

Chen, Yao; Palma, Nuno; Ward, Felix

Working Paper

Goldilocks: American precious metals and the Rise of the West

Tinbergen Institute Discussion Paper, No. TI 2022-063/VI

Provided in Cooperation with:

Tinbergen Institute, Amsterdam and Rotterdam

Suggested Citation: Chen, Yao; Palma, Nuno; Ward, Felix (2022) : Goldilocks: American precious metals and the Rise of the West, Tinbergen Institute Discussion Paper, No. TI 2022-063/VI, Tinbergen Institute, Amsterdam and Rotterdam

This Version is available at:

<https://hdl.handle.net/10419/265839>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

TI 2022-063/VI
Tinbergen Institute Discussion Paper

Goldilocks: American precious metals and the Rise of the West

Yao Chen^{1,3,4}

Nuno Palma^{2,4}

Felix Ward^{1,3}

1 Erasmus University Rotterdam

2 University of Manchester and Instituto de Ciências Sociais, Universidade de Lisboa

3 Tinbergen Institute

4 CEPR

Tinbergen Institute is the graduate school and research institute in economics of Erasmus University Rotterdam, the University of Amsterdam and Vrije Universiteit Amsterdam.

Contact: discussionpapers@tinbergen.nl

More TI discussion papers can be downloaded at <https://www.tinbergen.nl>

Tinbergen Institute has two locations:

Tinbergen Institute Amsterdam
Gustav Mahlerplein 117
1082 MS Amsterdam
The Netherlands
Tel.: +31(0)20 598 4580

Tinbergen Institute Rotterdam
Burg. Oudlaan 50
3062 PA Rotterdam
The Netherlands
Tel.: +31(0)10 408 8900

Goldilocks: American precious metals and the Rise of the West ^{*}

Yao Chen[†] Nuno Palma[‡] Felix Ward[§]

September 2022

Abstract

We estimate the contribution of the American precious metal windfall to West Europe's growth performance in the early modern period. The exogenous nature of American money arrivals allows for identification of monetary effects. We find that more than half of West Europe's growth can be attributed to American precious metals, whose arrival promoted trade intensification and capital formation. Our findings place West Europe's second-stage receivers in a particularly fortunate goldilocks zone that enjoyed monetary injections, while being insulated against the transport-loss induced financial crises that caused persistent damage to first-stage receiver Spain.

Keywords: money non-neutrality, Great Divergence, Little Divergence, Smithian growth, market integration

JEL Codes: E51, F40, N10

^{*}We thank Junhao Cao, Kivanç Karaman, Leonardo Ridolfi, and François R. Velde as well as participants at various seminars and conferences for helpful comments. We are grateful to Ulrich Pfister, Bas van Leeuwen, and Leonardo Ridolfi for sharing their data with us. Any remaining errors are our own.

[†]Erasmus School of Economics, Erasmus University Rotterdam; CEPR; Tinbergen Institute; (y.chen@ese.eur.nl).

[‡]Department of Economics, University of Manchester; Instituto de Ciências Sociais, Universidade de Lisboa; CEPR; (nuno.palma@manchester.ac.uk).

[§]Corresponding author: Erasmus School of Economics, Erasmus University Rotterdam, Burgemeester Oudlaan 50, 3062 PA Rotterdam; Tinbergen Institute; (ward@ese.eur.nl).

1. INTRODUCTION

The early modern epoch lies at a crucial junction between the Malthusian stagnation of the pre-modern era and modern economic growth. In the 300 years preceding the Industrial Revolution, income levels in Europe had already pushed ahead of income levels in other parts of the world, giving rise to an early stage of what subsequently turned into the *Great Divergence* of global incomes (Pomeranz, 2000; Broadberry, 2021b,a). In many explanations for why the Industrial Revolution began in Europe its already elevated income level in the mid 18th century is a crucial initial condition that prompts the transition to modern economic growth by encouraging investments in labor-saving technologies and human capital (Galor and Weil, 2000; Allen, 2009; Galor, 2011). Understanding European growth exceptionalism in the early modern period is thus crucial to a comprehensive understanding of the *Rise of the West*.

This paper proposes that Europe’s early modern growth exceptionalism has monetary roots. In the three centuries following the Colombian voyage of 1492, Europe received vast quantities of American precious metals, with the average annual influx amounting to around 1% of West European GDP. American precious metals, however, have rarely been attributed a causal role in Europe’s early modern growth exceptionalism. This is because, absent evidence to the contrary, the principle of long-run money neutrality discourages such an interpretation. Recent advances in the reconstruction of early modern GDP and monetary data, however, allow us for the first time to trace the real effects of American money arrivals across a panel of eight European countries.

The exogenous nature of early modern money arrivals in Europe allows for the identification of monetary effects (Palma, 2022; Brzezinski, Chen, Palma, and Ward, forthcoming). Neither the precious metal extraction of American mines, nor transportation losses were related to economic conditions in Europe. This allows us to determine that the continued arrival of American precious metals can account for more than half of West European GDP growth between 1530 and 1780. Impulse response function (IRF) estimates indicate that the stimulating effect of American money inflows quickly diffused along the geographic sequence from West to East, with Central European economies already exhibiting little responsiveness. West Europe, however, saw its GDP increase by around 1% for every doubling in American money arrivals measured relative to the European stock. At the end of the 18th century, the sustained nature of the monetary injections had swelled West European GDP by a cumulated 41%.

Disaggregated data reveal that American precious metals promoted West European growth in three ways. First, trade intensified, affording West Europe an episode of

Smithian growth. Second, capital formation accelerated, as the arrival of American money triggered investments in agriculture (land, livestock), transport (ships), and human capital (primary to tertiary education). These findings are indicative of American money arrivals easing liquidity constraints that previously had frustrated viable investment projects and trade connections. Finally, American money arrivals also exerted a demographic force by increasing female employment opportunities in pastoral agriculture and the service sector. The consequent delay in marriages is a prominent reason behind the low birth rates that contributed to increasing per capita incomes in early modern Europe (Wrigley, 1988)

The distribution of the American precious metal windfall is not just informative with respect to the early *Great Divergence* between Europe and other world regions, but also with respect to the *Little Divergence* in incomes between Europe’s Northwest and South. As a first-stage receiver, Spain suffered from greater exposure to transport losses than second-stage receivers like England and Holland (Brzezinski, Chen, Palma, and Ward, forthcoming). This is because annual money inflows from America on average amounted to 10% of Spain’s money stock. By contrast, the money flow’s subsequent fourfold dispersion among England, Holland, France, and Italy provided these second-stage receivers with some insulation against the vagaries of Atlantic precious metal transports. Accordingly, second-stage receivers experienced only a temporary output setback in the aftermath of a big maritime disaster loss, whereas Spain suffered from a severe financial crisis that caused lasting damage. This damage is quantitatively similar to findings for modern financial crises, ranging from 5% to 10% of GDP (Cerra and Saxena, 2008; Jordà, Schularick, and Taylor, 2020a). Over the early modern period as a whole, eleven big maritime disasters thus shaved a cumulative 67% off Spanish GDP growth, which can account for one third of the *Little Divergence* between Northwest Europe and Spain. Taken together, our findings suggest that Northwest Europe’s early modern growth stars – England and Holland – were located in a *monetary goldilocks zone* which benefited from sustained monetary injections, while being sufficiently insulated from maritime disasters to avoid being plunged into the repeated financial crises which contributed to Spain’s disappointing growth performance.

Our paper contributes to the literature studying the origins of Europe’s growth exceptionalism in the early modern period. Our findings are consistent with the conjecture that American precious metals promoted West European trade intensification by easing liquidity constraints (Keynes, 1936, ch.23). The ensuing specialization gains afforded West Europe an episode of Smithian growth (Jacks, 2004).¹ According to North and Thomas

¹Our findings lend empirical support to contemporary mercantilist notions that an increased money supply promoted trade (Rössner, 2018). Silver money was scarce in 15th century Europe (Spufford, 1989, pp.340,343). Day (1978) traces the origins of mercantilists’ preoccupation with the supply of precious metals to this bullion scarcity in the late medieval period (Dyer, 2002, pp.266,384). While Sussman (1998) qualifies the French evidence for the monetary scarcity hypothesis other research has confirmed the late medieval bullion scarcity elsewhere (Nightingale, 1990, 1997, 2010; Desan, 2014; Le Goff, 2012,

(1970, p.14), the trade intensification resulting from the arrival of American precious metals furthermore acted as a catalyst for institutional innovations, such as the joint stock corporation and limited liability.² Trade intensification and the institutional changes that typify West Europe’s *Commercial Revolution* are widely considered explanations for its early modern growth exceptionalism (Acemoglu et al., 2005). Other explanations highlight low birth rates and high death rates, which in a Malthusian environment gave rise to elevated income levels (Wrigley, 1988; Clark, 2007), cultural changes that led households to increase their labor supply to purchase novel consumer goods (e.g. tea, silk, and porcelain), in what has been termed the *Industrious Revolution* (de Vries, 1994; Berg, 2005; de Vries, 2008), increased capital formation – physical (Frank, 2011, p.44) and human (van Zanden, 2009, ch.6) – and incremental technological improvements that exploited scale economies in Europe’s newly integrated market environment (Nef, 1934; Mokyr, 1992). We propose that the high explanatory power of American money arrivals suggests that, to a considerable extent, the multifaceted change that underpinned West Europe’s early modern growth exceptionalism was driven by a common geographic fundamental – American gold and silver.

The literature suggest a variety of potential channels through which American money arrivals could have affected inputs of labor and capital, as well as technological, cultural, and even demographic outcomes in West Europe. First, to the extent that American precious metals promoted European market integration, they also rendered profitable the development of new technologies that exploited scale economies (Nef, 1934, pp.18–19). In this way, many industries that used to be dominated by household manufacturers were taken over by proto-industrial establishments.³ The up-scaling of proto-industrial production was furthermore facilitated by increasing urban agglomeration, which itself hinged on employers’ ability to reliably pay money wages – not a given in preceding centuries (Muldrew, 2007, pp.401,405,410). Second, and relatedly, low birth rates depended on womens’ access to a vibrant labor market in which money incomes were available for prospective maids and agricultural servants (de Moor and van Zanden, 2010). Third, American precious metals were a necessary prerequisite for Europe’s trade intensification with Asia, which brought tea, silk, and porcelain into European households and thus promoted the

p.143).

