Federal Reserve Bank of Cleveland Working Paper Series

Export-Led Decay: The Trade Channel in the Gold Standard Era

Bernardo Candia and Mathieu Pedemonte

Working Paper No. 21-11R

November 2021

Suggested citation: Candia, Bernardo, and Mathieu Pedemonte. 2021. "Export-Led Decay: The Trade Channel in the Gold Standard Era." Federal Reserve Bank of Cleveland, Working Paper No. 21-11R. https://doi.org/10.26509/frbc-wp-202111r.

Federal Reserve Bank of Cleveland Working Paper Series
ISSN: 2573-7953

Export-Led Decay:
The Trade Channel in the Gold Standard Era

Bernardo Candia — UC Berkeley

Mathieu Pedemonte — Federal Reserve Bank of Cleveland*

October 29, 2021

Abstract

Flexible exchange rates can facilitate price adjustments that buffer macroeconomic shocks. We test this hypothesis using adjustments to the gold standard during the Great Depression. Using prices at the goods level, we estimate exchange rate pass-through. Using novel monthly data on city-level economic activity, combined with employment composition and sectoral export data, we show that American exporting cities were significantly affected by changes in bilateral exchange rates. With those results we calibrate a general equilibrium model to obtain aggregate effects from cross-sectional estimates. We show that the gold standard deepened the Great Depression, and abandoning it was a key driver of the economic recovery.

JEL: E32, E65, F02, F41, N12

*We thank Michael McMain and Amber Sherman for excellent research assistance. We thank Tomas Breach, Chris Campos, José De Gregorio, Barry Eichengreen, Ezequiel Garcia-Lembergman, Yuriy Gorodnichenko, Ed Knotek, Todd Messer, Carlos Rondon, Andrés Rodríguez-Clare, Raphael Schoenle, Roman Zarate and seminar participants at UC-Berkeley, the Cleveland Fed, NBER SI DAE, and the Central Bank of Chile for helpful comments and suggestions. The views expressed here are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Cleveland or the Board of Governors of the Federal Reserve System. mathieu.pedemontelavis@clev.frb.org

1 Introduction

Many countries have used some sort of fixed exchange rate in past decades. There is an extensive literature that justifies its use as a way to promote price and financial stability. A fixed exchange rate has been used in the form of unilateral pegs (e.g., Argentina in the 1990s), monetary unions (euro area), or a commitment to international monetary rules (gold standard). But its use can have negative implications in an economic crisis, hindering the adjustment of relative prices and the associated external rebalancing, as Milton Friedman pointed out.[1] This paper shows that this happened in the US during the Great Depression. We show that the gold standard deepened the Great Depression, and leaving it significantly contributed to the economic recovery that started in 1933.

Using monthly data on economic activity at the city level in the 1930s, we show that cities that specialized more in exports were significantly affected by exchange rate appreciations, relative to cities that were less export oriented. We analyze events that occurred outside the US, but affected the US external sector. In particular, we study the large appreciation of the US dollar in 1931, when several countries, mainly the UK and Canada, abandoned the gold standard. Then we show that exporting cities exposed to the depreciation led the economic recovery that started in April 1933, when the US went off the gold standard, depreciating its currency.

We gather several data sets to document these facts. Using nominal and real measures of trade at the monthly level, we first document that US exports were particularly affected between October 1929 and March 1933. Then, using bilateral monthly exchange rates between the US and its trading partners, we construct a measure of an export weighted exchange rate. We show that after a stable exchange rate, the US experienced a large appreciation of its currency in August 1931, when the Mexican peso depreciated. One month later, the UK left the gold standard, followed by several countries whose currencies were tied to the British pound. We also document that the

[1] See Friedman (1953).

US experienced a significant depreciation relative to its trading partners in April 1933, when President Franklin D. Roosevelt took the United States off the gold standard.

The gold standard limited the adjustment of the US dollar, which had an impact on the competitiveness of the external sector. We first study how changes in the exchange rate affect the terms of trade. Using prices for tradable goods in local currency for the US, the UK, Germany, and France, we estimate exchange rate pass-through into prices. We find an incomplete price pass-through of about -0.5 percent in foreign prices in the local currency after a 1 percent depreciation of the US dollar. This finding implies an increase in the foreign price relative to the local price of the tradable good: The local good becomes cheaper in the foreign market and the foreign good becomes more expensive in the local market, inducing expenditure switching. We also document a similar pattern for the main events we evaluate: the UK abandoning the gold standard in 1931 and the US in 1933.

We then turn to evaluating the effect on economic activity. We construct a measure of trade exposure at the monthly and city levels, using census data, destination-sector-specific exports from the US in 1928, and the monthly bilateral exchange rate of the US with 33 destinations. We measure exposure to trade at the city level as a weighted sum of sectoral trade exposures, where we weigh by the 1930 share of workers in a city and sector. To compute sectoral trade exposure, we calculate a sector-specific weighted exchange rate, where the weight on each destination's bilateral exchange rate is given by the sector's export share for that country. We aggregate over 45 exporting sectors, obtaining high cross-sectional and time variation across cities.

This measure contains two main components: First, as we consider employment share in the exporting sectors over total employment, the variable shows how specialized a city is in terms of overall exports. The exporting sector was particularly affected in the Great Depression, so it works in the same way as other measures of trade exposure, such as the one used in Autor, Dorn, and Hanson (2013). Second, that component sums over the sector-specific weighted exchange rates, which varies according to country-specific movements, depending on how important they are as a destination of US exports. Therefore, the measure interacts city-level export exposure with monthly variation coming from the exchange rate of countries that are more important sectoral destinations than others. Thanks to these features, we can control for time fixed effects, exploiting the cross-sectional variation and differential exposure to exchange rate shocks.

Using this measure, we show that cities with full trade exposure increased their economic activity by 0.76 percent after a 1 percent city-specific depreciation.[2] We then evaluate particular events using the measure of trade exposure and also Bartik-type instruments. We start with the events of August and September 1931, when the Mexican peso was devalued and the UK left the gold standard, depreciating the British pound relative to the US dollar. All of these events produced an appreciation of the US dollar of more than 15 percent relative to US trading partners. We show that following a common pre-trend, cities with higher trade exposure exhibited an important drop in economic activity relative to non-exposed cities.

After measuring the importance of exchange rate movements for the external sector in the US, we explore the depreciation of 1933. US economic activity started to increase after President Roosevelt's inauguration. We show that starting in April 1933, cities exposed to exports to destinations whose currencies the US dollar depreciated the most in 1933 increased their economic activity more rapidly than cities with lower exposure. These results suggest that a flexible exchange rate plays an important role in buffering macroeconomic shocks.

Then, we use a general equilibrium model to inform the aggregate effects. The model has two regions, each exposed to a different foreign country, so we can simulate a depreciation in one region while the other remains in a fixed regime. The model generates a series of data that allow us to replicate the regressions that we estimate in the empirical part. We calibrate the model to match the empirical findings of the

[2] The average trade exposure is 0.35, implying an average effect of 0.27 for a 1 percent city depreciation, given the level of tradability of the cities.

paper. We find that the aggregate effect is smaller than the cross-sectional estimates. A 1 percent appreciation that affects half of the exporting sector of the economy should increase economic activity by 0.22 percent, which is 30 percent of the cross-sectional estimate. Considering the size and the importance of the exchange rate movements, this result suggests that the events of 1931 and 1933 had important aggregate consequences for the US economy. This shock can explain almost a third of the decline in economic activity between 1931 and 1932, and two-fifths of the increase in economic activity between 1933 and 1934.

The gold standard and fixed exchange rates continue to be of interest, both in the US and abroad. Diercks, Rawls, and Sims (2020) show that such a monetary regime in the context of a closed economy would have decreased welfare and produced more instability in the last 20 years due to the volatility of the price of gold. In this paper, we do not focus on the domestic money supply, but on the implications of the exchange rate regime. Along those lines, Obstfeld, Ostry, and Qureshi (2019) find that fixed exchange rate regimes magnify global financial shocks. The implications of the exchange rate regimes can be larger due to countries' increased vulnerability to the global financial cycle, as shown by Miranda-Agrippino and Rey (2020) and in a context where most countries remain somewhat pegged to other currencies, in particular the US dollar, as shown by Ilzetzki, Reinhart, and Rogoff (2019). In this paper, we show that the trading sector would also be affected by that vulnerability.

On the economic history side, many theories try to explain why March 1933 marks a turning point in economic activity in the US, reflecting the fact that several policies were implemented at that time (Romer (1992), Eggertsson (2008), Hausman, Rhode, and Wieland (2019), Jalil and Rua (2016), Jacobson, Leeper, and Preston (2019), among others).[3] Eichengreen and Sachs (1985), Campa (1990), and Bernanke (1995) have shown that countries that left the gold standard recovered faster than countries that remained on gold. There are many mechanisms linking currency depreciation and re-

[3] That month Roosevelt began his first term. He immediately implemented a battery of policies during a period called the "Hundred Days."

covery.[4] In this paper we focus on large exchange rate fluctuations and their impact on the level of economic activity through changes in the competitiveness of exports. We first test this mechanism using the large appreciation of the US dollar in 1931, when the UK and other trading partners abandoned the gold standard. This shock was unanticipated and, consequently, was perceived as exogenous. Then, we focus on the role that the depreciation of the US dollar played in the recovery of 1933.[5]

Hausman, Rhode, and Wieland (2019) show that the farm sector led the recovery. They claim that the increase in traded crop prices produced by the devaluation of 1933 created an income redistribution to indebted, high marginal propensity to consume farmers. In this paper, we focus on the whole exporting sector of the US, showing that the paths of the decay and recovery are also present, for example, in the manufacturing sector. The depreciation produced not only inflation, but also an actual increase in the real income of the exporting sector relative to the nontradable sector and its nontradable costs (wages). This real income growth can explain the increase in spending in the tradable cities. Moreover, we show that exporting sectors were particularly affected by the events of 1931, which can explain why the farm sector had relatively higher debt by March 1933.

We contribute to this literature by providing a clearer identification strategy, by exploiting the cross-sectional variation within the US, and testing the main effects in periods with exogenous shocks. The exposure measure built for this paper, which has city- and time-specific variation, and the large and monthly panel of cities' economic activity allow us to control for common time effects in the US and evaluate relative differences in a very short window. This setting provides a clean identification relative

[4] Abandoning the gold standard gave central banks and governments more leeway to stabilize the banking system, whose instability was the main source of monetary contraction in the United States (Bernanke (1995)). Devaluation raises final product prices lowering real production costs. All of the above mechanisms helped remove expectations of deflation, which is especially useful when nominal interest rates are stuck at the zero lower bound. On the other side, Bordo and Meissner (2020) show that currency issue of debt was an important consideration for countries in maintaining a fixed exchange rate and avoiding an increase in their debt burden.

[5] Although the depreciation of the dollar in this case cannot be considered an exogenous shock.

to the other evidence of the events of the Great Depression. We show that fluctuations in the exchange rate were key not only for deepening the crisis but also for exiting it. We also show that this mechanism was relevant before the events of April 1933. We call this mechanism the trade channel.

This paper is also closely related to the literature on the role of the exchange rate in economic growth. Rodrik (2008) argues that a depreciated exchange rate promotes economic growth. Levy-Yeyati and Sturzenegger (2003) find that flexible exchange rates are associated with higher economic growth, while Lopez-Cordova and Meissner (2003) find that fixed exchange rates promote trade, in the context of the early gold standard. In the short run, currency changes can have an effect on economic activity in the presence of market power and other rigidities, as explained by Dornbusch (1987). The conditions discussed in that paper are met in an open economy New Keynesian model, where a key variable in evaluating the effect of exchange rate movements is the price pass-through. Many papers have empirically estimated exchange rate pass-through in different periods of time. Feenstra (1989) and Knetter (1989) are examples of early empirical work that continued later. Goldberg and Knetter (1997) summarized those and other early works. This debate continued, adding other considerations such as the currency of invoicing as discussed and estimated in Gopinath, Itskhoki, and Rigobon (2010) and Auer, Burstein, and Lein (2021). We add to this discussion by also estimating the exchange rate pass-through in Section 3 using large changes in the exchange rate due to changes in regime. We find results similar to the one discussed in Goldberg and Knetter (1997) and find heterogeneity in tradability as in Burstein, Eichenbaum, and Rebelo (2005).

Finally, we also add to the literature on the costs of fixed exchange rates, especially when local shocks occur. For example, Obstfeld and Rogoff (1995) discuss that when a shock affects demand for local goods (namely, a productivity shock that affects the terms of trade, or some shock abroad that reduces the demand for local goods), a fixed exchange rate will damage the local economy, since local producers' prices will not be able to adjust. This is exacerbated by a restricted monetary authority. An alternative is to abandon the peg, which is more likely to occur when a negative export shock happens, as found by Mitchener and Pina (2020). These arguments have been used to analyze the Latin American crisis in the 1980s and the euro crisis in 2009. In both cases, there have been discussions about the role of fixed exchange rate in deepening the crisis. Eichengreen et al. (2014) discuss the similarities between both cases and the role of external adjustment (in particular with fiscal instruments constrained). This paper shows that this is the case using detailed micro-level data.

This paper is organized as follows. In Section 2 we document the trade and exchange rate dynamics during the Great Depression. In Section 3 we examine the connection between trade exposure and price adjustment. In Section 4 we focus on local exposure and economic activity. In Section 5, we show robustness results. In Section 6 we use a model to evaluate the aggregate effects from the cross-sectional estimates and in Section 7 we conclude.

2 The Trade Channel

The US dollar experienced a large depreciation in March 1933. After years on the gold standard, the US abandoned it days after President Roosevelt's inauguration. The gold standard was configured as an international system, where the exchange rate was fixed between the economies that participated (Eichengreen (1996)).

As stated by Bernanke (1995), understanding the Great Depression is the Holy Grail of macroeconomics. Eichengreen and Sachs (1985) argue that the length and depth of the Great Depression and the recovery from it can be explained by the fixed exchange rate regime. Under this type of regime, local shocks have long and profound effects on economic activity due to the lack of adjustment of the external sector. The flexible exchange rate, on the other hand, enables price adjustment, which reduces the decline in competitiveness. In this paper, we evaluate this mechanism empirically using novel micro data. We complement Eichengreen and Sachs (1985) evidence by exploiting cross-sectional variation in the US. This cross-sectional variation comes from novel data on high-frequency economic activity, bilateral international trade indicators, and census data. This variation allows us to control for common shocks across the US in a given period of time and identify the contribution of the mechanism.

