency Outside the Treasury, End of Month 06/1878-12/1914	5	0
Legend for transformation codes:			
1 Level			
2 First Difference			
4 Log-Level			
5 Log-First-Difference			
17 (1-L)(1-L^12)			
18 (1-L^12)Log(1+x/100) - For interest rates			