²In addition, trade intensification was accompanied by the development of a multilateral payments system, first centered in Amsterdam and later in London, within which the bill of exchange emerged as Europe’s dominant credit instrument (Schneider, 1986; Attman, 1996). American precious metals underpinned the smooth functioning of this system, because the market for bills was predicated on the expectation of final settlement in gold or silver coin; inside and outside money were complements rather than substitutes (Palma, 2018).

³At the eastern end of the Eurasian landmass, China moved in the opposite direction of less market integration in the late early modern period, as indicated by the regional correlation of wheat and rice prices (Bernhofen et al., 2020). By contrast, European wheat and rye prices reflect an increase in market integration during the early modern period (Jacks, 2004; Federico et al., 2021).

Industrious Revolution (Chaudhuri, 1986; Palma and Silva, 2022).⁴ Finally, annual silver price inflation of around 0.5% – a consequence of the continued influx of American silver – encouraged wealthy households to divest their silver treasures and invest in other assets instead (de Vries and van der Woude, 1997; van Bavel, 2016, pp.167–196), thereby contributing to West European capital formation (Frank, 2011, p.44). Our analysis of disaggregated output series allows us to discern between these various transmission channels and thereby reveal how exactly American precious metals affected West European growth.

Our paper also contributes to the literature on the *Little Divergence* between Europe’s Northwest and South. Existing research highlights the resource curse brought about by first-stage receivers rich endowment with precious metals (Palma, 2020; Kedrosky and Palma, 2021; Charotti, Palma, and Pereira dos Santos, 2022). This resource curse exerted its detrimental effect on Iberian economic development in two ways. First, a real exchange rate appreciation reduced the price competitiveness of first-stage receivers’ tradables sectors (Hamilton, 1934; Drelichman, 2005b). Second, institutional progress halted as the reliance of the Spanish and Portuguese states on American precious metals for their expenditure needs rendered their rulers unresponsive to the demands of local taxpayers (Drelichman, 2005a; Henriques and Palma, 2020). Our paper explores a third way in which the American precious metal windfall ended up hurting first-stage receivers – the monetary volatility entailed by first-stage receivers’s heavy exposure to maritime disaster losses.

Next, our paper shines a novel light on the long-standing question to which extent the *Rise of the West* was grounded in colonialism (Williams, 1944 [1994]; Frank, 1979; Wallerstein, 1974–1980). Recent research has focused on the indirect role of colonial trade in fostering commerce-friendly institutions brought about by the enrichment and subsequent political empowerment of Atlantic merchants (Acemoglu, Johnson, and Robinson, 2005). Our analysis shifts the attention back to the more direct role played by the single most valuable commodity that America supplied to Europe up to the late 18th century – precious metals. Gold and silver accounted for more than 80% of the value of cross-Atlantic shipments arriving in Spain.⁵ While the annual inflows were modest compared to the size of the European economy (Engerman, 1972; O’Brien, 1982; Inikori, 2002), our findings indicate that the sustained nature of American money injections over the course of three centuries in fact considerably promoted output growth – money was not neutral

⁴In particular Spanish pesos, minted in America, were accepted across East Asia for payment and even remained in circulation there (Irigoin, 2020).

⁵For much of the early modern period, America did not supply significant amounts of other commodities to Europe. Only late in the 18th century and in the 19th century did such imports become sufficiently large to significantly ease the land constraint under which the European economy was operating as suggested by Pomeranz (2000).

in the long-run.

Therefore our paper also contributes to the literature on long-run money non-neutrality (Blanchard and Summers, 1986; Benigno and Fornaro, 2018; Galí, 2022). Recent empirical evidence in favor of longer-run money non-neutrality comes from Jordà, Singh, and Taylor (2020b) and Palma (2018, 2022). Our finding that American money arrivals boosted West European growth by accelerating capital formation is particularly consistent with the operation of a Mundell-Tobin effect (Mundell, 1963; Tobin, 1965). Our account of the monetary roots of the within-European *Little Divergence* is closely related to recent research indicating that contractionary monetary shocks have the potency to trigger financial crises (Schularick, ter Steege, and Ward, 2021), which in turn can cause lasting damage to the economy (Teulings and Zubanov, 2014; Jordà, Schularick, and Taylor, 2020a). Along the same lines, the large money losses associated with Spain’s maritime disasters repeatedly triggered financial crises that exerted a negative long-run effect on Spain’s economic development.⁶

2. THE AMERICAN PRECIOUS METAL WINDFALL

This section describes the initial distribution of the American precious metal windfall and its subsequent global diffusion. Understanding the geographic diffusion of the American precious metal flow is key for understanding how the American precious metal windfall afforded West Europe a powerful monetary stimulus that was unique among world regions.

2.1. Initial distribution and diffusion of the windfall

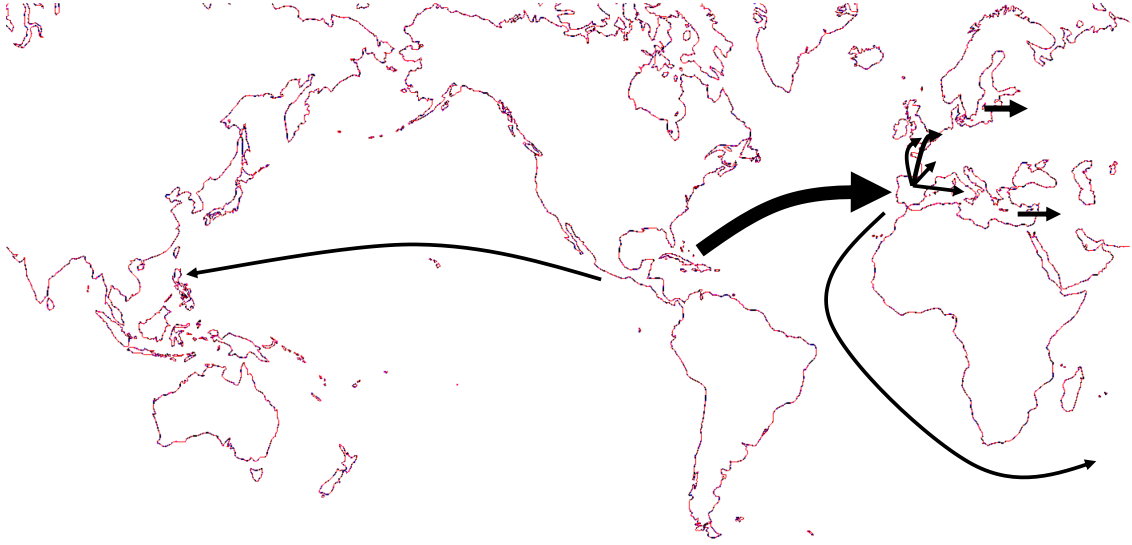
The arrows in Figure 1 present a true to scale depiction of American precious metal flows in the early modern period. By far the largest flow occurred across the Atlantic, towards the Iberian kingdoms which had recently colonized much of America. Over the early modern period, around 75,000 tonnes of silver thus arrived in West Europe (Chen, Palma, and Ward, 2021).⁷ By contrast, only around 13,000 tonnes went across the Pacific in the Manila Galleon trade between Acapulco (Mexico) and Manila (Philippines).⁸ This initial distribution of the American precious metal windfall was particularly lopsided given the distribution of global economic activity at the time. In the early 1500s, West Europe accounted for less than one fifth of global GDP, whereas Asia accounted for around two thirds (Bolt and van Zanden, 2020).

⁶A related strand of the literature analyzes the role of monetary volatility for macroeconomic outcomes (Fernández-Villaverde, Guerrón-Quintana, Rubio-Ramírez, and Uribe, 2011; Mumtaz and Zanetti, 2013).

⁷Throughout the text, we refer to metric tonnes. The values include gold flows translated into silver equivalent using contemporary gold-silver ratios.

⁸Throughout the text, we refer to countries as geographic entities in their modern borders even if they did not yet exist as politically unified entities during the early modern period.

Figure 1: Global distribution of the American precious metal windfall



Notes: Arrow width reflects cumulated flow size between 1500 and 1800. The Atlantic flow equals 75 kilotonnes. Data sources: [Chen et al. \(2021\)](#), [Attman \(1986\)](#), and [de Vries \(2003\)](#).

Once American precious metals had arrived in Spain, they began to diffuse eastward, especially by means of trade.⁹ The four most important second-stage receivers were England, Holland, France, and Italy, after which American silver began to diffuse more widely through Central and East Europe. Propelled by silver’s significant purchasing power differentials between West and East, American precious metals continued to flow further East, with important European outflows occurring through the Baltics, the Levant, and through the Cape route.

2.2. The geography of American precious metal flows

2.2.1 Diffusion from West to East

The extent to which the American precious metal windfall had a differential impact on money stocks across the world depends on the speed with which initial arrivals began to diffuse across world regions.¹⁰ Consider a sequence of R regions that are aligned along a geographic sequence running from West to East. The region index $r = 1, \dots, R$ reflects

⁹By contrast, the initial Atlantic flow between American colonies and Spain had little to do with trade, but predominantly constituted current transfers (remittances and repatriation of profits ([Brzezinski et al. forthcoming](#))).