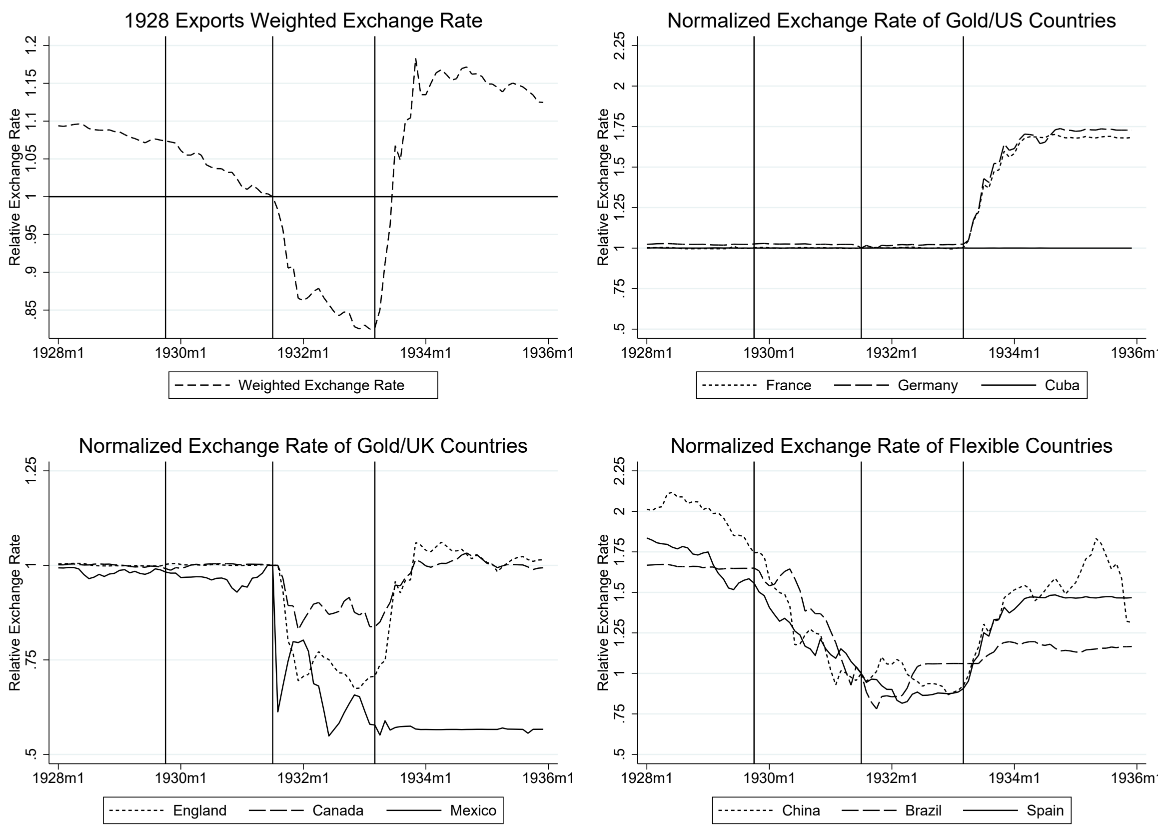
We start by showing some stylized facts in this section. We construct a measure of the export-weighted exchange rate for the US. The US was not the first country to abandon the gold standard. Mexico abandoned it in August 1931 after the monetary reforms called "Plan Calles," the UK left in September 1931,[6] and other countries had had flexible regimes since the beginning of the Great Depression. This variation generates many exchange rate shocks depending on the exposure of exporting sectors to those countries. The objective of this measure is to have a general idea of the main changes in the exchange rate that the US experienced during the Great Depression. To construct this measure, we obtain bilateral exchange rates at the monthly level for 33 countries representing 86.6 percent of total US trade with foreign countries in 1928.[7] We define the exchange rate as the US dollar over the foreign currency, so an increase in the indicator represents a depreciation of the US dollar. We normalize the exchange rate of each country to July 1931 (equal to 1). Then, we construct a weighted exchange rate, where the weight of each bilateral exchange rate is the fraction of total exports that goes to that country in 1928.[8] Figure 1 shows the evolution of this export-weighted exchange rate and the normalized bilateral exchange rate for some particular countries.

[6]Farhi and Maggiori (2018) argue that the exit of the UK and the subsequent devaluation of the sterling were due to stabilizing needs in line with the Triffin dilemma (Triffin (1961)). This need was explained by the high fiscal imbalances and the banking losses that followed the German financial crisis.

[7]From the Federal Reserve Bulletins. We obtain data for Austria, Belgium, Bulgaria, Czechoslovakia, Denmark, the UK, Finland, France, Germany, Greece, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, Yugoslavia, Canada, Cuba, Mexico, Argentina, Brazil, Chile, Colombia, Uruguay, China, Hong Kong, India, and Japan

[8]Solomou and Vartis (2005) use a similar strategy for the UK.

Figure 1: End of Gold Standard and Exchange Rates



Notes: The uppper left panel shows the weighted nominal exchange rate for the US. This measure is constructed by calculating the share of US exports in 1928 to 33 economies that represent 86.6 percent of total exports that year. Each bilateral exchange rate is normalized to one in July 1931 and we construct a weighted average, where the weights are export shares. The upper right, lower left and lower right panel represent the bilateral nominal exchange rate between the US and selected countries as indicated in each panel. Each bilateral exchange rate is normalized to 1 in July 1931. Vertical lines indicate October 1929, August 1931, and March 1933. The exchange rate is defined as the US dollar over the foreign currency.

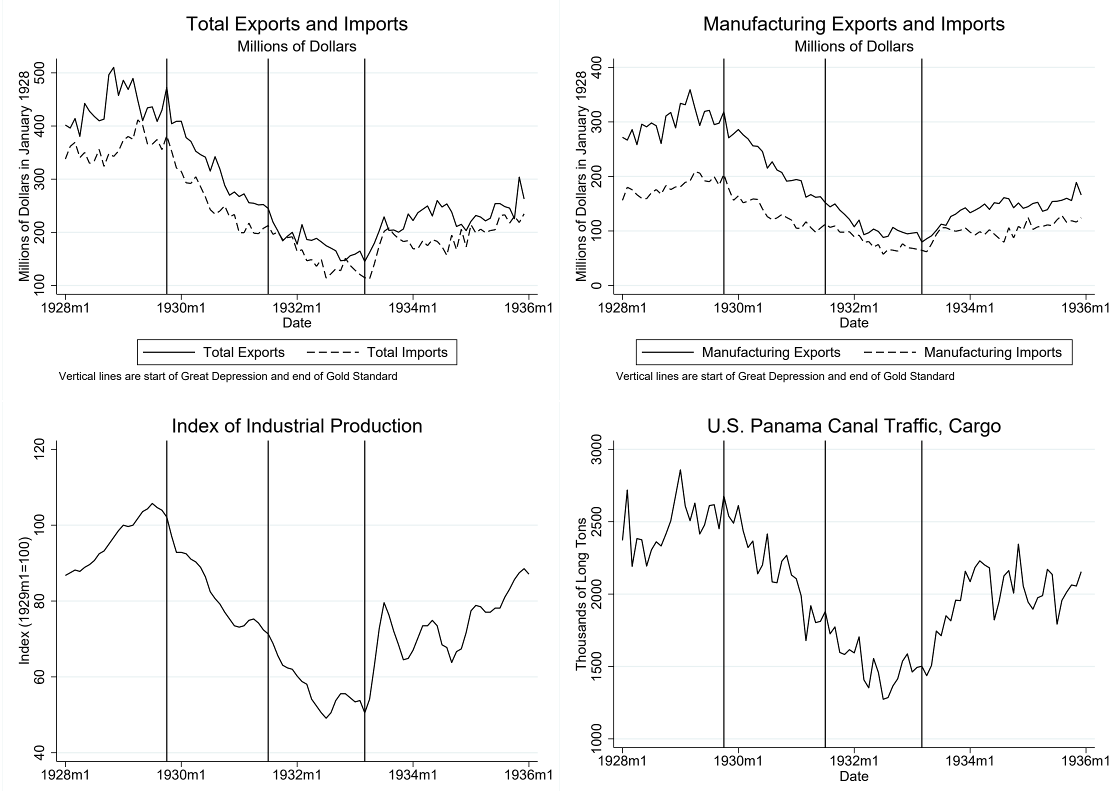
The upper left panel of Figure 1 shows that the weighted exchange rate of the US had been slowly appreciating since 1928. This is mainly due to countries that did not have a fixed exchange rate with the US, such as China (2.7 percent of total exports in 1928), Brazil (2 percent), and Spain (1.7 percent), as shown in the lower right panel. In August 1931 we can see a large appreciation of the US dollar relative to its trading partners. Mexico (2.6 percent) had a large depreciation of its currency that year as seen in the lower left panel. Then, the most important trade partners of the US -Canada (17.1 percent of total exports in 1928), the UK (16.6 percent), and the countries tied to the British pound- also depreciated their currencies. Other countries remained tied to gold, such as Germany (9.1 percent), France (4.7 percent), and Cuba (2.5 percent), so the exchange rate with these countries was not affected in 1931, as seen in the upper right panel. Then, when the US abandoned the gold standard, the US dollar experienced a large depreciation. This was produced by a depreciation relative to the countries that were not tied to gold, such as Canada and the UK, but also relative to the countries that remained on the gold standard, such as France and Germany. A few countries such as Cuba, remained tied to the US dollar.

Figure 2 shows that following these main events, measures of trade also reacted. Exports and quantities of exports decreased sharply during the Great Depression. Panels 1, 2, and 4, show that after the depreciation, exports experienced an increase as measured by value and volume. This trend coincided with the evolution of industrial production, which also strongly increased starting in April 1933, as shown in panel 3 of Figure 2.

These figures also show that the Great Depression was characterized by a large drop in exports. The US was not able to gain competitiveness using its currency. This situation was exacerbated when the UK and other economies tied to the British pound depreciated their currencies in 1931. Before October 1929, exports were slowly growing according to many measures, as well as economic activity. The gold standard worked in a cooperative way until 1928 (Eichengreen (1996)), but as October 1929 approached, that cooperation ended, producing a tightening of the money supply that increased the effects of the great crash.[9] During the years of the depression, real exports dropped almost 70 percent while industrial production dropped by a similar magnitude.

[9] Bernanke (1995) argues that the largest factor behind the monetary contraction in the US was the instability of the banking sector, while the collapse of the gold standard dominated outside the US.

Figure 2: End of Gold Standard and Trade



Notes: The upper left panel (panel 1) is seasonally adjusted total exports in millions of dollars normalized by the CPI (base January 2008). The data come from the NBER Macrohistory Database. The upper right panel (2) is the seasonally adjusted total exports in manufacturing in millions of dollars normalized by the CPI (base January 2008). The data come from the NBER Macrohistory Database. The lower left panel (3) shows monthly industrial production, normalized to January 1929 (100). The data come from the Fed's G.17 Industrial Production and Capacity Utilization. The lower right panel (4) is the seasonally adjusted long tons of US cargo in the Panama Canal from the Panama Canal Record, available in the NBER Macrohistory Database. Each bilateral exchange rate is normalized to 1 in July 1931. Vertical lines indicate October 1929, August 1931, and March 1933.

Depreciation lowers the price of American goods in terms of foreign currency, enhancing the competitiveness of exports. By March 1933, US exports reached their lowest value since 1929. The manufacturing sector (66 percent of total exports in September 1929) was particularly hard hit. In March 1933, manufacturing exports in real terms were 73 percent lower than in September 1929. Exports of crude materials (32.5 percent of exports in September 1929) decreased 50 percent. By March 1934, manufacturing exports were 85 percent higher, while exports of crude materials was 50 percent higher than one year before. After that low point in March 1933, the value of exports grew by 75.21 percent over the next six months. This effect was not only caused by rising prices. By April 1934, the weight of US cargo in the Panama Canal was 53.3 percent higher than in April 1933.

Relevant economic stakeholders at the time suggested that the volume of trade could have been even much greater after the United States went off the gold standard. The expansion of exports was hindered by the instability of the dollar. With the dollar falling in value, it was convenient for foreign importers to delay purchases of American goods in anticipation of further depreciation. Patch (1934), quoting a speech made in December 1933 by the head of the Foreign Credit Interchange Bureau of the National Association of Credit Men, William S. Swingle, reveals the thinking of the time:

> *An imposing backlog of orders is piling up abroad while customers for American products wait for the dollar to settle to a permanent level. They refuse to make advance commitments for fear competitors will be able to buy similar goods at a more favorable price later. A desire to profit by exchange is also having an effect upon collections in many foreign markets. Payments for shipments are being delayed in the hope that the dollar will be lower when the final settlement for goods purchased is made.*

According to him, foreign purchasers avoided making long-term commitments in the hope of receiving more American goods for the same amount of money. Patch (1934), now quoting the secretary of the Export Managers Club of New York, said: "Foreigners are buying more goods, but their purchases are made up of small orders placed at frequent intervals and represent no long-time commitments."

Depreciation also increases the price of imports of the depreciated currency, which would discourage the demand for foreign goods. However, after the United States abandoned the gold standard in the spring of 1933, the value of imports (seasonally adjusted) grew without interruption until August 1933, accumulating a growth of 84.6

percent as shown in Figure 2. The initial increase in imports is consistent with the empirical evidence provided in Blaum (2019), who shows that large devaluations are characterized by an increase in the aggregate share of imported inputs and by the reallocation of resources toward import-intensive firms, because large exporters are also large importers (Amiti, Itskhoki, and Konings (2014), Bernard et al. (2007), and Albornoz and García-Lembergman (2020)).[10] The effect on net exports is ambiguous.[11] This narrative and the quantitative evidence show that the external sector expanded starting in April 1933.

The opposite mechanism occurred when other countries abandoned the gold standard. When the UK left the gold standard in September 1931, newspapers at the time warned about the consequences for the US export sector. The New York Times, for example, highlighted the potential gains for the UK, expecting an increase in England's exports while increasing American imports. The Times considered that the US would experience "a temporary reduction in the standard of living." The article was optimistic about an increase in the UK's demand for US raw materials, which can explain why crude material exports did not decline as much as manufacturing exports during the Great Depression. This optimism did not last long: On October 4, the same newspaper documented that American cotton exports were stagnant. The paper attributed this situation to the "decline in sterling values," describing a "steady decline in prices." The article highlighted that it did not know when the price decline was going to stop.

We turn now to estimating the exchange rate mechanism empirically. In the next section, we evaluate changes in competitiveness due to changes in the exchange rate during the Great Depression. With this we can account for changes in the terms of trade

[10] Patch (1934) argues that the initial growth in imports was due to the sharp increase in industrial activity and the need for replenishing stocks of raw materials. With the dollar falling in value, it was convenient for importers to accumulate large stocks of foreign products in anticipation of further depreciation of the dollar. According to this author, the loss of purchasing power of the US dollar became an obstacle for importers by July 1933, as reflected in the decline of the year-over-year growth rate of imports, while the export growth rate increased progressively after August 1933.

[11] The increase in net exports is related to the elasticity of substitution between the local and foreign variety. We address this point in Section 6. In addition, see Gali and Monacelli (2005)

to see if we should expect benefits for the external sector. Then, we measure the effect on economic activity, comparing the economic performance of more export-oriented cities relative to less export-oriented cities.

3 Competitiveness Effect of Changes in Exchange Rate

We start by studying whether changes in exchange rates had an effect on prices. The amount of pass-through is relevant for understanding the gain in competitiveness for local producers. For example, if the US dollar depreciates by 1 percent, and at the same time the prices of American products in the UK decrease by 1 percent, US producers will receive the same revenue from any foreign sales. This measure is directly related to changes in the terms of trade.

In order to have incomplete pass-through in economic models, many works, such as Atkeson and Burstein (2008), have focused on variable markups. Incomplete pass-through can also be achieved in a New Keynesian model with sticky prices and some level of substitution between varieties as in Monacelli (2005).[12] After a negative local shock, the external sector of the domestic country loses competitiveness through an increase in the price of the tradable good produced domestically relative to the price of the same good produced abroad. On the other hand, under the flexible regime, the exchange rate buffers the loss of competitiveness, mitigating the negative impact of the shock. Consequently, under a fixed exchange rate, the recession is deeper and longer lasting.

For this reason we start estimating exchange rate pass-through, in order to evaluate the extent of the changes in the terms of trade. For this exercise, we gather prices at the individual goods level for the US, the UK, France, and Germany. We do not have data for all of the goods and all of these countries, but we do have data for all of the prod-

[12] The market conditions to achieve that result were proposed in Dornbusch (1987)

ucts at least in the US.[13] We use monthly data from 1928 to 1934 for most products .[14] Then, we run the following regression to see the effect of the exchange rate on prices:

$$\Delta Prices_{c,j,t} = \beta \Delta Exchange\_Rate_{c,t} + \gamma_{j,c} + \theta_{j,t} + \varepsilon_{c,j,t}, \tag{1}$$

where $Prices_{c,j,t}$ is the log of the price of the good j in country c at time t. $Exchange\_Rate_{c,t}$ is the log bilateral exchange rate (US/c) with respect to country c at time t. We also add a country-product fixed effect ($\gamma_{j,c}$) to control for the unit of the good, so we do not have to worry if the price of the product is in per pounds or per kilograms, for example, and a product-time fixed effect ($\theta_{j,t}$) that controls for any general effect on prices and also for any product-specific shock or seasonality. Standard errors are clustered at the product-country level and at the time level.

In addition to this regression, we can see whether more tradable products have a higher or lower pass-through. Every good has some tradable and nontradable component, so we expect that β should be significant for all of the goods, but we expect that the effect should be more pronounced for goods that have a higher tradable component.[15] Table 1 shows the results for the regression just mentioned.

[13]The products are bread (France and US), butter (UK and US), cattle (UK and US), copper (Germany and US), cotton yarn (Germany and US), eggs (UK and US), hides (Germany and US), hogs (Germany, UK and US), milk (UK and US), oats (UK and US), pig iron (France, Germany, UK, and US), potatoes (UK and US), poultry (UK and US), and wheat (France, Germany, UK, and US).

[14]Data for pig iron are not available for the UK in 1934, and data for wheat are available until November 1934 for the UK and June 1934 for France

[15]We classify as tradable goods copper, cotton yarn, hides, oats, pig iron, potatoes and wheat.

Table 1: Effect of Exchange Rate Changes on Prices

	(1)	(2)	(3)	(4)
Exchange Rate (log changes)	-0.500***	-0.522***	-0.507***	-0.232**
	(0.104)	(0.119)	(0.127)	(0.105)
Exchange Rate*Tradable		0.044		-0.543**
		(0.116)		(0.236)
Country-Product FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	-	-
Product-Time FE	No	No	Yes	Yes
Observations	2,719	2,719	2,719	2,719
R-squared	0.071	0.071	0.590	0.592

Notes: The table shows the results of specification 1. The dependent variable is the change in log of prices. The exchange rate is the change in logs of the exchange rate, measured as US dollars over one unit of local currency (1 for the US). Tradable is a dummy equal to 1 for tradable goods. Clusters are at the product-country level and at the time level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

We can see that the pass-through is not complete. After a 1 percent depreciation of the British pound, prices in the UK are around 0.5 percent more expensive in pounds, meaning that those prices, when converted to US dollars, are 0.5 percent cheaper for American consumers. This effect is consistent over all the specifications. Consistent with Burstein, Eichenbaum, and Rebelo (2005), we find higher pass-through for tradable goods as shown in column (4). The average coefficient is in line with those found in Goldberg and Knetter (1997) and Burstein and Gopinath (2014). For tradable goods the coefficient is close to 0.8. This is a high pass-through, but close to and relatively smaller than the one found by Gopinath, Itskhoki, and Rigobon (2010) for non-dollar invoiced goods and Auer, Burstein, and Lein (2021) for euro-invoiced goods.

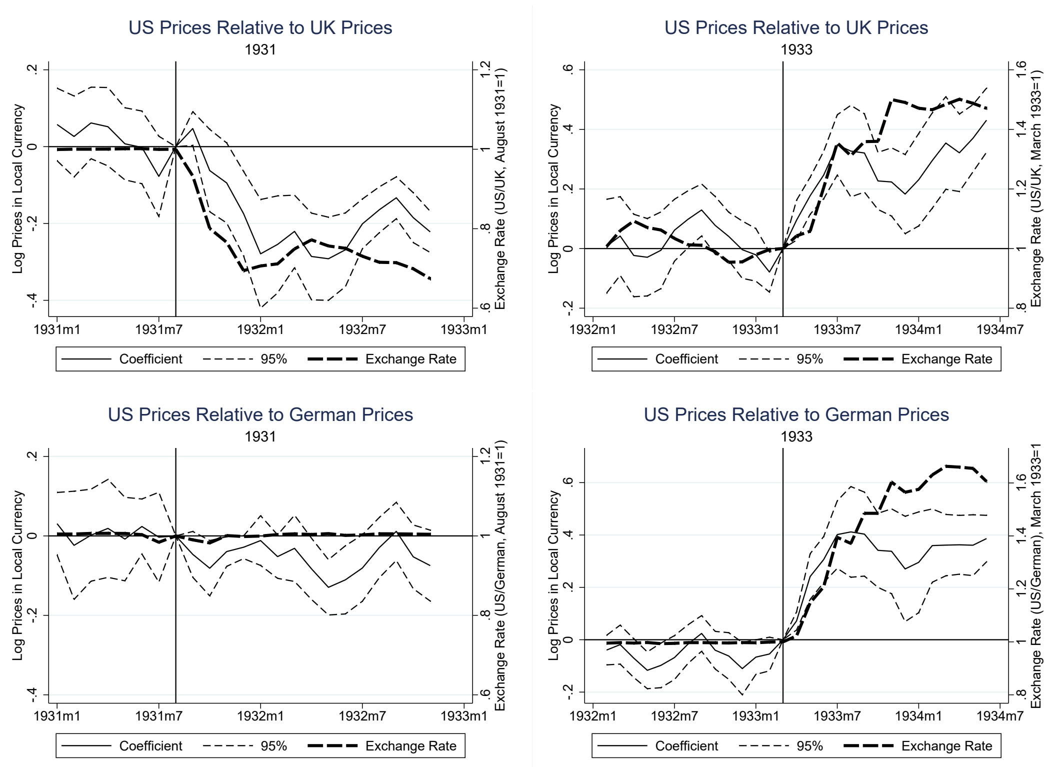
In addition to this result, we explore what happened during two important events during the Great Depression. The first event occurred in September 1931, when the UK left the gold standard, producing an appreciation of the US dollar of more than 25 percent relative to the British pound between September and December 1931, as shown in Figure 1. This shock is relatively exogenous from the US point of view. There is no evidence of changes in price expectations during that time (Binder (2016)). So, it is likely that the policy conducted in the UK was not related to prices in the US. This consideration will be more important when we discuss the results in terms of economic activity.

The second event occurred in April 1933, when the US left the gold standard. In this exercise, we only use product prices between a pair of countries and their bilateral exchange rate. We evaluate the effect of these events through the time series, exploring the cross-sectional differences in prices in each period of time. We perform this exercise between the US and the UK. For comparison, we also perform this exercise between the US and Germany. The bilateral exchange rate between the US and Germany did not change in 1931, so we should not see an effect that year. In 1933, the US dollar also depreciated relative to the German mark, so we expect to see an effect around that event of US prices relative to both British and German prices. We run the following regression:

$$Prices_{c,j,t} = \beta^{t} \times US_{c} \times \gamma_{t} + \gamma_{j,c} + \varepsilon_{c,j,t}, \tag{2}$$

where US_c is a dummy equal to 1 if the country is the US and γ_t is a time dummy. The rest of the variables are the same as in the previous equation. We explore the effect for the events of both 1931 and 1933 and show the results for all of the time series to test pre-trends and how persistent these effects are. Figure 3 shows the results.

Figure 3: Exchange Rate and Price Reaction after Gold Standard



Notes: The figure represents results from regression (2). The left panels represent results when the UK abandoned the gold standard in September 1931 and the right panels represent the event when the US left the gold standard in April 1933. The top two panels represent results of equation (2) for the US and the UK and the bottom two panels represent results of equation (2) for the US and Germany. The solid line represents the coefficient of the regression (β^t) for each period of time, which shows the reaction of US prices relative to the other economy. The light-dashed line represents confidence intervals at the 95 percent level. Standard errors have two-way clusters at the product-country level and at the time level. The dark-dashed line represents the bilateral exchange rate.

The figure shows a similar pattern compared with the general regression in Table 1. After the UK left the gold standard, US prices declined relative to UK prices at a lower rate than the appreciation of the US dollar. The opposite effect occurred in 1933. After the US went off the gold standard, US prices increased relative to UK prices at a lower rate than the depreciation of the US dollar. These changes are large and imply changes in the terms of trade. By August 1932, prices in the US were 16 percent lower than in the UK. This effect is the result of a 28 percent appreciation of the US dollar. A similar effect was produced over the same period of time (one year), but in 1933. US prices in March 1934 were 35 percent higher than in March 1933, after a 48 percent depreciation of the US dollar.

Relative prices between the US and Germany were less affected by the UK's departure from the gold standard. The results show only a mild reduction in bilateral prices around this event.[16] This shows that the change in prices did not come from some specific change in the US relative to all the other countries. In 1933, the change in relative prices between the US and Germany is similar to the change in relative prices between the US and the UK.[17]

The results found in this section are consistent with an incomplete pass-through. This incomplete pass-through is present around the main events that we analyze in this paper as well. From the price results, the implication is that exporters gained competitiveness in 1933, but the ones exposed to the UK in 1931 lost competitiveness. In the next section, using detailed cross-sectional variation in the US, we evaluate whether changes in competitiveness had an impact on the level of economic activity

4 Local Effect of Exchange Rate Changes on Economic Activity

We evaluate the effect on local economic activity. We use data on bank debits for more than 200 cities available on a weekly basis. As shown in Pedemonte (2020), this measure strongly correlates with measures of spending on durable goods. This measure highly predicts measures of economic activity, such as spending on cars, depart-

[16] According to Gopinath et al. (2020) pass-through of import prices should be driven by changes in the dominant currency. Eichengreen and Flandreau (2009) using data from Nurkse (1944) show that up to the 1930s the pound was still the dominant currency, but the US was also an important source of currency reserves. The British pound has been a more dominant currency for the United States than for Germany, which can explain why prices in the US might have declined slightly relative to the prices in Germany following the depreciation of the British pound. In any case, these relative changes are small.

[17] Note that this result is consistent with the British pound as a dominant currency.

ment store sales, industrial production and business activity, at the state, Federal Reserve District, and national levels on a monthly basis (see Appendix A.1, Tables A.1 and A.2). We aggregate these data to a monthly frequency and seasonally adjust the series.[18] This is relevant, since we are going to control for the economic characteristics of the cities, which can have important seasonal fluctuations, in particular in sectors such as agriculture.

We construct a measure of the exposure to changes in the exchange rate at the city level. In order to do this, we combine country sector-specific exports for the US in 1928, the bilateral exchange rate from 1928 to 1935, and city-level sectoral employment shares from the census of 1930 (Ruggles et al. (2021)). With this information, we construct a time-varying indicator that combines the specific exposure of a city to a country, through its economic specialization and get the variation over time through fluctuations in the bilateral exchange rate. Specifically, we construct the following measure of exposure:

$$Exposure\_Trade_{c,t} = \sum_{s} Sh\_W_{s,c,1930} \sum_{d} Sh\_Ex_{s,d,1928} \times RER_{d,t}, \tag{3}$$

where c indexes cities and t indexes dates. $Sh\_W_{s,c,1930}$ represents the share of workers in sector s in city c according to the census of 1930. $Sh\_Ex_{s,d,1928}$ is the sector's export share going to destination d and $RER_{d,t}$ is the relative bilateral nominal exchange rate of the US relative to destination d normalized to 1 in July 1931.

In order to combine the census industrial employment data with the sectoral trade information, we make a correspondence between both sources of information as described in Table A.3 in Appendix A.1. We have 45 sectors that represent US merchandise exports to 33 destinations. This information gives enough variation in terms of the exposure to trade to different destinations. While Canada and the UK were the main

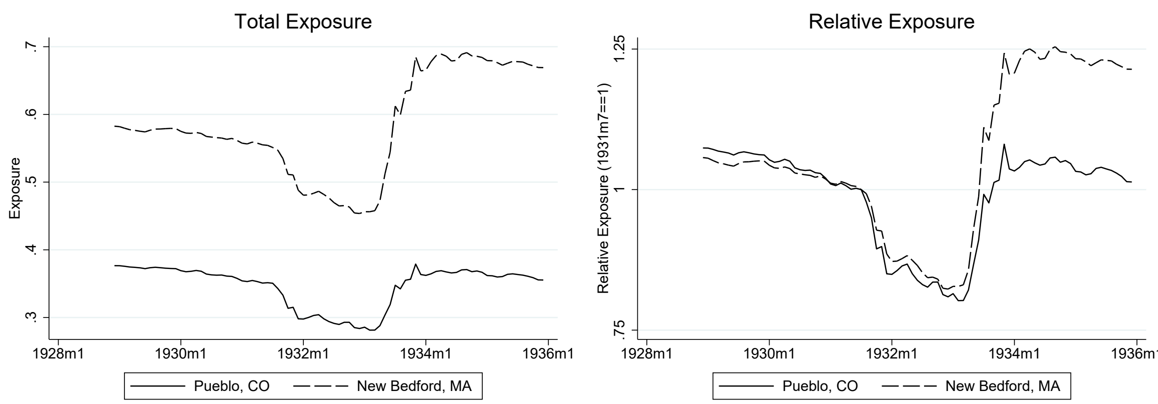
[18]We take logs and run a regression with city-month fixed effects. Then, we obtain the residual of the regression.

trading partners of the US, Japan, for example, dominated in forestry and fertilizers. Mexico dominated in explosives and firearms, the Netherlands in precious stones, and Germany in cotton. Also, while iron ore went mainly to Canada and the UK, only 12 percent of explosives and firearms went there in our sample. This variation gives us exposure to different exchange rate regimes and shocks.

$Exposure\_Trade_{c,t}$ incorporates the variation at the city level and across time. Considering the cross-sectional variation, the average value for each city shows how exposed to trade a city is relative to other cities. But it also incorporates the variation that is relevant given the exchange rate dynamics present in the Great Depression. For example, China had a flexible exchange rate with the US. This means that cities exposed to a sector where China is an important destination were losing competitiveness since the beginning of the Great Depression, but if those cities where not exposed to sectors where the UK or pound-tied countries were important, the appreciation of 1931 should not have been so relevant for those cities. At the same time, cities more exposed to France or Germany should benefit relatively more from the depreciation of 1933. This is also a direct measure of exposure, since it does not consider the exposure of the destination to other countries, through the same sector.