¹⁰American precious metal primarily fulfilled a monetary function. Until the late 18th century only around 20% of gold and silver found a non-monetary use in utensils and ornaments ([Jacob, 1831](#)). In fact, precious metals arriving from America were required to be minted upon arrival by regulation ([Hamilton 1934](#), pp.25,29) and over time the majority of American precious metals arrived in Europe already in coined form ([Céspedes del Castillo, 1996](#); [Irigoin, 2020](#)).

the regions' geographic sequencing, with $r = 1$ denoting the most Western first-stage receiver, and $r = R$ the most Eastern region. Each region receives inflows from its Western neighbor:

$$in_{r,t} = out_{r-1,t} \quad (1)$$

Region r retains a part $(1 - \omega_r)$ of these inflows. The remainder is passed on to r 's Eastern neighbor, potentially with some lag:

$$out_{r,t} = \omega_r \theta(L) in_{r,t}, \quad (2)$$

where $\theta(L)$ denotes a lag polynomial. ω_r is implicitly defined by $\omega_r^Y = (1 - \omega_r) \prod_{j=1}^{r-1} \omega_j$, where ω_r^Y denotes region r 's steady state weight in the global money distribution.^[11] Equations [1] and [2] allow for an expression of region r 's money inflow as a function of the primary money influx $in_{1,t}$

$$out_{r,t} = \prod_{j=1}^r \omega_j \theta(L)^r in_{1,t}$$

Correspondingly, region r 's money stock changes according to

$$\Delta M_{r,t} = in_{r,t} - out_{r,t} = [1 - \omega_r \theta(L)] \prod_{j=1}^{r-1} \omega_j \theta(L)^{r-1} in_{1,t} \quad (3)$$

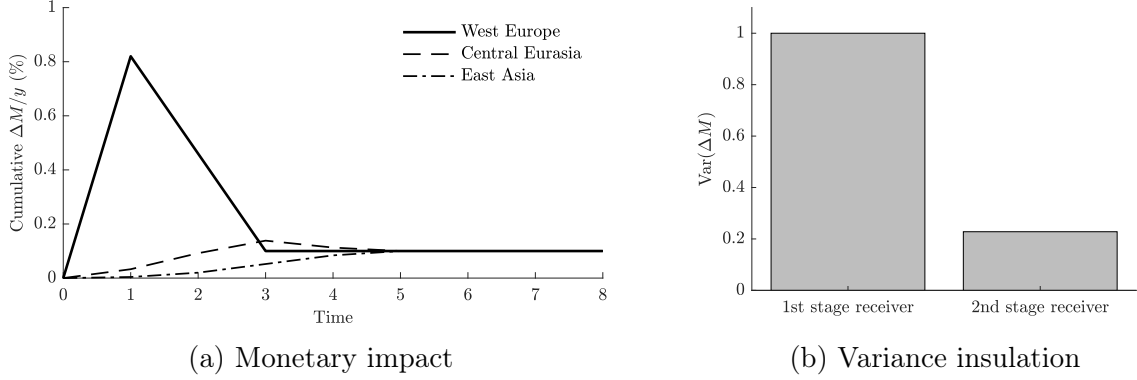
This equation reveals that as the money flow progresses from one region to another, the primary money influx $in_{1,t}$ is modulated by a region-specific lag structure that generates a wavelike undulation in money stocks across the geographic sequence from West to East.^[12] The magnitude of the temporary swelling of regional money stocks $M_{r,t}$ that the primary influx $in_{1,t}$ brings about fades along the geographic sequence, as each region retains part $(1 - \omega_r)$ of the primary influx. This fading effect is amplified when the economic weight of regions increases along the geographic sequence: $\omega_r^Y < \omega_{r+1}^Y$. This was the case for the geographic sequence along which American precious metals progressed from West Europe to East Asia. Thus, the initial distribution of the American precious metal windfall implied a disproportionate swelling of West European money stocks.

The left panel of Figure [2] shows the sequential swelling of money stocks from West to East after a 1 unit windfall of American precious metals arrives in West Europe. For this example, we considered three regions (West Europe, Central Eurasia, East Asia) and a mixture of instantaneous and lagged diffusion, $\theta(L) = 0.2 + 0.4L + 0.4L^2$. We set

¹¹For example, in an environment with no cross-region differences in money velocity V and with the law of one price equalizing price levels P across countries, the equation of exchange $MV = PY$ implies that ω_r corresponds to region r 's global GDP share.

¹²If the diffusion is instantaneous, $out_{r,t} = \omega_r in_{r,t}$, each region immediately receives its steady state share ω_r^Y of the primary money influx $in_{1,t}$. In this case the initial distribution of the precious metal windfall develops no differential impact on money stocks across the world – the geographic sequencing of money flows becomes irrelevant.

Figure 2: Diffusion of the American precious metal windfall



Notes: Panel (a) – results based on simulation of equation 3 for $\theta(L) = 0.2 + 0.4L + 0.4L^2$, and region weights $\omega_1^Y = 10\%$, $\omega_2^Y = 50\%$, $\omega_3^Y = 40\%$. The Figure shows the monetary stimulus enjoyed by different regions in response to a 1 unit increase in the primary influx $in_{1,t}$. Panel (b) – variance of money stock changes based on 1000 draws of $in_{1,t}$ from a normal distribution. first-stage receiver variance is normalized to 1. $\omega_1^Y = 2\%$, $\omega_2^Y = 8\%$, $\omega_3^Y = 90\%$

region weights in line with population levels: $\omega_1^Y = 10\%$, $\omega_2^Y = 50\%$, $\omega_3^Y = 40\%$.¹³ The resulting $\Delta M_{r,t}$, expressed relative to GDP, show how money stocks expanded along the geographic sequence from West to East. While West European money stocks exhibit a large expansion in the aftermath of an inflow of precious metals from America, East Asian money stocks exhibit a comparatively tame increase towards their new steady state level.

2.2.2 Volatility insulation and monetary goldilocks zone

Another implication of the geographic sequence described by equation 3 is that a large second-stage receiver’s money supply is considerably better insulated from the year-to-year volatility of American precious metal arrivals than a small first-stage receiver’s money supply. American precious metal inflows could be highly volatile, primarily due to maritime disasters in which large amounts of precious metals were lost (Brzezinski et al., forthcoming). For Spain, the loss of a large shipment of American precious metals could amount to 10% of its money stock. By contrast, the subsequent fourfold dispersion of the American precious metal flow to England, Holland, France, and Italy implied that their annual inflow of American precious metals only amounted to around 2.5% of the money stock. Thus, money stock turnover was significantly lower among second-stage receivers than in Spain. In addition, any diffusion delays contained in equation 3 imply that for second-stage receivers maritime disaster losses were smoothed out over time.

This insulation from the vagaries of American precious metal inflows mattered, espe-

¹³These shares correspond to the population numbers from Bolt and van Zanden (2020) for around 1600 (South Asia, e.g. India, is included in the *Central Eurasia* group). The per capita money stock data by Bonfatti et al. (2020) suggest that actual eastward diffusion to East Europe and Russia in practice fell short of these regions’ global population shares.

cially because maritime disasters could trigger severe financial crises in Spain (Brzezinski et al., forthcoming). Owing to the volatility insulation that Europe’s second-stage receivers enjoyed, the financial turmoil in the aftermath of maritime disasters remained largely restricted to the Iberian peninsula. This is evidenced by the absence of systematic lending rate increases among Europe’s second-stage receivers in response to a maritime disaster shock (Brzezinski et al., forthcoming, Appendix). To the extent that maritime disaster-induced financial crises caused lasting damage (Cerra and Saxena, 2008; Jordà et al., 2020a), the insulation afforded to second-stage receivers thus potentially safeguarded their economic development.¹⁴

A simulation of the inflow-outflow apparatus presented by equations 1 to 3 serves to illustrate the insulation that second-stage receivers enjoyed. For this simulation we consider Spain as the first-stage receiver and England, Holland, France, and Italy as the second-stage receiver region. We set region weights to $\omega_1^Y = 2\%$, $\omega_2^Y = 8\%$, and $\omega_3^Y = 90\%$, with region $r = 3$ acting as a summary region for the rest of Eurasia. We apply the same lag polynomial as before. We then calculate the variance of money supply changes $\Delta M_{r,t}$ on the basis of 1000 random draws of the primary influx $in_{1,t}$ from a normal distribution. The right panel in Figure 2 displays the variance result, which illustrates that the first-stage receiver is exposed to a substantially higher money supply variance than a second-stage receiver.

In sum, the American precious metal windfall gave rise to a powerful monetary stimulus that was unique to West Europe. Within West Europe, second-stage receivers were situated in a particularly fortunate goldilocks zone, which enjoyed considerable monetary stimulus while being insulated against the high volatility of the primary precious metal influx. The following analysis investigates the extent to which these insights find reflection in how the arrival of American precious metals affected economic outcomes across Europe.

3. DATA

Economic historians have recently reconstructed GDP series for the early modern period based on the data contained in probate inventories and the account books of long-lived institutions, such as monasteries, hospitals, and universities. Our dataset includes the GDP series for Spain, England, Holland, France, Italy, Germany, Poland, and Sweden.¹⁵

¹⁴American precious metals were initially owned by a Spanish entity, as by the Spanish Empire’s regulation transatlantic business with Spain’s American colonies was restricted to Spanish merchants (Nogues-Marco, 2011, p.6).

¹⁵The GDP series come from Malanima (2011), van Zanden and van Leeuwen (2012), Schön and Krantz (2012), Álvarez-Nogal and Prados de la Escosura (2013), Broadberry et al. (2015), Krantz (2017), Malinowski and Van Zanden (2017), Ridolfi and Nuvolari (2021), and Pfister (2021). We do not use the series by Álvarez-Nogal et al. (2021), because its annual variation is exclusively informed by agricultural tithe data. Consequently, the annual ups and downs of this series are indicative of agriculture only. By

These GDP series allow us to trace the effects of the American precious metal influx across Europe. In particular, our analysis distinguishes between first-stage receiver (Spain), second-stage receivers in West Europe (England, Holland, France, Italy), and 3rd stage receivers further East (Germany, Poland, Sweden).¹⁶

Early modern GDP estimates come in two variants, demand-side estimates (Spain, France, Italy, Germany, Poland, Sweden) and supply-side estimates (England, Holland). The former draw on income data – wages and land rents – and price data to calculate real GDP from the demand side. The latter draw on a variety of disaggregated output series to calculate real GDP from the supply side (van Zanden and van Leeuwen, 2012; Broadberry et al., 2015). While the two approaches have been confirmed to produce consistent results (Broadberry et al., 2015, pp.120–124), an advantage of the Dutch and English supply-side estimates is that they come with a wealth of industry-level output series that allow for a more detailed analysis of how American precious metals affected the European economy. We make use of this data to gain insights into the channels through which American precious metals fostered economic growth in Northwest Europe.¹⁷

To better understand the reaction of Spain’s economy to big maritime disaster shocks, we draw on disaggregated output data compiled by Brzezinski et al. (forthcoming). Compared to the disaggregated output data for England and Holland the Spanish data is more fragmentary, covering shorter time periods and fewer regions, e.g. the revenues from a tax on cloths entering Toledo from 1540 to 1659.¹⁸ Such time series nevertheless offer some insight into how transport-loss induced financial crises affected different industries in Spain. We also draw on the agricultural output series provided by Álvarez-Nogal et al. (2021), which is based on annual variation in agricultural levies. This series covers our entire sample period.