In order to illustrate the characteristics of this measure, we take two cities as examples: Pueblo, CO, and New Bedford, MA. Pueblo is an inland city, with geographical conditions less favorable to international trade. Surprisingly, this city had the median allocation of labor to exporting sectors according to our sample: 35.3 percent of its working population. This city had the main plant of the Colorado Fuel and Iron Company, an important steel conglomerate. Eighteen percent of the labor force of Pueblo worked in the steel manufacturing sector. The main destination of this sector's product was Canada, with 44 percent of the total exports in our sample, and then Japan, with 18 percent. On the other hand, New Bedford was a city open to international trade. Located on the coast of Massachusetts, the city had direct access to the Atlantic. This could explain why 55 percent of the city's labor force worked in the exporting sector. They specialized in textiles, another important exporting sector of the US. Forty-two percent of New Bedford's working population was employed in the cotton sector, distributed among several cotton mills in the city. The main destination of the semi-manufactured cotton products was Germany (25 percent of all the exports in our sample) and the UK (24 percent). These characteristics of the cities' employment exposed them to different shocks. We show the measure of exposure for both cities in the left panel of Figure 4 and the exposure relative to the city's value in July 1931 in the right panel.

Figure 4: Exposure Measure for Selected Cities



Notes: The figure shows the value of the variable from equation 3 for Pueblo, Colorado, and New Bedford, Massachusetts. The left panel shows the raw measure and the right panel shows the same measure, but relative to the city value in July 1931.

The left panel of Figure 4 shows that the measure is lower for Pueblo compared to New Bedford. This reflects the fact that Pueblo had a smaller fraction of its population working in the export sector. The right panel shows the same index normalized to 1 in July 1931. We can see that until July 1931, there were no changes in the relative exposure of both cities. This is because both cities were exposed to countries that had a fixed exchange rate with the US up to 1931. Then, we can see that starting in April 1933, the New Bedford exposure increases relative to the Pueblo exposure. This is because there were no significant changes in the bilateral exchange rate with Japan, while the US dollar depreciated sharply against the German mark. Overall, we can see that the measure combines general exposure to trade, with time series variations reflecting exposure to countries and their exchange rate movements.

We use this variable to evaluate the effect of trade on economic activity. Using monthly data, we run the following regression:

$$D_{c,t} = \gamma_c + \gamma_t + \beta \times Exposure\_Trade_{c,t} + \varepsilon_{c,t}, \tag{4}$$

where $D_{c,t}$ is the log of bank debits in city c at time t. We do not have many controls at the city-monthly level, so we include a city fixed effect in all specifications. We do this to focus on the variation in debits within the city, independent of the size. We include a time fixed effect to control for the common variation and focus on the cross-sectional variation given by changes in the relative exchange rate by individual countries. In some specifications, we include state-time fixed effects to control for any common change at the state level or Fed-time fixed effects to control for any common change at the Federal Reserve District level. Errors are clustered at the city level. Table 2 shows the results.

Table 2: Exposure to Trade and Exchange Rate Variation and Economic Activity

	(1)	(2)	(3)	(4)	(5)	(6)
Exposure Trade	1.193***	0.836***	0.758***	2.176***	1.965***	1.564***
	(0.253)	(0.260)	(0.216)	(0.449)	(0.453)	(0.529)
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	-	-	Yes	-	-
Fed-Time FE	No	Yes	No	No	Yes	No
State-Time FE	No	No	Yes	No	No	Yes
Sample	All	All	All	≤1933m3	≤1933m3	≤1933m3
Observations	21,807	21,807	21,164	13,269	13,269	12,899
R-squared	0.990	0.992	0.993	0.994	0.994	0.995

Notes: The table shows the results of regression 4. The dependent variable is the log of bank debits at the city level. The independent variable is the measure constructed according to equation 3. The different columns show the results with a combination of fixed effects as specified in the table. Standard errors are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

We find a significant effect of trade exposure (competitiveness) on economic activity. A big part of the identification comes from the common variation, since the main events affected many countries. But thanks to our measure, which considers country-specific variation, we can estimate an effect even including time fixed effects. A 1 percent variation in the city cross-section exposure, considering the time variation, increases economic activity by 1.19 percent. Using even more granular variation at the state level still yields positive and significant results. This variation takes into account some common exposure of regions. For example, cities in Michigan specialized in the automotive industry, so the results with state-time fixed effects take that common variation into account. The results are still significant and large, with a coefficient of 0.76.

These results should consider the variation in the trade exposure measure. In particular, we should account for the share of workers in the exporting sector, as the exchange rates are normalized to 1 in July 1931. In this case, the average and median city had 35 percent of its workers in the exporting sector. This measure goes from 3.7 percent to 75.2 percent in our sample. These numbers imply that the result found in this section should consider those levels, meaning that the median city increased its economic activity between 26.6 and 41.8 percent after an effective 1 percent city-specific depreciation.

One concern is that the results might be biased by US-led events and might be endogenous. In April 1933, the US abandoned the gold standard. As we explained before, there is no evidence that this event was expected, but still the results might be contaminated by that common variation across US cities and other policies that were implemented at that time. In columns (4)-(6) we consider only the period when the US was on the gold standard. Therefore, the variation in the exchange rate came from policy decisions in foreign countries. We can see that the coefficients are not only significant, but even larger: Including time fixed effects, a 1 percent variation in the city cross-section exposure increases economic activity by 2.17 percent. These results are in line with Obstfeld, Ostry, and Qureshi (2019), who show that under fixed regimes, global shocks are magnified.

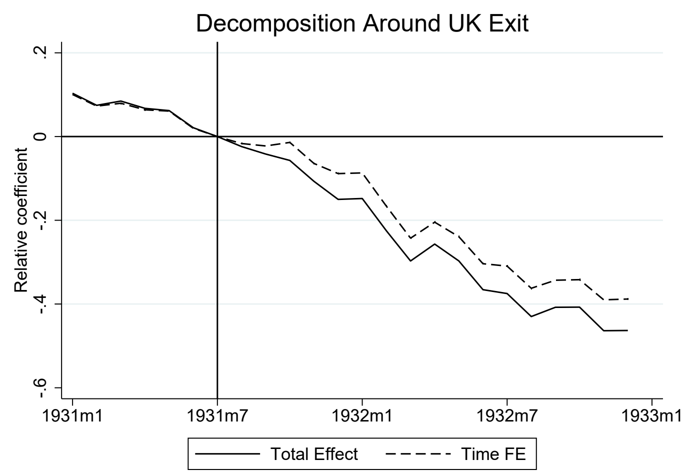
Next, we estimate the contribution of trade exposure to the depth of the Great Depression between 1931 and 1932 and to the recovery between 1933 and 1934. For simplicity, we use a version of equation 4 with a unique time fixed effect. Then, we assess the contribution of the average effect over the cities $\beta \times \overline{Exposure\_Trade_{c,t}}$ compared with the time effect γ_t, around the two main events covered in this paper. In particular, we will show how much of the total change in economic activity after those events can be attributed to the trade channel. This analysis abstracts from spillover effects and only shows direct effects. In a sense, it would be a lower bound of the total contribution of the trade channel. In the next subsection, we evaluate the event of 1931.

4.1 UK's Exit and Trough of the Great Depression

We first analyze what happened to the external sector after the large appreciation of the US dollar in 1931. This event was the consequence of policies implemented by other countries to deal with their respective local crises. As discussed before, Mexico exited in August 1931 and the UK in September 1931. In this sense, the event is exogenous relative to our observation units, which are particular cities in the US.

Figure 5 plots the total average effect $\gamma_t + \beta \times \overline{Exposure\_Trade}_{c,t}$ versus the time fixed effect γ_t. For both cases, it shows the changes over its own level in July 1931. As the dependent variable is in logs, this approximates to percentage changes with respect to the level of each effect in that period of time.

Figure 5: Effect of Exchange Rate Appreciation on Trade-Exposed Cities



Notes: The figure plots the changes in the average time fixed effect γ_t and the average total effect $\gamma_t + \beta \times \overline{Exposure\_Trade}_{c,t}$ relative to July 1931. The result comes from regression 4 reported in Table 2.

Figure 5 shows a large reaction of trade-exposed cities. After having similar trends, cities more exposed to trade show a large decrease in economic activity after August 1931 relative to the rest of the sample, conditional on their individual exposure to changes in the exchange rate. This effect is economically significant. As shown in Figure 5, on average, the economy had reduced its economic activity by 16 percent by the end of 1931 and around 40 percent of that effect was due to trade exposure. After that, the economy continues to decline. By the end of 1932, the trade exposure effect directly accounted for 16 percent of that effect.

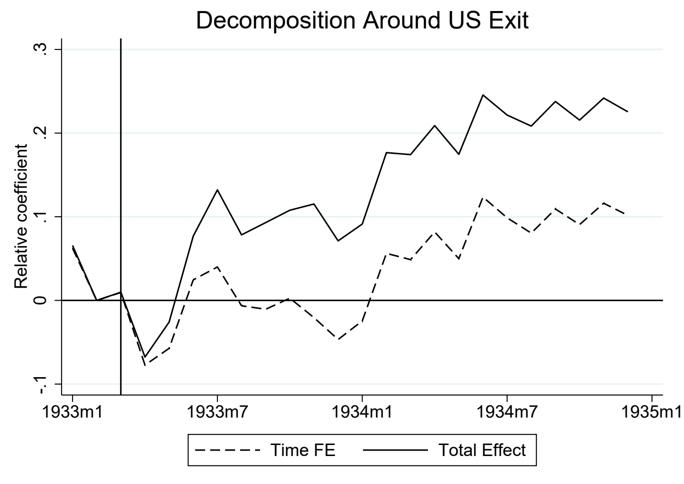
This result shows that the effect of the trade channel was relevant compared with the common trends in the economy at that time. This is a direct effect, meaning that we do not estimate any other type of multiplier. The appreciation of the US dollar in 1931 was strong, but the depreciation of 1933 was much greater in magnitude. In the next subsection, we evaluate the recovery starting in April 1933.

4.2 Recovery

In April 1933, the US left the gold standard and the US dollar depreciated relative to other currencies, as shown in Figure 1. The abandonment of the gold standard was part of the plan of the Democratic Party according to Eggertsson (2008) and not expected until March 1933 (Hsieh and Romer (2006)). But the change in policy was accompanied by many other policy changes. Many factors can explain the recovery that the economy experienced beginning in the spring of 1933. Some work has focused on expectation channels, whereby higher inflation expectations induced by Roosevelt's policies reduced the ex-ante real interest rate, stimulating investment and consumption through traditional channels (Eggertsson (2008), Jalil and Rua (2016), Sumner (2015), and Taylor and Neumann (2016)). Other work focuses on the role of public debt in the context of higher inflation; see, for example, Jacobson, Leeper, and Preston (2019). Hausman, Rhode, and Wieland (2019) argue that higher inflation coming from higher traded crop prices redistributed income from lenders (nonfarm households and businesses) with a relatively low marginal propensity to consume, to debtors (farmers) with a relatively high marginal propensity to consume. Cole and Ohanian (2004) argue that the recovery from the Great Depression was weak due to New Deal cartel-type policies.

In order to evaluate the contribution of the trade channel relative to that of other policies, we perform the same exercise as in the previous subsection, but relative to February 1933 to capture the contribution of the depreciation. The other policies implemented at the time do not seem to have a special focus on the external sector, so those considerations will be captured by common trends (time fixed effects) if they affected trade cities in the same way as nontrade cities. Figure 6 shows the effect following the abandonment of the gold standard by the US.

Figure 6: Trade Exposure Effect and US Abandons the Gold Standard



Notes: The figure plots the changes of the average time fixed effect γ_t and the average total effect $\gamma_t + \beta \times \overline{Exposure\_Trade}_{c,t}$ relative to February 1933. The result comes from regression 4 reported in Table 2.

As Figure 6 shows, in this case the trade channel's contribution is very important. We observe that after April 1933, more exposed cities experienced a large increase in their economic activity. After March 1933 there is a drop on average. That month was characterized by a bank holiday, so there are fewer observations for our sample and some cities show very small numbers that month. After that, there is an immediate increase in economic activity in more exposed cities. This effect is persistent. More exposed cities continued to have a higher level of economic activity. Overall, we can see that the trade channel also played an important role in the recovery that occurred after 1933.

The effect is large. We can see that the contribution of the trade channel is particularly important in 1933. By the end of that year, all the effect in terms of the recovery was due to the trade exposure, where cities on average increased their economic activity around 10 percent relative to February, even if the common trend was negative. Starting in 1934, the average time fixed effect is positive. By April 1934, the average total effect was 20 percent relative to February 1933, and the trade channel contributed more than 60 percent of the total effect. By the end of 1934 the contribution was still over 50 percent. We can see that the trade channel was the main driver of the economic recovery that started in 1933 and it continued to be relevant after that year.

These results were obtained with very granular data at the city level, but a good part of the variation is common to the cities. In the next section, we construct a measure of the increase in economic activity and we interact it with time dummies, to not rely on the effect of the exchange rate and see how income translated into spending. We use these results as a robustness check.

5 Robustness

5.1 Bartik Instrument

In this section, we use another measure of trade exposure as a robustness test, exploiting the growth rates of the export sectors between 1932 and 1933. This measure will closely indicate the increase in income that cities received given their sectoral exposure to trade. We rely on the main events analyzed before -the UK exit in 1931 and the US exit in 1933- to evaluate the effect of changes in the exchange rate on the economic activity of export-oriented cities. For this empirical exercise, instead of using the changes in the exchange rate, we rely only on time fixed effects interacted with the measure of exposure to an increase in exports to see whether more exposed cities had a relatively stronger economic recovery compared with less exposed cities.

In particular, we build a constant city-level measure of exposure to trade. As in the previous section, we get industrial employment at the county and industry level in 1930. Then, we obtain data on the sectoral exports of the US between April 1932 and March 1933 and compare them with the data between April 1933 and March 1934. With that information, we construct the following measure of exposure à la Autor, Dorn, and Hanson (2013):

$$Trade\_Exposure_{c,33-32} = \sum_{s} \frac{L_{c,s,1930}}{L_{c,1930}} \times \frac{Exports_{s,1934m3} - Exports_{s,1933m3}}{Exports_{s,1933m3}}, \tag{5}$$

where $L_{c,s,1930}$ is employment in 1930 in county c and sector s, $L_{c,1930}$ is total employment in county c, and $Exports_{s,y}$ is total exports in sector s over the last 12 months of y. This measure of exposure combines the sectoral employment composition of the county where the city is located with goods-level information on exports in terms of the US products that were more in demand abroad. Table A.4 shows the composition of merchandise exports between April 1932 and March 1933 and the annual growth rate of the value of exports from April 1933 to March 1934, compared with April 1932-March 1933 by type of commodities.