Data on the inflow of American precious metals into Europe comes from Palma (2022) and Brzezinski et al. (forthcoming). Figure 3 depicts this inflow fluctuating between 1 and 2% of the European money stock. The vast majority of the precious metals arriving from

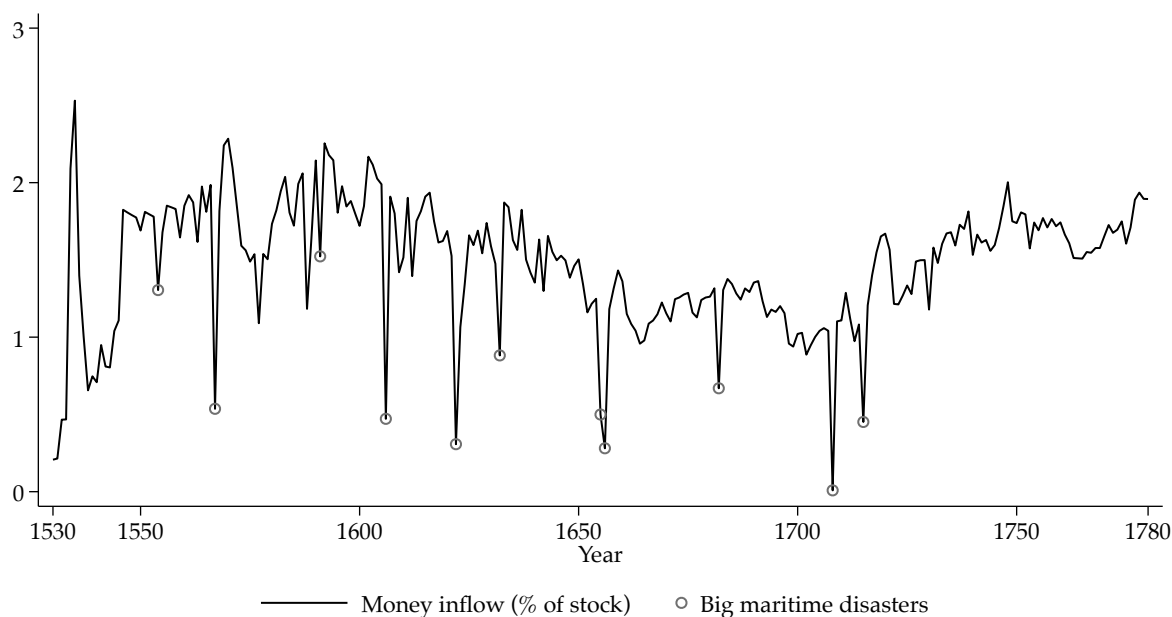
contrast, the series by Álvarez-Nogal and Prados de la Escosura (2013) is based on a broader set of income indicators, such as wages (urban and rural) and land rents.

¹⁶The baseline analysis does not include Portugal, due to its ambiguous status as simultaneous first-stage receiver of Brazilian gold towards the end of our sample, and a second-stage receiver of American precious metals from Spain’s colonies. The Appendix presents results based on a sample that includes Portugal as a first-stage receiver (data from Palma and Reis, 2019). The estimated monetary effects for West Europe are somewhat smaller in this case, but qualitatively the results are very similar (Figure A.13 and Table A.1).

¹⁷Demand-side GDP estimates often contain interpolated urbanization rate data which is uninformative with respect to short-term fluctuations in output. As a robustness check we therefore remove all interpolated urbanization data from the demand-side GDP estimates and re-run our analysis. While this slightly increases the size of the coefficient estimates of interest, the shape and statistical significance of the IRF estimates remains unaffected (Figures A.1 and A.2 in the Appendix).

¹⁸We deflate nominal series with price indices constructed from corresponding goods prices from the same region or nearby regions as described in Brzezinski et al. (forthcoming).

Figure 3: Atlantic money inflows into Europe (% of European money stock)



America was privately owned. The Spanish Crown typically received significantly less than one fifth of money arrivals (García-Baquero González, 2003; Costa et al., forthcoming).¹⁹ The exogenous nature of the variation in the precious metal inflow series allows for a clean identification of monetary effects. Neither the production of precious metals in America, nor Atlantic transport losses were related to economic conditions in Europe.²⁰ American precious metal production primarily depended on the discovery of new mines, which was of an accidental nature (Bakewell, 1971; Boxer, 1962, pp.254–256). Once operational, American mines were too profitable for mining intensity to become a marginal decision influenced by the price of precious metals in Europe (Bacci, 2010). Instead, mining output was constrained by the availability of technology and location-specific costs, such as the supply of mercury for amalgamation and local administrative conditions.

¹⁹Brzezinski et al. (forthcoming) show that variations in the inflow of American precious metals did not exert their influence on European economic outcomes through their effect on government finances. Although American precious metals could make up an important share of government revenues among first-stage receivers, public sector shares were too small for this to translate into aggregate economic effects.

²⁰Although exogenous to the state of the European economy, American precious metal arrivals were partly anticipated by the public. The amount of annual inflows was highly persistent, and thus last year's inflows were a good predictor of this year's inflows. Each year the economic press reported how much gold and silver had arrived in Portugal and Spain (Morineau, 1985). In addition, small and fast dispatch boats carried information on the amount of precious metals that was about to arrive ahead of the treasure fleet (Martín, 1965, p.6). While published amounts and actual arrivals deviated from one another (Palma, 2022), literate contemporaries were in a position to form broadly accurate expectations about the annual inflow of American precious metals into Europe. To the extent that this happened, the analysis of American precious metal inflows resembles the analysis of anticipated monetary policy changes (Mishkin, 1982; Cochrane, 1998; Hoover and Jordà, 2001; Milani and Treadwell, 2012). By contrast, maritime disaster losses constituted exogenous variation that was unanticipated.

The eleven marked downward spikes in the money inflow series depicted in Figure 3 reflect big maritime disaster losses from Brzezinski et al. (forthcoming). Whereas Brzezinski et al. (forthcoming) describe more than 30 maritime disaster events, we here focus exclusively on the biggest disasters events – those resulting in a money loss exceeding 0.5% of the European stock and followed by a financial crisis.²¹ Like American mining output, maritime disaster losses were exogenous to the state of the European economy. Most maritime disasters were caused by bad weather, especially Caribbean hurricanes. Navigational errors, the second most common cause of maritime disaster losses, was similarly unrelated to economic conditions in Europe. Piracy and combat losses were the distant third and fourth causes of maritime disaster losses. Both were rooted in interstate conflicts, that potentially affected European economies in other ways than just through the loss of silver money. Conditional on that, however, piracy and combat losses arose as the consequence of random tactical opportunities, not the trajectory of economic variables in Europe.²²

4. METHOD

We estimate cumulative impulse response functions (IRF) that describe the effect of money inflow on real output through local projections over a 15-year horizon $h = 1, \dots, H$; $H = 15$ (Jordà, 2005):

$$\ln(Y_{i,t+h}) - \ln(Y_{i,t-1}) = \alpha_{i,h} + \beta_h \ln_t^M + \gamma_h X_{i,t} + u_{i,t+h}, \quad (4)$$

where $Y_{i,t}$ denotes the outcome variable of interest and \ln_t^M denotes the money inflow measure – either the natural logarithm of the inflow-to-stock ratio, or the disaster-loss-to-stock ratio, when we analyze the effect of maritime disaster shocks. When we distinguish between the different reaction of 1st, 2nd, and 3rd stage receivers we augment this specification with a term that interacts the money inflow measure with binary region indicators, D_i^r , that indicate to which region country i belongs: $\sum_{r=2}^R \beta_h^r \ln_t^M D_i^r$. The baseline specification contains country- and horizon-specific constants $\alpha_{i,h}$, a vector of controls $X_{i,t}$, and country- and horizon-specific error terms $u_{i,t+h}$.

The control vector includes two lags of the outcome variable’s growth rate and two lags of the exogenous control variables: average growing season temperatures (Anderson et al., 2017) and two war dummies indicating the involvement of country i in a war with another European country or a colonial war further abroad (Brecke, 1999). In addition, $X_{i,t}$ includes leads of the exogenous control variables up to the projection horizon h , a linear

²¹Indicative of their less disruptive nature, maritime disasters with a loss figure below 0.5% of the European stock are not systematically followed by rising lending rates.

²²Brzezinski et al. (forthcoming) document that the money value of the non-monetary losses entailed by maritime disasters (ships, non-money cargo) was negligible compared to the value of the monetary loss.

time trend and its square (Stock and Watson, 2018).²³ We calculate confidence bands based on Driscoll-Kraay standard errors that account for cross-sectional and temporal dependencies among observations (Driscoll and Kraay, 1998). We set the lag order of autocorrelation equal to the projection’s horizon h . The coefficient estimates $\{\hat{\beta}_h\}_{h=1}^H$ describe the trajectory of the outcome of interest in response to a change in the money inflow-to-stock-ratio.²⁴

Based on the coefficient estimates $\{\hat{\beta}\}_{h=1}^H$ we can sum up the overlapping GDP change effects of past money inflows as

$$\Delta_{i,t}^{M \rightarrow GDP} = \sum_{h=0}^{\phi} \left(\hat{\beta}_h in_{t-h}^M Y_{i,t-1-h}^M \right), \quad (5)$$

where ϕ denotes the effect persistence. We equate ϕ with the projection horizon $H = 15$ beyond which we usually do not find significant coefficient estimates, i.e. we assume $\{\hat{\beta}_h\}_{h=16}^{\infty} = 0$.²⁵ $Y_{i,t}^M$, the gross GDP growth attributable to money inflows in region i at time t , is defined recursively as

$$Y_{i,t}^M = 1 + \Delta_{i,t}^{M \rightarrow GDP} \quad (6)$$

We initialize $Y_{i,t}^M$ to equal 1 in 1530 – the beginning of our dataset. We can then compare $Y_{i,t}^M$ with actual gross GDP growth to get an idea of the importance of American money inflows for Europe’s early modern growth.²⁶

5. RESULTS

5.1. American precious metals and the *Rise of the West*

How did the arrival of American precious metals affect European economies? Figure 4 traces the real GDP responses to a doubling in the precious metal inflow-to-stock ratio across the European continent. The left panel depicts the GDP response in Spain – the first-stage receiver. It displays a short-lived boom during which output increased by

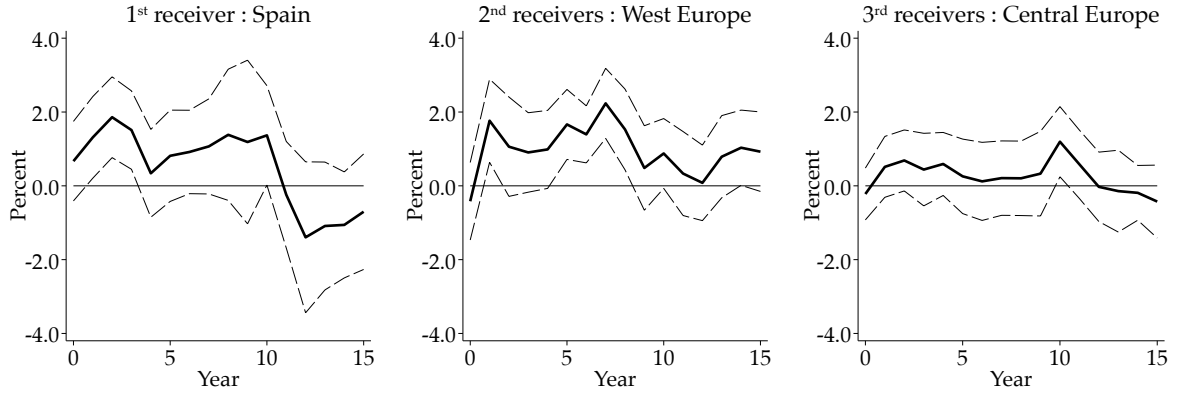
²³The results are robust to dropping the control vector from the specification (Figures A.3 to A.4 in the Appendix).

²⁴In some cases, the fragmentary nature of the disaggregated Spanish output series does not allow us to work with the saturated control vector $X_{i,t}$. In this case, to prevent the number of coefficients from exceeding the number of observations, we drop the leads of exogenous control variables and the higher order time trend from $X_{i,t}$. This is the case for shipbuilding and the Toledan series on fishing, coarse cloth output, theater visits, and brothel visits (Montemayor, 1996).

²⁵Only in the case of Spain’s GDP reaction to maritime disasters, do we find evidence for a permanent output effect that lasts beyond 15 years (Section 5.3). Accordingly, we extend the sum in equation 5 over the entire sample period in this case.

²⁶The Appendix displays results obtained from a mean group estimator that allows for dynamic heterogeneity (Pesaran and Smith, 1995). The results are very similar to the baseline results that pool the West European data, or partially pool the data in the 2nd and 3rd stage receiver groups (Figures A.5 to A.7).

Figure 4: Real GDP response to doubling in money-inflow-to-stock ratio



Notes: Dashed lines – 90% confidence interval.

around 2%. After four years the boom has run its course. The output response remains somewhat elevated until year ten, but is statistically indistinguishable from zero.

The middle panel depicts the GDP reaction of second-stage receivers – England, Holland, France, and Italy. Here, the real effect of a monetary injection persisted for longer. Real GDP increased by around 2% within one year. Output then remained elevated for around seven years, before returning to normal. The finding that Europe’s second-stage receivers benefited more from American precious metals than Spain is consistent with the notion that Spain suffered from *Dutch disease*: Spanish manufacturers became too expensive compared to their competitors located in England, Holland, and France. As a consequence, Spain suffered a persistent trade deficit with these countries, which she settled with precious metals from America (Hamilton, 1934; Forsyth and Nicholas, 1983; Drelichman, 2005b; Abad and Palma, 2021).

Finally, the right panel depicts the output response of 3rd stage receivers – Germany, Poland, and Sweden. The IRF estimate suggests that an increase in precious metal inflows failed to develop a stimulative effect in Central Europe. Although the mean IRF estimate tends to be slightly positive, most coefficient estimates are insignificant. These findings indicate that by the time an increase in American precious metals had worked its way into Central Europe, it no longer afforded any real stimulation. By implication, no real effects should be expected further East.

Which part of West Europe’s GDP growth over the early modern period can plausibly be attributed to American precious metals? To assess this according to the machinery laid out in equations 5 and 6, we first calculate the cumulative IRF for Europe’s 1st and second-stage receivers together. Expectedly, the resulting real GDP response is very similar to that of West Europe’s second-stage receivers (Figure A.14 in the Appendix). We then

Table 1: Monetary origins of the early Great Divergence

	Western Europe	East Asia
Monetary effect	41%	2%
GDP change	77%	16%
% of early <i>Great Divergence</i>	72%	

Notes: % of early Great Divergence calculated as $(\Delta Y_{Europe,1780}^M - \Delta Y_{Asia,1780}^M)/(\Delta Y_{Europe,1780} - \Delta Y_{Asia,1780})$. Italics: monetary effect for East Asia based on West European IRF estimate, scaled down by East Asia's large GDP share and small share of direct American precious metal inflows across the Pacific.

calculate the West European GDP growth that is attributable to injections of American money according to equation [6]. The result amounts to 41% – around half of the actual West European GDP increase of 77% (Table [1]). This suggests that American precious metals were a key factor behind West Europe's early modern growth exceptionalism.

The second column of Table [1] contrasts West Europe's growth experience, with that of East Asia over the same time period. The East Asian economy grew by around 16% between 1530 and 1780. While the lack of annual GDP estimates for early modern East Asian economies prevents the calculation of an East Asia-specific GDP IRF, we can calculate a monetary effect for East Asia based on the West European GDP IRF, scaled down by East Asia's higher GDP level and its smaller role as a first-stage receiver of American precious metals through the Pacific.²⁷ The resulting GDP growth that is attributable to money in East Asia amounts to 2% – around 10% of the measured East Asian GDP increase of 16%. These numbers imply that 72% of the early Great Divergence between West and East can be attributed to American precious metals. While the sustained inflow of large quantities of American precious metals into Europe billowed West European GDP, little comparable stimulus arrived at the Eastern end of the Eurasian landmass.

5.2. How did American precious metals promote growth?

How exactly did the arrival of American precious metals affect economic activity in West Europe. To answer this question, we analyze the wide variety of industry-level output series that exist for Holland and England. To estimate IRFs for the disaggregate output series we apply the same local projection specification as above. The abundance of disaggregated output series makes an exhaustive analysis impracticable. Therefore, in the following we only highlight the most salient IRFs which help to better understand

²⁷The scaling factor amounts to 0.04, which reflects a primary influx of around 13,000 tonnes in East Asia (compared to Europe's 75,000 tonnes), and a close to four times larger GDP. Consistent with our finding that the stimulative effect of American precious metals had run its course by the time these metals arrived in Central Europe, we assume that money that arrived in East Asia across the overland silk routes from West to East developed no stimulative effect in East Asia.

through which channels American precious metal arrivals affected real GDP. All other disaggregated output IRFs are displayed in the Appendix (Figures A.8 – A.9).

5.2.1 Holland

Figure 5 displays the output responses of various Dutch industries. The results mesh well with three overarching themes – capital formation, a short-run consumption boom, and trade intensification. First, the arrival of American precious metals triggered investments in capital – agricultural land, ships, and human capital. Agricultural land investment is evidenced by the persistent increase in agricultural output by around 5%. Increases in agricultural output predominantly reflect increases in cultivated land area, resulting from reclamation projects such as newly created polders.²⁸ This is consistent with the operation of a Mundell-Tobin effect (Mundell, 1963; Tobin, 1965) that has also been noted by the historical literature: urban elites developed an interest in land investments in an attempt to avoid inflation losses on their precious metal holdings (de Vries and van der Woude, 1997; van Bavel, 2016, pp.167–196). The feared (silver) inflation losses were the consequence of the continued influx of American precious metals into West Europe which gave rise to a positive inflation rate averaging around 0.5% per year over the early modern period.²⁹ Similarly, we find evidence for investments in ships and human capital. Concerning ship production, the IRF displayed in Figure 5 indicates a sizable increase of 20%, but this increase is only marginally significant in years 1 and 8. By contrast, the IRF for education is estimated more precisely. The aggregate of primary, secondary, and tertiary education provided in Holland increases by around 1.5% in the aftermath of a doubling in the inflow-to-stock ratio.³⁰

Second, the consumption boom theme is reflected in the responses of beer and soap production, both of which increase by around 2% within three years. While beer can be clearly categorized as a final consumption good, the attribution for soap is more ambiguous owing to the use of soap as an intermediate good in industry, especially for washing wool. However, we do not find any indication that Dutch textile production increased in the aftermath of an increase in American precious metal arrivals (Figure A.8 in the Appendix). This suggests that the short-run increase in Dutch soap output was consumed domestically (or exported).³¹