With this measure we will show which cities grew more after the shock in 1933, relative to the lowest level of exports in 1932. This could be seen as a direct effect. A city that exported more will have an increase in economic activity if exports rise. But in our estimations, we will compare the growth of the more exposed cities relative to less export-dependent cities, so we are an estimating the additional direct effect on the exposed cities.

As in the previous section, we estimate the effect of the appreciation of 1931 on economic activity in trade-exposed cities. Here, we will not use the changes in the exchange rate; instead, we will use the across-time variation as a source of identification because the largest appreciation occurred at a specific period. We can compare the pre-trends with the performance of the more exposed cities following the appreciation. This event occurred outside the US so it is unlikely that a more exposed city could have influenced that event. We run the following specification:

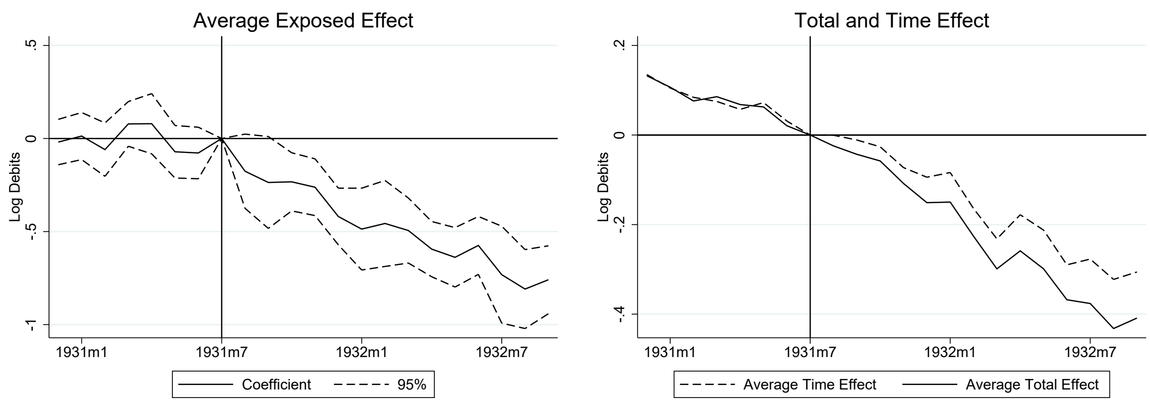
$$D_{c,t} = \alpha_c + \gamma_{s(c),t} + \sum_{\tau=0}^{T} \beta^{\tau} \times Trade\_Exposure_{c,33-32} \times \mathbb{1}_{\tau} + \varepsilon_{i,t}, \tag{6}$$

where $D_{c,t}$ is the seasonally adjusted log debits, $Trade\_Exposure_{c,33-32}$ is the trade exposure measure shown in equation 5, $\gamma_{s(c),t}$ is a state-time fixed effect, and α_c is a city fixed effect. $\mathbb{1}_\tau$ is an indicator variable that is one for year τ. The regression includes time-specific effects, meaning that β^τ will capture differential outcomes across more and less exposed cities. This empirical design implies that the coefficient β^τ represents the time fixed effect of average exposed cities relative to a baseline that considers the average effect of the rest of our sample. We will run this exercise around main events when countries with fixed exchange rates changed their regime. This exercise allows us to isolate those events from other changes in the bilateral exchange rate that occurred in countries with flexible exchange rates, that could be influenced by local shocks, such as changes in tariffs.[19]

In 1931, the economic activity of the whole country was decreasing. $\gamma_{s(c),t}$ will capture that effect even at the state level. The left panel of Figure 7 shows how more exposed cities behaved after the appreciation of the US dollar, given the shock of several countries exiting the gold standard. In the right panel, we show the contribution of this effect relative to the average effect over the cities at each period of time. We compute the average time effect ($\overline{\gamma_{s(c)t}}$), and the average exposed effect ($\overline{\gamma_{s(c)t}} + \beta^t \times \overline{Trade\_Exposure_{c,33-32}}$).

[19]For evidence on the effect of changes on tariffs in the US during the Great Depression, see Crucini and Kahn (1996) and Mitchener, Wandschneider, and O'Rourke (2021)

Figure 7: Effect of Exchange Rate Appreciation on Trade-Exposed Cities



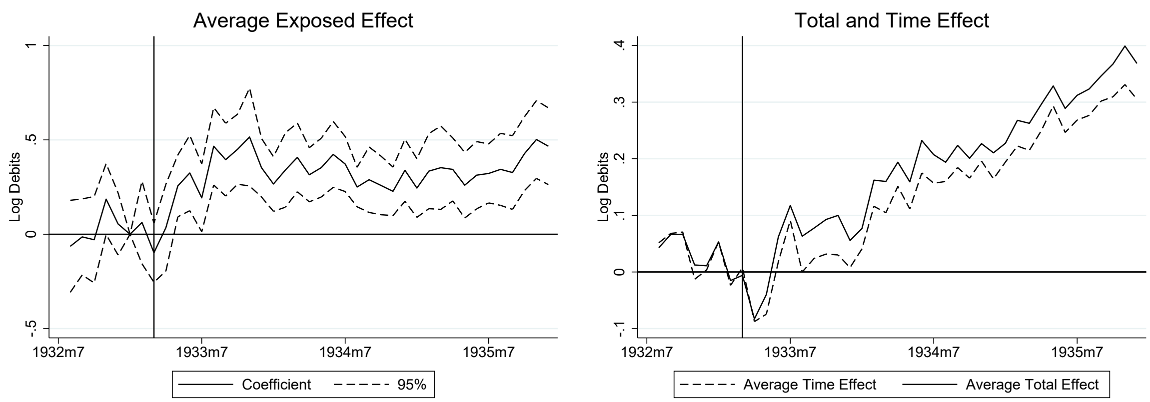
Notes: The right panel shows the results from the regression of the specification in equation 6. The solid line represents the coefficient β^t. The coefficient is relative to July 1931 (equal to 0). The dashed lines represent confidence intervals at the 95 percent level. Standard errors are two-way clustered at the city and time level. The right panel plots the average time effect $\overline{\gamma_{s(c)t}}$ and the average total effect $\overline{\gamma_{s(c)t}} + \beta^t \times \overline{Trade\_Exposure_{c,33-32}}$.

After having similar trends, cities more exposed to trade show a large decrease in economic activity after August 1931 relative to the rest of the sample. This effect is economically relevant. As shown in the left panel of Figure 7, the average exposure compared with the common trend of cities (time fixed effects) represents around a third of the effect by 1932.

These effects are large. The average measure of exposure is 0.136 and the standard deviation is 0.091. This means that in August 1932, an average trade-exposed city decreased its economic activity by 10 percent, relative to a less exposed city even in the same state. We can see in the right panel of Figure 7 that the contribution of this effect is economically significant. These results are similar to those found in the previous section.

We then run the specification in equation 6, but relative to January 1933 to capture the effect of the depreciation. The other policies implemented at the time do not seem to have a special focus on the external sector, so those considerations will be captured by common trends by the time fixed effect if they affected trade cities in the same way as no-trade cities. In this regression we will basically see if the trade channel has a differential effect versus the other channels. Figure 8 shows the effect following the abandonment of the gold standard by the US.

Figure 8: Trade Exposure Effect and US Abandons the Gold Standard



Notes: The figure shows the results from the regression of the specification in equation 6. The solid line represents the coefficient β^t. The coefficient is normalized to 1 in February 1933. The dashed lines represent confidence intervals at the 95 percent level. Standard errors are two-way clustered at the city and time level. The right panel plots the average time effect $\overline{\gamma_{s(c)t}}$ and the average total effect $\overline{\gamma_{s(c)t}} + \beta^t \times \overline{Trade\_Exposure_{c,33-32}}$.

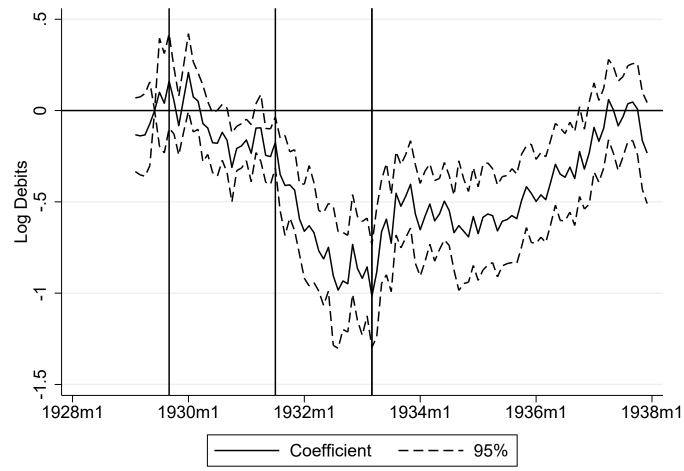
We observe that after April 1933, more exposed cities experienced a large increase in their economic activity. There is a small drop in the more exposed cities in March 1933. That month was characterized by a bank holiday, so there are fewer observations for our sample and some cities show very small numbers that month. After that, there is an immediate increase in economic activity in more exposed cities. This effect is persistent. More exposed cities continued to have a higher level of economic activity. Overall, we can see that the trade channel also played an important role in the recovery that occurred in 1933.

The coefficient is close to 0.5 by the end of 1933, which represents on average 7 percent more economic activity compared to the average growth. As explained before, many other policies were implemented at that time. Many of those are captured by the state-time fixed effect. The results show that more exposed cities grew relative to the rest of the sample. This indicates that the trade channel accounts for a significant differential effect, in a period when the whole country was growing. Considering this estimation, the contribution of the trade channel is similar to the numbers obtained in the previous section.

These results show that cities that increased their export-related income because of their trade exposure and increased their exports due to the exit of the US from the gold standard also significantly increased their spending relative to the other cities. Also, these results show that those same cities were particularly affected when the UK left the gold standard.

With this specification we can map the whole Great Depression and see how trade-exposed cities behaved. Also, we do not rely on data on the exchange rate, which experienced changes over time. In the next figure, we plot the coefficient of regression 6, between 1929 and 1936, representing the whole Great Depression and the recovery before the crisis of 1937. We normalize the coefficient to 0 in June 1929.

Figure 9: Trade Exposure Effect and the Great Depression



Notes: The figure shows the results from the regression of the specification in equation 6. The solid line represents the coefficient β^t. The coefficient is normalized to 0 in June 1929. The dashed lines represent confidence intervals at the 95 percent level. Standard errors are two-way clustered at the city and time level. Vertical lines represent October 1929, August 1931, and March 1933.

We can see an interesting pattern that coincides with some main events during the Great Depression. There is a stable relationship in the level of economic activity between exposed and non-exposed cities until June 1930, when the Smoot-Hawley Tariff Act was signed, and exposed cities lost ground relative to non-exposed cities. The Smoot-Hawley Tariff Act produced a trade war in which countries retaliated by boycotting US products, which can explain why export-oriented cities were affected (see Mitchener, Wandschneider, and O'Rourke (2021)). Then, when the UK and its major trading partners went off the gold standard, exposed cities were hit hard once again. There was an incomplete recovery when the US left the gold standard in April 1933 and exposed cities began to improve relative to non-exposed cities during the second half of 1935, when President Roosevelt signed trade agreements with the main trading partners of the US (e.g. with Canada in November 1935). Exposed cities converged to the level of less exposed cities at the state level only by the end of 1936.

These results show the importance of the trade channel during the Great Depression. US exporting cities were significantly affected relative to less dependent cities in the US, and their recovery depended on the devaluation of the exchange rate and the creation of trade agreements.

5.2 State-Level Evidence

The city- level estimation does not consider a large part of the country that can be affected by this policy. In particular, a large proportion of the agricultural sector might not be part of the counties included in the sample of cities. In order to have a better representation, we include results at the state level, so we include all the workers and exports of the economy.

An additional concern could be that bank debits are a poor measure of spending.[20] As a robustness check, in this section, we run the regressions with a direct measure of spending: new car sales, used in Hausman, Rhode, and Wieland (2019). These data have monthly frequency and are available at the state level. We create a measure of exposure at the state level (3), using the same data used in the previous section. We run regression (4) using the logarithm of new car sales by state. As we do not have reliable monthly data on population at the state level, we include state fixed effects to control for the constant size of the state. Table 3 presents the results.

[20] Which would not be justified, since we have already shown that bank debits correlate highly with several measures of economic activity and spending.

Table 3: Log New Cars by State

	(1)	(2)	(3)	(4)	(5)	(6)
Export Trade	6.049***	3.681***	3.952***	13.358***	5.236***	6.566***
	(0.276)	(0.388)	(0.409)	(0.499)	(1.451)	(1.207)
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	-	No	Yes	-
Fed-Time FE	No	No	Yes	No	No	Yes
Observations	3,528	3,528	3,528	2,499	2,499	2,499
R-squared	0.758	0.929	0.961	0.846	0.925	0.960

Notes: The table shows the results of regression 4. The dependent variable is the log of new car sales at the state level. The independent variable is the measure constructed according to equation 3. The different columns show the results with a combination of fixed effects as specified in the table. Standard errors are clustered at the city level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

We can see very consistent results as in the bank debit regression. The coefficients are statistically significant and large for all the specifications considered. A 1 percent city-specific depreciation increases new car sales between 3.7 percent and 14.4 percent depending on the specification and the period included.

The implied results are somewhat higher than the estimates with bank debits. This is shown in part in Table A.1. The reason behind these larger coefficients is the fact that cars are a durable good, so we expect them to react more to shocks. Summarizing, this result confirms that the exchange rate variation produced economic effects. In addition, we show that when we include the complete external sector in the US at the time, the effects remain similar.

6 Aggregate Effects

The results found in the previous section show how tradable cities affected by an specific depreciation behaved relative to other cities. These cross-sectional results alone tell us little about the aggregate effects of those changes. In the previous section we tried to inform the aggregate effect with the time fixed effect, but that is not necessarily the right counterfactual.

Even with a positive cross-sectional effect, it is not clear what the aggregate effect is after an exchange rate shock. After a depreciation, an exposed city increases its output relative to the non exposed city, but we do not have a good sense of the levels. The non exposed city could also be expanding, as there could be an increase in demand for its good from the exposed cities. On the other side, the depreciation increases the price of the good produced in the exposed regions, which can reduce demand in the less exposed city, thereby reducing output. Moreover, interest rates are also affected. These general equilibrium effects are not captured in the cross-sectional estimates. In addition to this, the import competition margin can play an important role, but we do not have data on that. So, the model can inform us about this margin.

In this section, we propose a simple model that will help us obtain the aggregate effect of the exchange rate shock. The model has the basic ingredients necessary to replicate the empirical results found. Then, we will shock the exchange rate from a symmetric steady state. With this shock and using similar data, we can replicate the empirical estimate, calibrate the model, and estimate the aggregate effect after an exchange rate shock.