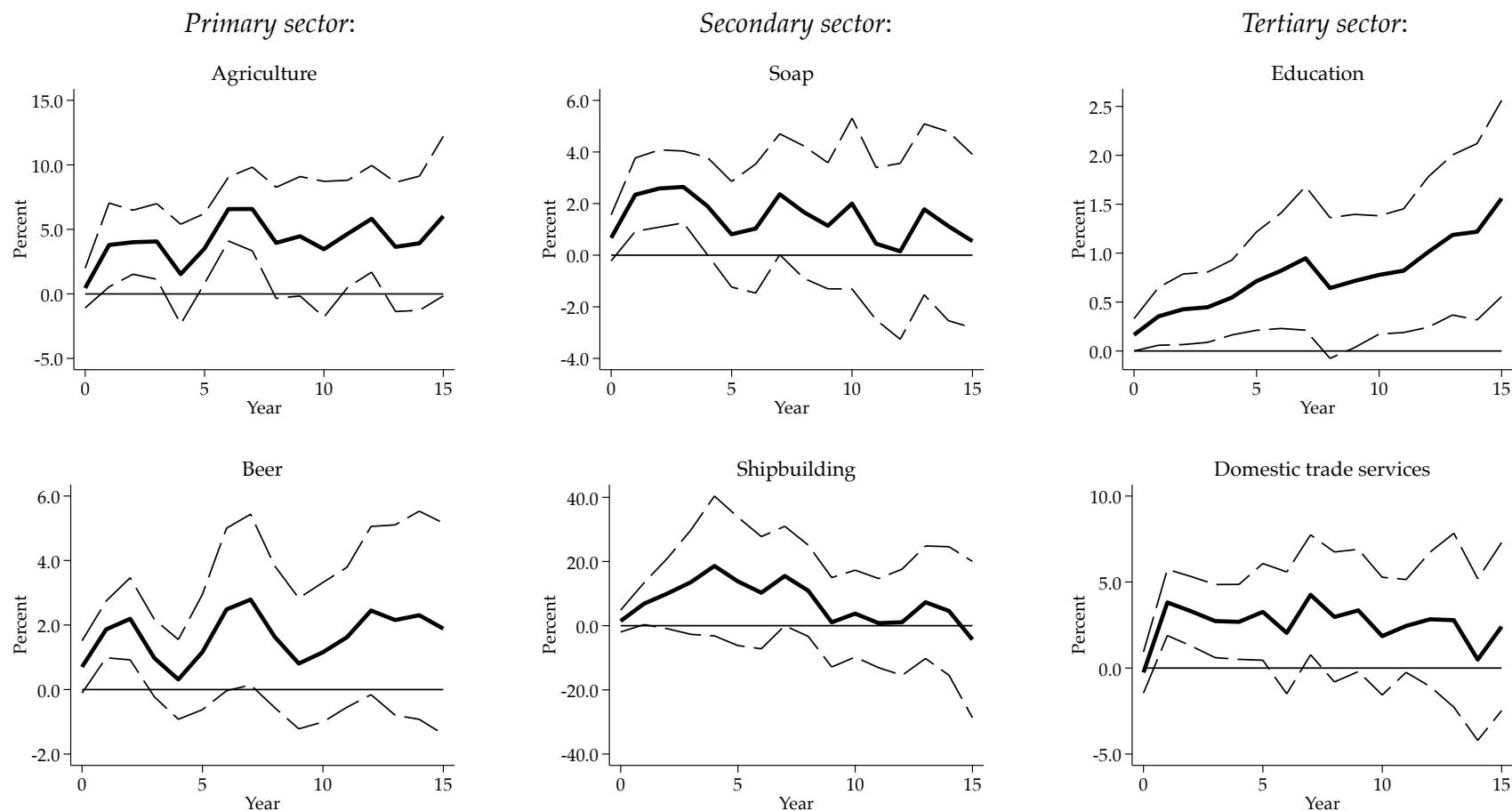
²⁸The rental value of land, which also enters the calculation of agricultural value added, is an average that stretches over many decades. Thus, it cannot account for the short-run increase in agricultural value added that according to our IRF estimate occurred within one year of an increase in the primary influx of American precious metals.

²⁹Bread production followed the increase cultivated land (Figure A.8 in the Appendix).

³⁰Eisenstein (1979), Baten and Van Zanden (2008), and van Zanden (2009, ch.6) give a prominent role to human capital accumulation in West Europe's early modern development.

³¹Export is a distinct possibility given that 50% to 80% of Dutch soap was exported abroad (van Zanden and van Leeuwen, 2012, Data Appendix).

Figure 5: Disaggregated output responses to a doubling in the money inflow-to-stock ratio – Holland



Notes: Dashed lines – 90% confidence interval.

Finally, the increase in domestic trade services depicted in the lower right panel of Figure 5 mirrors the overall increases in agricultural and industrial production. Together with the finding that shipbuilding increased, the uptick in domestic trade services is supportive of the notion that American precious metals allowed Holland to realize gains of trade, affording her an episode of Smithian growth. Beyond that, Holland likely benefited from the uptick in West European GDP more generally due to its role as a key trade intermediary and financial center.³²

5.2.2 England

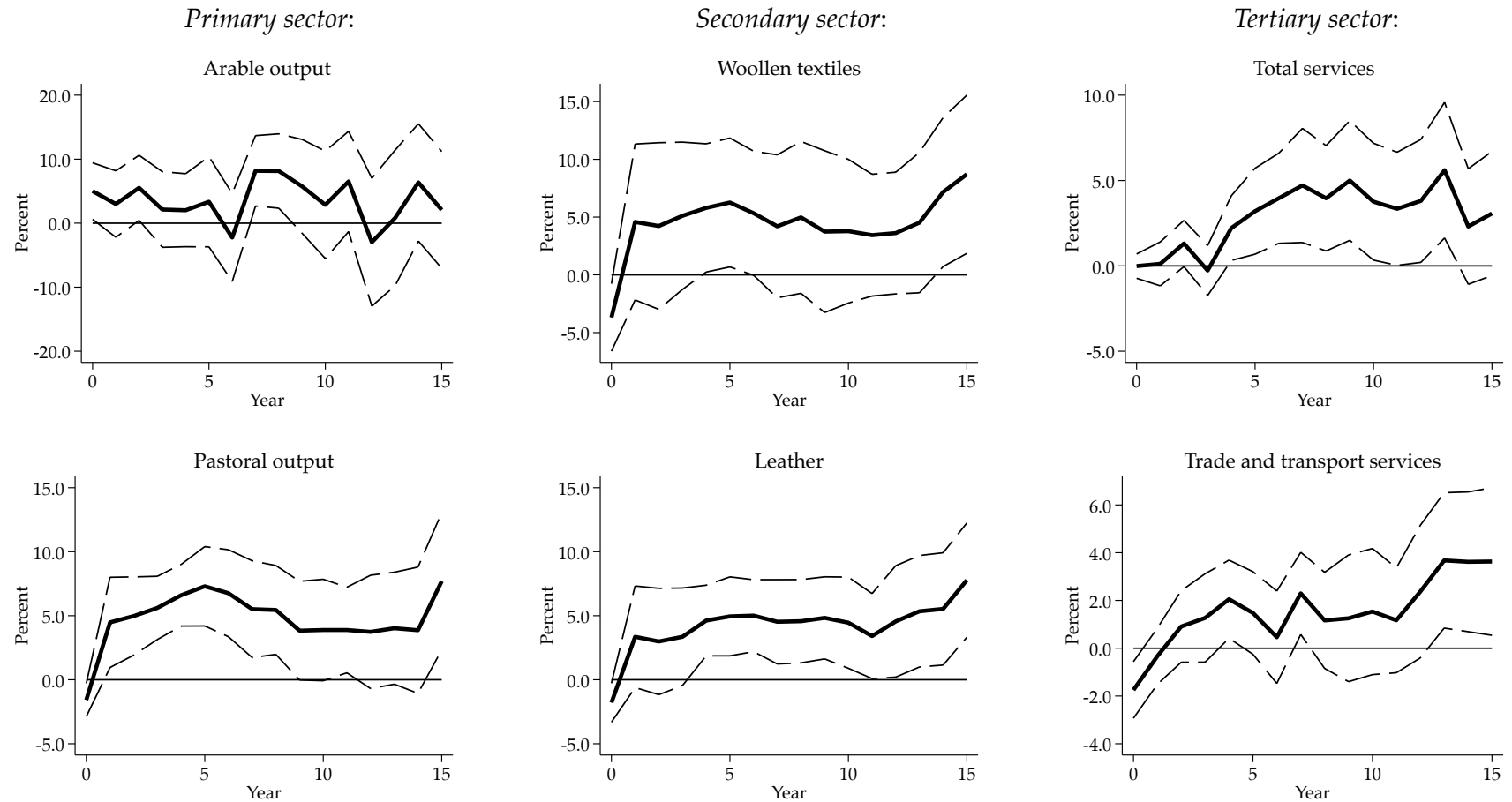
How did American precious metals contribute to economic growth in early modern Europe’s second growth star – England? Figure 6 displays IRF estimates that are indicative of the economic forces that the arrival of American precious metals set in motion there. As in the case of Holland, three themes emerge: capital formation, an increase in female employment opportunities, and trade intensification. First, agricultural output increased, in particular pastoral output (left panels of Figure 6). Pastoral output is primarily determined by the stock of animals and the 5% increase in pastoral output thus indicates that American precious metals found an outlet in livestock investments. The increase in livestock is also reflected in downstream industries in the secondary sector: woollen textile output and leather output increase in line with pastoral output (center panels of Figure 6).³³

Second, in West Europe’s early modern economies pastoral agriculture was an important employer of women (Boserup et al., 1970 [2013]; Burnette, 1999, 2005). The increase in livestock investment that was triggered by the arrival of American precious metals thus also constituted an improvement of female labor market opportunities, possibly putting

³²Several industries exhibit a slow increase in response to an increase in the influx of American precious metals, which only turns statistically significant after 15 years. Among these are housing services, domestic servants, clothing, and other foods. Partly, the delayed response may reflect the use of interpolations in the construction of these particular output series (van Zanden and van Leeuwen, 2012, Data Appendix). Consistent with a causal link between a country’s monetary capacity and warfare intensity (Bonfatti et al., 2020) Dutch military expenditure is another tertiary sector item that significantly increased in the aftermath of an increase in American money arrivals (Figure A.8 in the Appendix). Finally, the TFP series provided by (van Zanden and van Leeuwen, 2012) does not exhibit any reaction to an increase in money inflows, suggesting that American money exerted its growth effect through increases in factor inputs, rather than productivity increases (Figure A.16 in the Appendix).