The model has a "Home" country with two regions that trade with each other. Each region of the home country specializes in trade with one of the foreign countries. For simplicity, we assume there is no trade between the two foreign countries. The preferences for a particular region in the home country are

$$U_{i,t} = \frac{C_{i,t}^{1-\gamma}}{1-\gamma} - \psi \frac{L_{i,t}(z)^{1+\alpha}}{1+\alpha},$$

where $L_{i,t}(z)$ is the labor supply to a specific firm in region i, at time t producing variety z. $C_{i,t}$ is the consumption bundle in region i and at t and it is defined as

$$C_{i,t} = \left[\phi_H^{\frac{1}{\sigma}} C_{H,i,t}^{\frac{\sigma-1}{\sigma}} + \phi_C^{\frac{1}{\sigma}} C_{C,i,t}^{\frac{\sigma-1}{\sigma}} + \phi_F^{\frac{1}{\sigma}} C_{F,i,t}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}},$$

with $C_{H,i,t}$ is the good produced in the local region, $C_{C,i,t}$ is the good produced in the other region of the country and $C_{F,i,t}$ is the good produced in the foreign country. We assume that $\phi_H + \phi_C + \phi_F = 1$. In the case of the foreign country we have

$$C^*_{i,t} = \left[(\phi_H + \phi_C)^{\frac{1}{\sigma}} C_{H,i,t}^{\frac{\sigma-1}{\sigma}} + \phi_F^{\frac{1}{\sigma}} C_{F,i,t}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}.$$

Each type of good has varieties. Consumers everywhere have the same elasticity of substitution equal to η. Firms face sticky prices a la Calvo, with a probability of updating prices equal to θ. The price of each variety is the same in the country in which it is produced and between regions in the home country, but in case of international trade, they must pay an exchange rate equal to E_j, where $j = 1, 2$ are the foreign countries. The Phillips curve for the home country is :

$$\pi_{i,t} = \beta \pi_{i,t+1} + \frac{(1-\theta\beta)(1-\theta)}{\theta} \frac{1}{1+\alpha\eta} mc_{i,t},$$

where $mc_{i,t}$ is the average marginal cost for a firm in region i and for the foreign country

$$\pi^*_{j,t} = \beta \pi^*_{j,t+1} + \frac{(1-\theta\beta)(1-\theta)}{\theta} \frac{1}{1+\alpha\eta} mc^*_{j,t},$$

where $mc_{j,t}$ is the average marginal cost for a firm in country $j \neq H$.The market clearing conditions are

$$Y_{H,1,t} = C_{H,1,t} + C_{C,2,t} + C^*_{F,1,t},$$

$$Y_{H,2,t} = C_{H,2,t} + C_{C,1,t} + C^*_{F,2,t},$$

$$Y_{F,1,t} = C^*_{1,t} + C_{F,1,t},$$

and

$$Y_{F,2,t} = C^*_{2,t} + C_{F,2,t}.$$

The risk-sharing condition holds between regions and countries as well as the uncovered exchange rate parity. Using the risk-sharing condition, the market clearing conditions, and the optimal conditions of consumers, we see that local output depends on the terms of trade (as in Gali and Monacelli (2005)), which will change depending on the exchange rate pass-through. Then, we have that the log-linearized[21] output of the local economy's output depends on

$$\check{y}_t = \check{y}_t^* + \left[2\sigma(\phi_H + \phi_H)\phi_F + \frac{1}{2\gamma}\left(1 - 2(\phi_H + \phi_C)\right)^2\right]\check{q}_t,$$

with $\check{y}_t$ being the aggregate output of the home economy, $\check{y}_t^*$ is the sum of the foreign output and $\check{q}_t = \check{q}_1 + \check{q}_2$ is the sum of the terms of trade with $\check{q}_{i,t} = \check{p}_{F,i,t} + \check{e}_{i,t} - \check{p}_{H,i,t}$ with $i = \{1, 2\}$. With this expression, we can get an expression of the net exports over the aggregate GDP of the home region

$$\check{nx}_t = \phi_F\left((\phi_H + \phi_C)\left(\sigma - \frac{1}{\gamma}\right) - \frac{\gamma - 1}{2\gamma}\right)\check{q}_t.$$

We can see that while aggregate output, conditional on the output of the foreign region, depends positively on the terms of trade as long there is home bias, the sign of the net exports depends on the elasticity of substitution between the tradable and non-tradable goods and its relationship with the intertemporal elasticity of substitution.

We model the exchange rate regimes to mimic what happened during the period studied in the previous sections. The home country and foreign country 2 have a fixed exchange rate, as they are on the gold standard. Their nominal GDP is equal to a constant value, and the log-linearized expression for the exchange rate between both countries is

$$\check{e}_{2,t} = 0.$$

In the case of the exchange rate with foreign country 1, this depends on an exogenous shock that represents the changes in the exchange rate that we see in the data

[21] We define $\check{x}_t \equiv \frac{X_t - \bar{X}}{\bar{X}}$.

$$\check{e}_{1,t} = \nu_t,$$

with

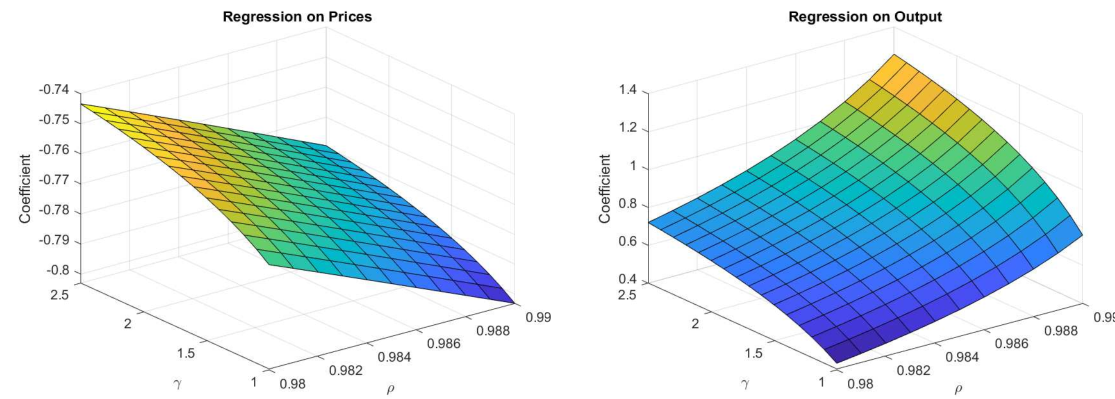
$$\nu_t = \rho \nu_{t-1} + \varepsilon_t.$$

Foreign country 1 has an independent monetary authority. We simulate the model, using a value of $\alpha = 2.0$, consistent with estimates of the labor supply elasticity in Chetty (2012). From Nakamura and Steinsson (2014), we use $\eta = 7$, $\theta = 0.75$, $\sigma = 2.0$ and the size of the local economy relative to the rest of the monetary union $\frac{\phi_H}{\phi_C + \phi_H} = 0.69$. Then, from the employment census data, we estimate a size of the tradable economy of 35 percent of total employment. From the export data we find that exports over national income is equal to 7 percent. Then, scaling by the size of the tradable economy, we use $\phi_F = 0.2$ and then we can obtain $\phi_H = 0.55$. Finally, and consistent with a relatively higher real interest rate at the time, we use $\beta = 0.985$. We simulate the model for different values of γ and the persistence of the shock ρ. With each simulation, we generate a series of prices, output by region, and exchange rates.

With that information, we run regression (2).[22] Those data include prices for the same variety in the local currency, but we cannot differentiate between local and foreign goods. We then run the regression over the price indexes. We compare the price index of foreign country 1 with home region 1 over the exchange rate with foreign country 1 and of foreign country 2 with home region 2 over the exchange rate with foreign country 2. We also run regression (4), where we compare overall output in regions 1 and 2 in the home country, with the respective exposure to the exchange rate. In this case, the region is fully exposed to a foreign country, so the variation in the exchange rate is not weighted by any value. Figure 10 shows the results for the main coefficient of those regressions.

[22] The log-linearized model and exact regressions are in Appendix A.2

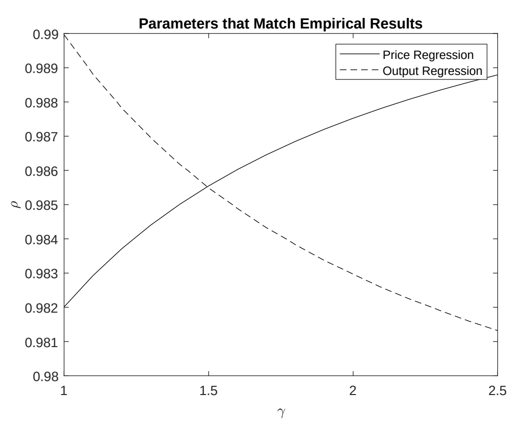
Figure 10: Regressions under Different Parameters



Notes: The figure shows the results from the regression of the specification in equation (2) (left) and (4) (right) for the simulated data generated in the model for different values of γ and ρ.

Then, we use those parameters to generate the values of γ and ρ that can replicate the regression results. In particular, we match the results in column (4) of Table 1 (-0.775). We use the sum of both coefficients, because in the model we only have tradable goods. We also match the results with column (3) of Table 2 (0.758). Figure 11 shows the combination of parameters that generates the values for the regressions.

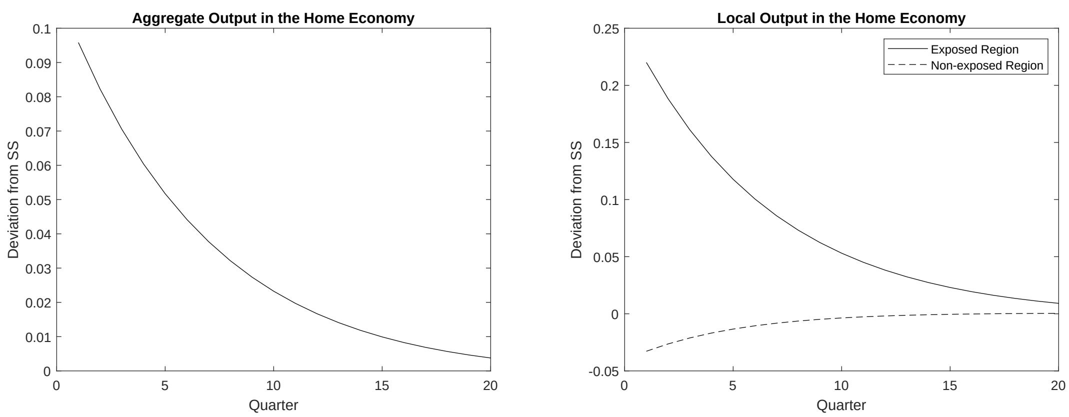
Figure 11: Parameters That Match Empirical Results



Notes: The figure shows the combination of parameters that generates the results of the sums of the coefficients in column (4) of Table 1 (-0.775) and column (3) in Table 2 (0.758).

We can see that in the intersection of both lines, there is a combination of parameters that matches both regressions. That combination is $\rho = 0.9855$ and $\gamma = 1.5$. We can see that this implies a very high persistence, which is consistent with changes in regime that produced long-lasting effects in the exchange rate. It also uses a reasonable value for the intertemporal elasticity of substitution. With those values we simulate what happened to the aggregate economy after the shock. Figure 12 shows the aggregate effect of the exchange rate shock in the global economy.

Figure 12: Aggregate Output after Depreciation



Notes: The left panel shows how aggregate output in the home economy reacts to a 1 percent depreciation in one of the economies. The right panel shows the deviation of each region with respect to the steady state after the shock.

We can see that a 1 percent depreciation increases local output by 0.22 percent on impact, but decreases output in the non exposed city by 0.03 percent. This effect can explain the deepening of the depression in 1931 after the UK left the gold standard, directly affecting many exporting cities. This effect can also explain the fast recovery of the US economy in 1933.

The results confirm that the cross-sectional estimates found in the empirical part may be associated with aggregate effects, but the coefficients are biased. Running a regression on aggregate output and the export-weighted exchange rate produced by the data gives us an estimate of 0.601 (or 0.301 for a depreciation of the exchange rate that affects half of the exporting sector), which is smaller than the cross-sectional estimate, but still high. This highlights the role of the events of 1931 in the Great Depression. Using this estimate we evaluate the contribution of the changes in exchange rate to aggregate economic activity. Between July 1931 and June 1932, the export-weighted exchange rate decreases by 14.2 percent, due to a more than 30 percent appreciation of the US dollar relative to the UK pound. If we consider that those estimates affect half of the exporting sector, there would be an 8.53 percent drop in economic activity. This effect would account for nearly a third of the drop in industrial production between July 1931 and August 1932 (1 year, 29 percent). When we look at the depreciation of the US dollar in 1933, the export-weighted exchange rate increased by 39 percent. Considering this magnitude, this change in the exchange rate implies an increase in economic activity of 23.44 percent, relative to an increase in industrial production of 39 percent by February 1934.

7 Conclusion

This paper explores the effect that the gold standard, as a fixed exchange rate system, had on the US economy during the Great Depression. Using novel micro data, we show that the terms of trade adjusted after the large currency changes that occurred when countries abandoned the gold standard. We show that the US was affected by the exit of the UK. The average trade-exposed city led the decline in economic activity in 1931. We also find that the opposite happened when the US abandoned the gold standard. This paper shows that the trade channel played an important role in the depth of and the recovery from the Great Depression.

This channel can be added to others that have been analyzed in the literature, but it has the advantage that we tested it in a different context than the recovery of 1933, when many other policies were implemented at the same time.

This paper shows that fixed exchange rate regimes contributed to the economic crises of the past and can have important implications today. Some type of fixed exchange rate is still used by a large number of countries according to recent evidence (Ilzetzki, Reinhart, and Rogoff (2019)). Our results show that those regimes could have detrimental effects for their external sectors in the case of negative shocks. Moreover, countries belonging to currency unions, such as those of the Eurozone, have experienced different recovery paths since the Great Recession. In a world with high financial and trade integration, limiting the ability of the exchange rate to adjust can have important sectoral implications that could translate into deep economic recessions.

This paper also shows that relaxing those pegs could be beneficial for economic recovery. In this paper we show that exporting cities experienced an almost immediate recovery compared with nonexporting cities when the dollar depreciated in 1933. As Friedman (1953) pointed out, the exchange rate is a relatively flexible price that allows the rest of the prices in the economy to adjust relative to those in other countries. The results of this paper confirm that logic and highlight the importance of that mechanism in buffering macroeconomic shocks.

References

Albornoz, Facundo and Ezequiel García-Lembergman. 2020. "Importing After Exporting." *Unpublished Manuscript* .

Amiti, Mary, Oleg Itskhoki, and Jozef Konings. 2014. "Importers, Exporters, and Exchange Rate Disconnect." *American Economic Review* 104 (7):1942–78. DOI https://doi.org/10.1257/aer.104.7.1942.

Atkeson, Andrew and Ariel Burstein. 2008. "Pricing-to-Market, Trade Costs, and International Relative Prices." *American Economic Review* 98 (5):1998–2031. DOI https://doi.org/10.1257/aer.98.5.1998.

Auer, Raphael, Ariel Burstein, and Sarah M. Lein. 2021. "Exchange Rates and Prices: Evidence from the 2015 Swiss Franc Appreciation." *American Economic Review* 111 (2):652–86. DOI https://doi.org/10.1257/aer.20181415.

Autor, David H., David Dorn, and Gordon H. Hanson. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *American Economic Review* 103 (6):2121–68. DOI https://doi.org/10.1257/aer.103.6.2121.