³³The increase in arable and pastoral output is reflected in an increase in foodstuffs output. Two industries see their output decline in the aftermath of an increase in the arrival of American precious metals: tin and iron. The tin industry experiences a brief, but marked 10% decline two years after the increase in arrivals. An immediate recovery ensues in the subsequent year. One plausible suspect for this salient response is a crowding out effect, in which the newly arriving American gold and silver causes mints to temporarily shift from minting bronze and tin coins to minting gold and silver coins. The English iron industry sees its output decline by around 5% within 10 years after the increase in precious metal arrivals. Increased land use for pastoral agriculture may have lowered the supply of wood and thus lowered the charcoal reserves necessary for iron production. Alternatively, any upward pressure on iron prices caused by the influx of American precious metals may have rendered English iron uncompetitive vis-à-vis the competition from Sweden and Russia (King, 2020, p.8).

Figure 6: Disaggregated output responses to a doubling in the money inflow-to-stock ratio – England



Notes: Dashed lines – 90% confidence interval.

downward pressure on fertility rates (Galor and Weil, 1996; de Moor and van Zanden, 2010). Relatedly, the upper right panel of Figure 6 displays the output response of the service sector – another important employer of women. The service sector output data is not strictly annual as it employs 10-year averages. Given this caveat, however, it appears that the arrival of American precious metals positively influenced service sector output and thus provided even more employment opportunities for young women, e.g. as domestic maids.

Finally, the lower right panel in Figure 6 documents an increase in trade and transport services. This increase only takes hold several years after an increase in the arrival of precious metals, but it persists beyond 15 years. As in the case for Holland, American precious metals thus afforded England a period of trade intensification and the accompanying Smithian growth (Jacks, 2004; Palma and Silva, 2022).

In sum, the evidence from Holland and England suggests that the arrival of American precious metals fostered capital formation (land, livestock, ships, human capital) and gave rise to a trade intensification.³⁴ The English evidence is furthermore consistent with a demographic effect of American precious metal arrivals that was mediated through an improvement in female employment opportunities.³⁵ These findings indicate that the arrival of American precious metals was deeply enmeshed in the multifaceted process that underpinned West Europe’s early modern growth exceptionalism.³⁶

5.3. Maritime disaster insulation and monetary goldilocks zone

Why did first-stage receiver Spain, with direct colonial control over American precious metals, grew considerably less than West Europe’s second-stage receivers? Existing research has focused on the detrimental impact of American precious metals on first-stage receiver price competitiveness and political institutions (Palma, 2020; Henriques and Palma, 2020). In this section we explore a novel reason for why Spain failed to benefit from the American precious metal windfall as much as some second-stage receivers did: the exposure to big maritime disaster losses that triggered severe financial crises with persistent output costs.

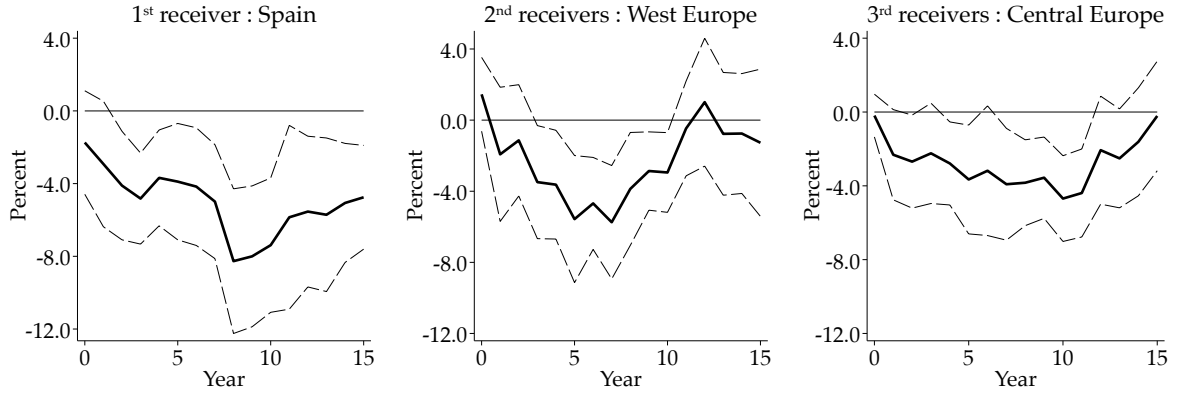
Did second-stage receivers enjoy insulation against such maritime disaster effects? Figure 7 contrasts the real GDP trajectories of 1st, 2nd, and 3rd stage receivers in the

³⁴To the extent that an increase in the influx of American precious metals led to a simultaneous increase in investments across various West European industries it bears some semblance to a *Big Push* policy that overcomes an investment coordination problem across industries (Rosenstein-Rodan, 1943; Murphy et al., 1989).

³⁵More generally, Galor and Weil (1996) propose that capital accumulation increased the relative wage of women vis-à-vis men, thereby increasing labor market participation and reducing fertility rates.

³⁶Figure A.10 in the Appendix presents the disaggregated output findings for the more fragmentary Spanish data, which indicates that American precious metal arrivals stimulated Spanish textile production and shipbuilding.

Figure 7: Real GDP response to negative 1 percentage point maritime disaster shock



Notes: Dashed lines – 90% confidence interval.

aftermath of a maritime disaster loss amounting to 1% of the European money stock. first-stage receiver Spain sees its output decline by up to 8% in the aftermath of such a loss. Output is still 4% below its baseline level 15 years after the event. Research by [Brzezinski et al. \(forthcoming\)](#) confirms on the basis of merchant letters, that maritime disasters triggered severe financial crises in Spain. The failure of Spanish output to recover in the aftermath of maritime disasters is thus reminiscent of the finding for modern times that output costs of severe financial crises can be permanent ([Cerra and Saxena, 2008](#); [Jordà et al., 2020a](#)). Consistent with this notion, we find no indication for a recovery when scanning over a 50-year horizon (Figure [A.15](#) in the Appendix). The Spanish economy appears to have been permanently damaged by big maritime disasters and the financial crises they caused.

Next, second-stage receivers see their output decline by around 5% within five years (middle panel of Figure [7](#)). Thereafter, however, output makes a full recovery. In contrast to Spain, the travails of Europe’s second-stage receivers in the aftermath of maritime disasters were only temporary.³⁷ Even among 3rd stage receivers in Central Europe a recessionary effect is visible (right panel of Figure [7](#)), but it is shallower and its onset is delayed compared to the West European case. A full recovery occurs after around ten years.

These findings are informative with respect to the origins of the *Little Divergence* between Europe’s South and Northwest. Whereas the Spanish economy only grew around

³⁷Interest rate data indicates that, whereas the Spanish interest rate level remained elevated for several years after a maritime disaster, interest rates did not increase in Europe’s second-stage receivers. In fact, interest rates decreased in the immediate aftermath of maritime disaster events, possibly the result of capital flight away from Spain. This suggests that second-stage receivers were spared the financial duress that Spain experienced in the aftermath of maritime disasters. We find no indication for a response of interest rates in Central Europe (Figure [A.12](#) in the Appendix).

Table 2: Monetary origins of the Little Divergence

	Spain	Northwest Europe
Disaster effect	-67%	NA
GDP change	36%	255%
% of <i>Little Divergence</i>	30%	

Notes: % of Little Divergence calculated as $(\Delta Y_S^M - \Delta Y_{NW}^M)/(\Delta Y_S - \Delta Y_{NW})$. NA entry for Northwest Europe reflects absence of long-run maritime disaster cost in that region (Figure 7). As no big maritime disasters occur in the decades preceding 1780, we assume that any short-run effect from the last disaster event in our sample has already dissipated by that time.

36% between 1530 and 1780, the economies of England and Holland grew by 255% (Bolt and van Zanden, 2020). If Spain never recovered from its maritime-disaster induced crisis losses ($\phi = \infty$ in equation 5), then equation 6 implies that, absent the eleven big maritime disasters that hit Spain over the early modern period, Spanish GDP would have grown by 103% instead of only 36% – a 67 percentage points difference (Table 2). Thus, its exposure to the high volatility of the American primary influx can account for around one third of the Little Divergence between Spain and Northwest Europe’s growth stars.

5.4. How did maritime disasters hurt Spanish economic development?

To better understand how maritime disasters hurt Spanish economic development, we again turn to disaggregated output indicators. Figure 8 displays the trajectories of six output series that cover Spain’s primary, secondary and tertiary sectors.³⁸ Agricultural output shows no sign of being negatively affected by disaster losses. By contrast, fish consumption undergoes a 50% contraction after three years. Relatedly, ship production contracts by almost 50% within the first two years after a large maritime disaster loss.³⁹ More generally, the shipbuilding contraction is indicative of a disruption to proto-industrial capital formation in the aftermath of large maritime disaster losses.