Bernanke, Ben S. 1995. "The Macroeconomics of the Great Depression: A Comparative Approach." *Journal of Money, Credit and Banking* 27 (1):1–28. DOI https://doi.org/10.2307/2077848.

Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott. 2007. "Firms in International Trade." *Journal of Economic Perspectives* 21 (3):105–130. DOI https://doi.org/10.1257/jep.21.3.105.

Binder, Carola Conces. 2016. "Estimation of Historical Inflation Expectations." *Explorations in Economic History* 61:1–31. DOI https://doi.org/10.1016/j.eeh.2016.01.002.

Blaum, Joaquin. 2019. "Global Firms in Large Devaluations." *Unpublished Manuscript, Brown University* .

Bordo, Michael D. and Christopher M. Meissner. 2020. "Original Sin and the Great Depression." DOI https://doi.org/10.3386/w27067.

Burstein, Ariel, Martin Eichenbaum, and Sergio Rebelo. 2005. "Large Devaluations and the Real Exchange Rate." *Journal of Political Economy* 113 (4):742–784. DOI https://doi.org/10.1086/431254.

Burstein, Ariel and Gita Gopinath. 2014. "International Prices and Exchange Rates." In *Handbook of International Economics*, vol. 4. Elsevier, 391–451. DOI https://doi.org/10.1016/B978-0-444-54314-1.00007-0.

Campa, Jose Manuel. 1990. "Exchange Rates and Economic Recovery in the 1930s: An Extension to Latin America." *Journal of Economic History* 50 (3):677–682. DOI https://doi.org/10.1017/S0022050700037232.

Chetty, Raj. 2012. "Bounds on elasticities with optimization frictions: A synthesis of micro and macro evidence on labor supply." *Econometrica* 80 (3):969–1018.

Cole, Harold L. and Lee E. Ohanian. 2004. "New Deal Policies and the Persistence of the Great Depression: A General Equilibrium Analysis." *Journal of Political Economy* 112 (4):779–816. DOI https://doi.org/10.1086/421169.

Crucini, Mario J. and James Kahn. 1996. "Tariffs and aggregate economic activity: Lessons from the Great Depression." *Journal of Monetary Economics* 38 (3):427–467. DOI https://doi.org/10.1016/S0304-3932(96)01298-6.

Diercks, Anthony M., Jonathan Rawls, and Eric Sims. 2020. "Bury the Gold Standard? A Quantitative Exploration." *NBER Working Paper* 28015. DOI https://doi.org/10.3386/w28015.

Dornbusch, Rudiger. 1987. "Exchange Rates and Prices." *American Economic Review* 77 (1):93–106. DOI http://www.jstor.org/stable/1806731.

Eggertsson, Gauti B. 2008. "Great Expectations and the End of the Depression." *American Economic Review* 98 (4):1476–1516. DOI https://doi.org/10.1257/aer.98.4.1476.

Eichengreen, Barry. 1996. *Golden Fetters: The Gold Standard and the Great Depression, 1919-1939*. Oxford University Press. DOI https://doi.org/10.1093/0195101138.001.0001.

Eichengreen, Barry and Marc Flandreau. 2009. "The rise and fall of the dollar (or when did the dollar replace sterling as the leading reserve currency?)." *European Review of Economic History* 13 (3):377–411. DOI https://doi.org/10.1017/S1361491609990153.

Eichengreen, Barry, Naeun Jung, Stephen Moch, and Ashoka Mody. 2014. "The Eurozone Crisis: Phoenix Miracle or Lost Decade?" *Journal of Macroeconomics* 39:288–308. DOI https://doi.org/10.1016/j.jmacro.2013.08.005.

Eichengreen, Barry and Jeffrey Sachs. 1985. "Exchange Rates and Economic Recovery in the 1930s." *Journal of Economic History* 45 (4):925–946. DOI https://doi.org/10.1017/S0022050700035178.

Farhi, Emmanuel and Matteo Maggiori. 2018. "A Model of the International Monetary System." *The Quarterly Journal of Economics* 133 (1):295–355. DOI https://doi.org/10.1093/qje/qjx031.

Feenstra, Robert C. 1989. "Symmetric pass-through of tariffs and exchange rates under imperfect competition: An empirical test." *Journal of International Economics* 27 (1):25–45. DOI https://doi.org/10.1016/0022-1996(89)90076-7.

Friedman, Milton. 1953. "The case for flexible exchange rates." *Essays in Positive Economics* 157 (203):33.

Gali, Jordi and Tommaso Monacelli. 2005. "Monetary Policy and Exchange Rate Volatility in a Small Open Economy." *Review of Economic Studies* 72 (3):707–734. DOI https://doi.org/10.1111/j.1467-937X.2005.00349.x.

Goldberg, Pinelopi Koujianou and Michael M. Knetter. 1997. "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature* 35 (3):1243–1272. DOI http://www.jstor.org/stable/2729977.

Gopinath, Gita, Emine Boz, Camila Casas, Federico J Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller. 2020. "Dominant Currency Paradigm." *American Economic Review* 110 (3):677–719. DOI https://doi.org/10.1257/aer.20171201.

Gopinath, Gita, Oleg Itskhoki, and Roberto Rigobon. 2010. "Currency Choice and Exchange Rate Pass-through." *American Economic Review* 100 (1):304–36. DOI https://doi.org/10.1257/aer.100.1.304.

Hausman, Joshua K., Paul W. Rhode, and Johannes F. Wieland. 2019. "Recovery from the Great Depression: The Farm Channel in Spring 1933." *American Economic Review* 109 (2):427–72. DOI https://doi.org/10.1257/aer.20170237.

Hsieh, Chang-Tai and Christina D. Romer. 2006. "Was the Federal Reserve Constrained by the Gold Standard During the Great Depression? Evidence from the 1932 Open Market Purchase Program." *Journal of Economic History* :140–176DOI https://doi.org/10.1017/S0022050706000064.

Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff. 2019. "Exchange Arrangements Entering the Twenty-First Century: Which Anchor will Hold?" *Quarterly Journal of Economics* 134 (2):599–646. DOI https://doi.org/10.1093/qje/qjy033.

Jacobson, Margaret M., Eric M. Leeper, and Bruce Preston. 2019. "Recovery of 1933." .

Jalil, Andrew J and Gisela Rua. 2016. "Inflation Expectations and Recovery in Spring 1933." *Explorations in Economic History* 62:26–50. DOI https://doi.org/10.1016/j.eeh.2016.07.001.

Knetter, Michael M. 1989. "Price Discrimination by U.S. and German Exporters." *American Economic Review* 79 (1):198–210. DOI http://www.jstor.org/stable/1804781.

Levy-Yeyati, Eduardo and Federico Sturzenegger. 2003. “To Float or to Fix: Evidence on the Impact of Exchange Rate Regimes on Growth.” *American Economic Review* 93 (4):1173–1193. DOI https://doi.org/10.1257/000282803769206250.

Lopez-Cordova, J. Ernesto and Christopher M. Meissner. 2003. “Exchange-Rate Regimes and International Trade: Evidence from the Classical Gold Standard Era.” *American Economic Review* 93 (1):344–353. DOI https://doi.org/10.1257/000282803321455331.

Miranda-Agrippino, Silvia and Helene Rey. 2020. “U.S. Monetary Policy and the Global Financial Cycle.” *Review of Economic Studies* 87 (6):2754–2776. DOI https://doi.org/10.1093/restud/rdaa019.

Mitchener, Kris James and Gonçalo Pina. 2020. “Pegxit Pressure.” *Journal of International Money and Finance* 107:102191. DOI https://doi.org/10.1016/j.jimonfin.2020.102191.

Mitchener, Kris James, Kirsten Wandschneider, and Kevin O’Rourke. 2021. “The Smoot-Hawley Trade War.” *NBER Working Paper* 28616. DOI https://doi.org/10.3386/w28616.

Monacelli, Tommaso. 2005. “Monetary Policy in a Low Pass-through Environment.” *Journal of Money, Credit and Banking* :1047–1066DOI https://doi.org/10.1353/mcb.2006.0007.

Nakamura, Emi and Jon Steinsson. 2014. “Fiscal stimulus in a monetary union: Evidence from US regions.” *American Economic Review* 104:753–92.

Nurkse, Ragnar. 1944. *International Currency Experience: Lessons of the Inter-War Period*, vol. 2. League of Nations.

Obstfeld, Maurice, Jonathan D. Ostry, and Mahvash S. Qureshi. 2019. “A Tie That

Binds: Revisiting the Trilemma in Emerging Market Economies." *Review of Economics and Statistics* 101 (2):279–293. DOI https://doi.org/10.1162/rest_a_00740.

Obstfeld, Maurice and Kenneth Rogoff. 1995. "The Mirage of Fixed Exchange Rates." *Journal of Economic Perspectives* 9 (4):73–96. DOI https://doi.org/10.1257/jep.9.4.73.

Patch, Buel W. 1934. "Foreign Trade and Currency Stability." http://library.cqpress.com/cqresearcher/cqresrre1934012500.

Pedemonte, Mathieu. 2020. "Fireside Chats: Communication and Consumers' Expectations in the Great Depression." *Federal Reserve Bank of Cleveland Working Papers* (WP 20-30). DOI https://doi.org/10.26509/frbc-wp-202030.

Rodrik, Dani. 2008. "The Real Exchange Rate and Economic Growth." *Brookings Papers on Economic Activity* 2008 (2):365–412. DOI https://ideas.repec.org/a/bin/bpeajo/v39y2008i2008-02p365-439.html.

Romer, Christina D. 1992. "What Ended the Great Depression?" *Journal of Economic History* 52 (4):757–784. DOI https://doi.org/10.1017/S002205070001189X.

Ruggles, Steven, Sarah Flood, Ronald Goeken, Jose Pacas, Megan Schouweiler, and Matthew Sobek. 2021. "IPUMS USA: Version 11.0 [dataset]." *Minneapolis, MN: IPUMS* DOI https://doi.org/10.18128/D010.V11.0.

Solomou, Solomos and Dimitris Vartis. 2005. "Effective Exchange Rates in Britain, 1920-1930." *Journal of Economic History* 65 (3):850–859. DOI https://doi.org/10.1017/S0022050705000318.

Sumner, Scott. 2015. *The Midas Paradox: Financial Markets, Government Policy Shocks, and the Great Depression*. Independent Institute.

Taylor, Jason E. and Todd C. Neumann. 2016. "Recovery Spring, Faltering Fall: March to November 1933." *Explorations in Economic History* 61:54–67. DOI https://doi.org/10.1016/j.eeh.2016.03.003.

Triffin, Robert. 1961. *Gold and the Dollar Crisis: The Future of Convertibility*, vol. 39. Yale University Press.

A Appendix

A.1 Other Tables and Figures

Table A.1: Relationship of Debits to Regional Measures of Economic Activity

	Log Car Registration (State)				% Change in Department Store Sales (Fed)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Debits	0.610***	1.032***	0.588***	0.349***	0.376***	0.375***	0.248***	0.226***
	(0.008)	(0.037)	(0.006)	(0.053)	(0.023)	(0.023)	(0.037)	(0.037)
Region FE	No	Yes	No	Yes	No	Yes	No	Yes
Time FE	No	No	Yes	Yes	No	No	Yes	Yes
Observations	3,480	3,480	3,480	3,480	792	792	792	792
R-squared	0.681	0.786	0.839	0.929	0.438	0.441	0.896	0.900

Notes: The table shows the results of regressions of economic activity variables and bank debits. Rows 1 to 4 show regressions of the monthly log of car registrations at the state level from Hausman, Rhode, and Wieland (2019) and log bank debit, between 1929 and 1934. Rows 5 to 8 show regressions of the percentage change in department store sales over the percentage change in debits at the monthly and Federal Reserve District level, excluding the NY Fed, between 1930 and 1935. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.2: Relationship of Debits to National Measures of Economic Activity

	Industrial Production			Business Activity		
	(1)	(2)	(3)	(4)	(5)	(6)
Log Debits	0.346***	0.514***	0.592***	0.496***	0.613***	0.470***
	(0.032)	(0.029)	(0.066)	(0.026)	(0.035)	(0.051)
Sample	All	$< 1933m3$	$\geq 1933m3$	All	$< 1933m3$	$\geq 1933m3$
Observations	117	51	66	117	51	66
R-squared	0.359	0.823	0.492	0.668	0.817	0.457

Notes: The table shows the results of regressions of economic activity variables and bank debits. Rows 1 to 3 show regressions of the monthly log industrial production at the national level and log bank debit, between 1929 and 1938. Rows 4 to 6 show regressions of log business activity measures from the Cleveland Trust Company over the percentage change in debits at the monthly level between 1929 and 1938. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A.3: Correspondence between Export Sectors and Industrial Classification

Group	Commodities Groups	1930 Census Industrial Classification
1	Fish	Fish Curing and Packing
		Fishing
2	Dairy Products	Butter, Cheese, and Condensed Milk Factories
3	Animals, Edible	Slaughter and Packing Houses
	Meat Products	
	Animal Oils and Fats, Edible	
	Other Edible Animal Products	
	Hides and Skins, Raw, Except Furs	
	Animals, Oils, Fats, and Greases Inedible	
	Other Inedible Animals and Animal Products	
4	Leather	Trunk, Suitcase, and Bag Factories
	Leather Manufactures	Tanneries
		Harness and Saddle Factories
		Leather Belt, Leather Goods, etc Factories
		Shoe Factories
5	Grains and preparations	Flour and Grain Mills
	Fodders and Feeds	
	Vegetables Oils and Fats, Edible	
	Oilseeds	
	Seeds, Except Oilseeds	
6	Sugar and Related Products	Sugar Factories and Refineries
7	Cocoa and Coffee	Liquor and Beverage Industries
	Beverages	

Continued on next page

Table A.3 – *Continued from previous page*

Group	Commodities Groups	1930 Census Industrial Classification
8	Tobacco and Manufactures	Cigar and Tobacco Factories
		Agriculture (Tobacco)
9	Rubber and Manufactures	Rubber Factories
10	Fruits and Nuts	Agriculture (No Cotton-Tobacco)
	Vegetables and Preparations	
	Drugs, Herbs, Leaves and Roots Crude	
	Nursery and Greenhouse Stock	
	Miscellaneous Vegetable Products	
11	Silk manufactures	Silk Mills
12	Rayon and other Synthetic Textiles	Rayon Factories
		Hat Factories (felt)
13	Furs and Manufactures	Corset Factories
	Dyeing and Tanning Materials	Other and Not Specified Textile Mills
	Cotton Manufactures	Shirt, Collar, and Cuff Factories
	Wool Manufactures	Glove Factories
	Silk Unmanufactured	Carpet Mills
		Lace and Embroidery Mills
		Straw Factories
		Button Factories
		Sail, Awning, and Tent Factories
		Other Clothing Factories
		Broom and Brush Factories
		Textile Dyeing, Finishing, and Printing Mills
		Suit, Coat, and Overall Factories
		Knitting Mills

Continued on next page

Table A.3 – *Continued from previous page*

Group	Commodities Groups	1930 Census Industrial Classification
14	Cotton, Unmanufactured	Cotton Mills
	Cotton Semimanufactures	Agriculture (Cotton)
15	Jute and Manufactures	Hemp, Jute, and Linen Mills
	Flax, Hemp and Ramie Manufactures	Rope and Cordage Factories
	Other Vegetable Fibers and Manufactures	
16	Wool, Semimanufactures	Woolen and Worsted Mills
	Wool, Mohair, and Angora Rabbit Hair, Unmanufactured	
17	Wood, Unmanufactured	Forestry
	Naval Stores, Gums, and Resins	
	Cork and Manufactures	
18	Wood manufactures	Wagon and Carriage Factories
		Other Woodworking Factories
		Furniture Factories
19	Wood Semimanufactures-Sawmill Products	Saw and Planing Mills
20	Paper and Manufactures	Paper Box Factories
		Blank Nook, Envelope, Tag, Paper Bag, etc. Factories
21	Paper Base Stocks	Paper and Pulp Mills
22	Coal and Related Fuels	Coal Mines
		Charcoal and Code Works
23	Stone, Sand, Cement and Lime	Quarries
		Lime, Cement, and Artificial Stone Factories
24	Petroleum and Products	Petroleum Refineries
		Oil Wells and Gas Wells
25	Glass and Glass Products	Glass Factories
26	Clays and Clay Products	Potteries

Continued on next page

Table A.3 – *Continued from previous page*

Group	Commodities Groups	1930 Census Industrial Classification
		Brick, Tile, and Terra-Cotta Factories
27	Precious Stones including Pearls	Marble and Stone Yards
28	Other Nonmetallic Mineral Products	Salt Wells and Works
29	Iron Ore	Iron Mines
30	Iron and Steel, Advanced Manufactures	Tinware, Enamelware, etc, Factories
31	Precious Metals, Jewelry and Plated Ware	Jewelry Factories
32	Agricultural Machinery and Implements	Agricultural Implement Factories
33	Automobiles and other Vehicles	Automobile Factories
34	Coal-tar Products	Paint and Varnish Factories
	Pigments, Paints and Varnishes	
35	Fertilizer and Fertilizer Materials	Fertilizer Factories
36	Vegetable Oils	Soap Factories
	Soap and Toilet Preparations	
37	Musical Instruments	Piano and Organ Factories
38	Clocks and Watches	Clock and Watch Factories
39	Silver	Gold and Silver Mines
	Gold	Gold and Silver Factories
40	Iron and Steel Semimanufactures	Other Iron and Steel and Machinery Factories
	Steel Mill Products-Manufactures	Blast Furnaces and Steel Rolling Mills
41	Ferro-alloys	Not Specified Metal Industries
	Nonferrous Metals, except Precious	Copper Factories
		Brass Mills
		Not Specified Mines
		Lead and Zinc Factories
		Other Metal Factories

Continued on next page

Table A.3 – *Continued from previous page*

Group	Commodities Groups	1930 Census Industrial Classification
		Copper Mines
		Lead and Zinc Mines
		Other Specific Mines
42	Electrical Machinery and Apparatus	Electrical Machinery and Supply Factories
	Industrial Machinery	
43	Office Appliances	Other Miscellaneous Manufacturing Industries
	Printing Machinery	
44	Medicinal and Pharmaceutical Preparations	Other Chemical Factories
	Industrial Chemicals Specialties	
	Industrial Chemicals	
45	Explosives, Fuses, etc.	Explosives, Ammunition, and Fireworks Factories
	Firearms and Ammunition	

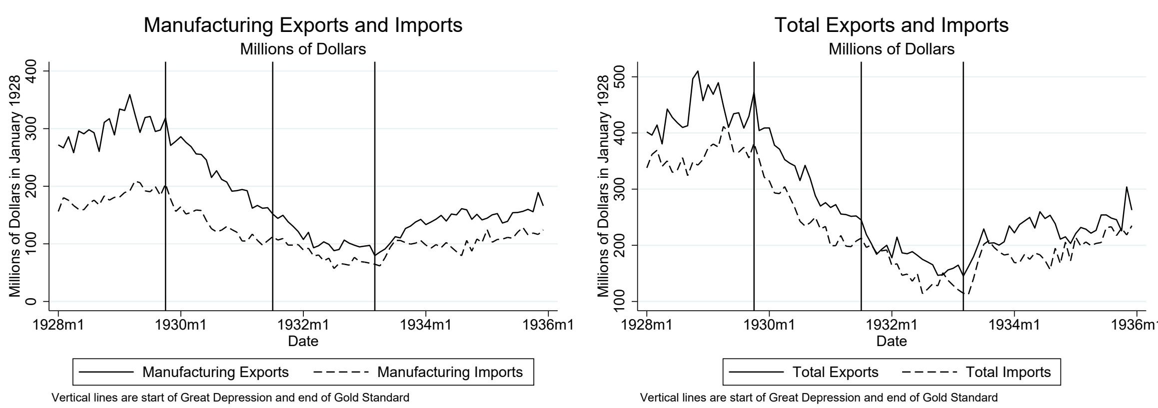
Notes: The table contains the correspondence between export sectors and industrial sectors. The classification of export sectors is the one used in the Statistical Abstract of the United States Foreign Commerce 1935. The classification of industrial sectors corresponds to the 1930 census industrial classification system.

Table A.4: Exports by Commodities Groups

Commodities Groups	Exports Share 32A-33M (%)	Growth Rate 33M-34M (%)
Group 00. Animal and animal products, edible	4.6	20.1
Animal oils and fats, edible	2.4	2.1
Meat products	1.3	62.71
Group 0. Animals and animal products, inedible	2.3	44.0
Group 1. Vegetable food products and beverages	10.6	-4.1
Fruits and nuts	4.9	13.3
Grains and preparations	3.9	-34.9
Group 2. Vegetable products, inedible, except fibers and wood	7.7	33.6
Tobacco and manufactures	5.0	36.8
Rubber and manufactures	1.1	27.7
Group 3. Textiles	25.7	38.2
Cotton, unmanufactured	21.4	46.1
Cotton manufactures	2.5	-9.6
Group 4. Wood and paper	3.8	39.1
Wood semimanufactures-sawmill products	1.8	46.7
Paper and manufactures	1.0	10.6
Group 5. Nonmetallic mineral products	18.5	10.4
Petroleum and products	13.9	7.5
Coal and related fuels	2.9	4.8
Other nonmetallic mineral products	1.1	49.9
Group 6. Metals and manufactures, except machinery and vehicles	5.5	71.6
Nonferrous metals, except precious	2.1	55.5
Iron and steel semimanufactures	1.0	157.8
Group 7. Machinery and vehicles	14.1	36.7
Automobiles and other vehicles	6.1	50.0
Industrial machinery	3.8	21.8
Electrical machinery and apparatus	2.7	28.7
Office appliances	1.0	27.8
Group 8. Chemicals and related products	4.8	19.88
Industrial chemicals	1.0	28.0
Group 9. Miscellaneous	4.2	-3.1
Miscellaneous articles	1.5	-9.2

Notes: The table shows the share of exports between April 1932 and March 1933 and the growth between April 1932 and March 1933 and between April 1933 and March 1934. The table selects sectors with a share of total exports, excluding gold and silver, higher than 1 percent.

Figure A.1: Exports and Imports



A.2 Model Log-linearization and Estimation

In Section 6, we present a model of a simple monetary union. In this section, we present the log-linearize equations that are used to simulate the model. We define $\check{x}_t \equiv \frac{X_t - \bar{X}}{\bar{X}}$. We use upper case for the price index and price index inflation.

$$\check{c}_{1,t} = -\frac{1}{\gamma}(\check{i}_t - \check{\Pi}_{1,t+1}) + \check{c}_{1,t}$$

$$-\gamma\check{c}_{1,t} + \gamma\check{c}^*_{1,t} = \check{P}_{1,t} - \check{P}^*_{1,t} - \check{e}_{1,t}$$

$$-\gamma\check{c}_{1,t} + \gamma\check{c}_{2,t} = \check{P}_{1,t} - \check{P}_{2,t}$$

$$-\gamma\check{c}_{2,t} + \gamma\check{c}^*_{2,t} = \check{P}_{2,t} - \check{P}^*_{2,t} - \check{e}_{2,t}$$

$$\check{\pi}_{1,t} = \kappa\frac{1}{1+\eta\alpha}\check{mc}_{1,t} + \beta\check{\pi}_{1,t+1}$$

$$\check{\pi}_{2,t} = \kappa\frac{1}{1+\eta\alpha}\check{mc}_{2,t} + \beta\check{\pi}_{2,t+1}$$

$$\check{\pi}^*_{1,t} = \kappa\frac{1}{1+\eta\alpha}\check{mc}^*_{1,t} + \beta check\pi^*_{1,t+1}$$

$$\check{\pi}^*_{2,t} = \kappa\frac{1}{1+\eta\alpha}\check{mc}^*_{2,t} + \beta\check{\pi}^*_{2,t+1}$$

$$\check{mc}_{1,t} = \alpha\check{y}_{1,t} + (\gamma - (1/\sigma))\check{c}_{1,t} + (1/\sigma)\check{c}_{1,t}$$

$$\check{mc}_{2,t} = \alpha\check{y}_{2,t} + (\gamma - (1/\sigma))\check{c}_{2,t} + (1/\sigma)\check{c}_{1,t}$$

$$\check{mc}^*_{1,t} = \alpha\check{y}^*_{1,t} + (\gamma - (1/\sigma))\check{c}^*_{1,t} + (1/\sigma)\check{c}^*_{1,t}$$

$$\check{mc}^*_{2,t} = \alpha\check{y}^*_{2,t} + (\gamma - (1/\sigma))\check{c}^*_{2,t} + (1/\sigma)\check{c}^*_{1,t}$$

$$\check{i}_t - \check{i}^*_{1,t} = \check{e}_{1,t+1} - \check{e}_{1,t}$$

$$\check{i}_t - \check{i}^*_{2,t} = \check{e}_{2,t+1} - \check{e}_{2,t}$$

$$\check{P}_{1,t} = \phi_H\check{p}_{1,t} + \phi_C\check{p}_{2,t} + \phi_F(\check{p}^*_{1,t} + \check{e}_{1,t})$$

$$\check{P}_{2,t} = \phi_H \check{p}_{2,t} + \phi_C \check{p}_{1,t} + \phi_F(\check{p}^*_{2,t} + \check{e}_{2,t})$$

$$\check{P}^*_{1,t} = (\phi_H + \phi_C)\check{p}^*_{1,t} + \phi_F(\check{p}_{1,t} - \check{e}_{1,t})$$

$$\check{P}^*_{2,t} = (\phi_H + \phi_C)\check{p}^*_{2,t} + \phi_F(\check{p}_{2,t} - \check{e}_{2,t})$$

$$\check{\Pi}_{1,t} = \check{P}_{1,t} - \check{P}_{1,t-1}$$

$$\check{\Pi}_{2,t} = \check{P}_{2,t} - \check{P}_{2,t-1}$$

$$\check{\Pi}^*_{1,t} = \check{P}^*_{1,t} - \check{P}^*_{1,t-1}$$

$$\check{\Pi}^*_{2,t} = \check{P}^*_{2,t} - \check{P}^*_{2,t-1}$$

$$\check{\pi}_{1,t} = \check{p}_{1,t} - \check{p}_{1,t-1}$$

$$\check{\pi}_{2,t} = \check{p}_{2,t} - \check{p}_{2,t-1}$$

$$\check{\pi}^*_{1,t} = \check{p}^*_{1,t} - \check{p}^*_{1,t-1}$$

$$\check{\pi}^*_{2,t} = \check{p}^*_{2,t} - \check{p}^*_{2,t-1}$$

$$-\check{c}_{F,1,t} + \check{c}_{H,1,t} = \sigma(\check{p}^*_{1,t} + \check{e}_{1,t} - \check{p}_{1,t})$$

$$-\check{c}_{F,2,t} + \check{c}_{H,2,t} = \sigma(\check{p}^*_{2,t} + \check{e}_{2,t} - \check{p}_{2,t})$$

$$-\check{c}_{C,1,t} + \check{c}_{H,1,t} = \sigma(\check{p}_{H,2,t} - \check{p}_{H,1,t})$$

$$-\check{c}_{C,2,t} + \check{c}_{H,2,t} = \sigma(\check{p}_{H,1,t} - \check{p}_{H,2,t})$$

$$-\check{c}^*_{F,1,t} + \check{c}^*_{H,1,t} = \sigma(\check{p}_{1,t} - \check{e}_{1,t} - \check{p}^*_{1,t})$$

$$-\check{c}^*_{F,2,t} + \check{c}^*_{H,2,t} = \sigma(\check{p}_{2,t} - \check{e}_{2,t} - \check{p}^*_{2,t})$$

$$\check{c}_{1,t} = \phi_H \check{c}_{H,1,t} + \phi_C \check{c}_{C,1,t} + \phi_F \check{c}_{F,1,t}$$

$$\check{c}_{2,t} = \phi_H \check{c}_{H,2,t} + \phi_C \check{c}_{C,2,t} + \phi_F \check{c}_{F,2,t}$$

$$\check{c}^*_{1,t} = (\phi_H + \phi_C)\check{c}^*_{H,1,t} + \phi_F \check{c}^*_{F,1,t}$$

$$\check{c}^*_{2,t} = (\phi_H + \phi_C)\check{c}^*_{H,2,t} + \phi_F \check{c}^*_{F,2,t}$$

$$\check{y}_{1,t} = \phi_H \check{c}_{H,1,t} + \phi_C \check{c}_{C,2,t} + \phi_F \check{c}^*_{F,1,t}$$

$$\check{y}_{2,t} = \phi_H \check{c}_{H,2,t} + \phi_C \check{c}_{C,1,t} + \phi_F \check{c}^*_{F,2,t}$$

$$\check{y}^*_{1,t} = (\phi_H + \phi_C)\check{c}^*_{H,1,t} + \phi_F \check{c}_{F,1,t}$$

$$\check{y}^*_{2,t} = (\phi_H + \phi_C)\check{c}^*_{H,2,t} + \phi_F \check{c}_{F,2,t}$$

$$\check{e}_{1,t} = \varepsilon_t$$

$$\check{e}_{2,t} = 0$$

$$0 = \frac{1}{2}(\check{p}_{1,t} + \check{y}_{1,t} + \check{p}_{2,t} + \check{y}_{2,t}) + \check{p}^*_{2,t} + \check{y}_{2,t}$$

$$\nu_t = \rho \nu_{t-1} + \epsilon_t.$$

With that model, we then run a regression to obtain γ and ρ from the data. In order to do so, we run the following regressions:

$$\check{p}_{H,1,t} + \check{y}_{H,1,t} - \check{p}_{H,2,t} - \check{y}_{H,2,t} = a + b \times \check{e}_{1,t}.$$

We compare the value b with β in equation (4)

$$\check{P}_{H,i,t} - \check{P}^*_{H,i,t} = c + d \times \check{e}_{i,t}.$$

with $i = 1, 2$. We use the value of d to compare it with β in equation (1). The regressions are run over 24 periods with the calibration explained in the main text.