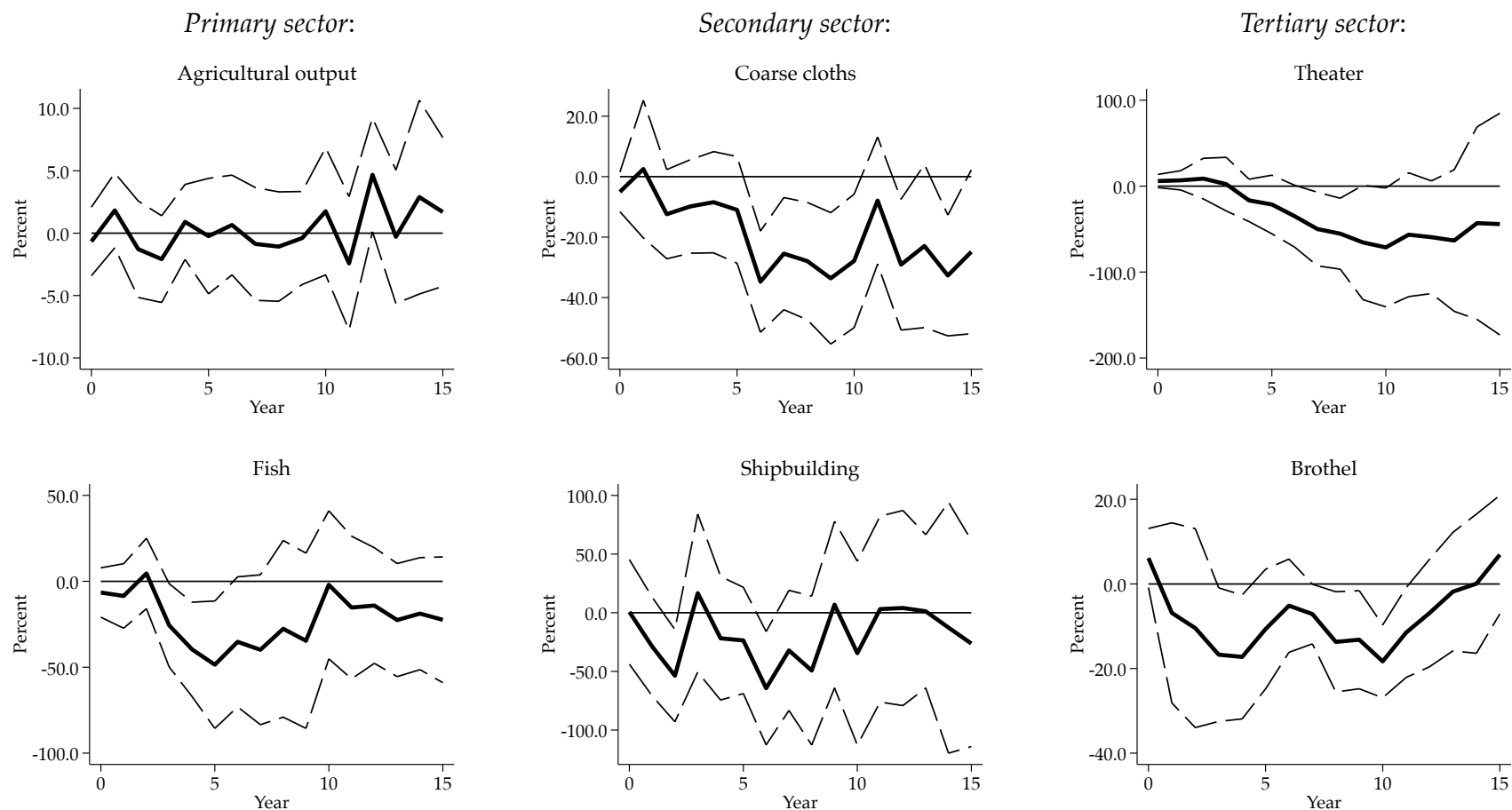
Coarse cloth production (upper middle panel of Figure 8) exhibits a large persistent decline of around 30%.⁴⁰ Brzezinski et al. (forthcoming) document the difficulties Spanish merchants faced in supplying their manufacturing networks with intermediary inputs as credit supply dried up in the aftermath of maritime disasters. The long-run IRFs displayed here, suggest that Spanish textile manufacturing underwent a persistent contraction as a

³⁸Figure A.11 in the Appendix displays additional disaggregated output responses.

³⁹When including 20 smaller maritime disasters into the analysis, Brzezinski et al. (forthcoming) find that there is no systematic ship production response to maritime disaster shocks. This suggests that the contraction in shipbuilding is specific to large maritime disasters that trigger severe financial crises.

⁴⁰Relatedly, fine cloth production initially declines more rapidly, experiences a brief recovery between years five and ten, and then declines again without recovering for 25 years after a disaster event (Figure A.11 in the Appendix).

Figure 8: Disaggregated output responses to 1 percentage point maritime disaster loss – Spain



Notes: Dashed lines – 90% confidence interval.

result of such credit crunches.

The available data for the tertiary sector is comparatively brief – covering around 50 years and straddling only two large maritime disaster events. Nevertheless, the data for Toledan theater and brothel revenues points towards a contractionary effect of maritime disaster losses on tertiary sector activity (right panels of Figure 8). Theater visits almost come to a complete halt within the 10 years after a large maritime disaster loss. After that, there are some indications of a recovery taking hold. Brothel visits temporarily decline by around 10% before undergoing a full recovery.

In sum, the disaggregated output data for Spain suggests that maritime disaster-induced financial crises dealt severe blows to Spain’s non-agricultural production. Textile manufacturing, in particular, experienced very persistent contractions. In addition, the shipbuilding response indicates that maritime disaster losses may have acted as a drag on Spain’s proto-industrial capital formation.

6. CONCLUSION

The influx of vast amounts of American precious metals into Europe is a salient feature of the economic history of the early modern period. So is Europe’s early modern growth performance which by the mid-18th century had carried Europe to the doorstep of the Industrial Revolution. While traditionally a causal connection between American precious metals and European growth has been discouraged by the principle of long-run money neutrality, our findings lend support to the conjecture that American precious metals played an important role in facilitating the *Rise of the West*.

We find that the effect of American precious metal inflows into Europe were large and persistent. At the end of the 18th century the sustained injection of American precious metals can account for three quarters of the early *Great Divergence* between West Europe and the East Asia. An analysis of industry-level output series suggests that American money arrivals stimulated West European growth by accelerating capital formation, intensifying trade, and by improving female employment opportunities, thereby lowering birth rates.

While our analysis thus identifies American precious metals as a blessing for West European growth in the early modern period, the Spanish experience was more ambiguous. As the almost exclusive first-stage receiver of American precious metals, it was uniquely exposed to Atlantic transport losses – the main source of the high volatility of the American precious metal inflow into Europe. Big maritime disasters triggered severe financial crises in Spain that caused lasting damage. By contrast, Europe’s second-stage receivers were sufficiently insulated from maritime disaster losses to avoid the same fate. As a consequence, Northwest Europe’s early modern growth stars – England and Holland –

were located in a *monetary goldilocks zone* which benefited from monetary injections that were sizable as well as sufficiently stable to avoid repeated financial turmoil.

REFERENCES

- Abad, Leticia Arroyo, and Nuno Palma. 2021. The fruits of El Dorado: the global impact of American precious metals. In *The fruits of the early globalization*, 95–131. Springer.
- Acemoglu, Daron, Simon Johnson, and James Robinson. 2005. The rise of Europe: Atlantic trade, institutional change, and economic growth. *American Economic Review* 95(3): 546–579.
- Allen, Robert C. 2009. *The British industrial revolution in global perspective*. Cambridge University Press.
- Álvarez-Nogal, Carlos, Leandro Prados de la Escosura, and Carlos Santiago-Caballero. 2021. Growth recurring in preindustrial Spain? *Cliometrica* 1–27.
- Álvarez-Nogal, Carlos, and Leandro Prados de la Escosura. 2013. The rise and fall of Spain (1270–1850). *The Economic History Review* 66(1): 1–37.
- Anderson, Robert Warren, Noel D. Johnson, and Mark Koyama. 2017. Jewish persecutions and weather shocks: 1100–1800. *The Economic Journal* 127(602): 924–958.
- Attman, Artur. 1986. American bullion in the European world trade 1600–1800. *Acta Regiae Societatis Scientiarum Et Litterarum Gothoburgensis: Humaniora* 26.
- Attman, Artur. 1996. Dutch enterprise in the world bullion trade. In *Bullion transfer from Western Europe to the Baltic and the problem of trade balances: 1550–1750*, edited by North, M. Aldershot.
- Bacci, Massimo Livi. 2010. *El Dorado in the marshes: gold, slaves and souls between the Andes and the Amazon*. Polity.
- Bakewell, Peter John. 1971. *Silver mining and society in colonial Mexico, Zacatecas, 1546–1700*. Cambridge University Press.
- Baten, Joerg, and Jan Luiten Van Zanden. 2008. Book production and the onset of modern economic growth. *Journal of Economic Growth* 13(3): 217–235.
- Benigno, Gianluca, and Luca Fornaro. 2018. Stagnation traps. *The Review of Economic Studies* 85(3): 1425–1470.
- Berg, Maxine. 2005. *Luxury and pleasure in eighteenth-century Britain*. Oxford University Press.
- Bernhofen, D.M., M. Eberhardt, J. Li, and S.L. Morgan. 2020. The secular decline of market integration during the Qing China’s Golden Age. *Unpublished manuscript*.
- Blanchard, Oliver J., and Lawrence H. Summers. 1986. Hysteresis and the European unemployment problem. In *NBER Macroeconomics Annual*, edited by Fischer, Stanley, 15–78. MIT Press.
- Bolt, Jutta, and Jan Luiten van Zanden. 2020. Maddison style estimates of the evolution of the world economy. A new 2020 update. *Maddison Project Database, version 2020*.
- Bonfatti, Roberto, Adam Brzezinski, Kıvanç Karaman, and Nuno Palma. 2020. Monetary capacity. CEPR Discussion Paper No. DP15299.
- Boserup, Ester, Su Fei Tan, and Camilla Toulmin. 1970 [2013]. *Woman’s role in economic development*. Routledge.
- Boxer, Charles Ralph. 1962. *The golden age of Brazil: growing pains of a colonial society, 1695–1750*. University of California Press.
- Brecke, Peter. 1999. Violent conflicts 1400 AD to the present in different regions of the world. 1999 Meeting of the Peace Science Society.
- Broadberry, Stephen. 2021a. Accounting for the Great Divergence: recent findings from historical national accounting. CEPR Discussion Paper No. DP15936.
- Broadberry, Stephen. 2021b. The Industrial Revolution and the Great Divergence: recent findings from historical national accounting. In *The Handbook of Historical Economics*, edited by Bisin, Alberto, and Giovanni Federico, 749–771. Elsevier.
- Broadberry, Stephen, Bruce Campbell, Alexander Klein, Mark Overton, and Bas van Leeuwen. 2015. *British Economic Growth, 1270–1870*. Cambridge University Press.

- Brzezinski, Adam, Yao Chen, Nuno Palma, and Felix Ward. forthcoming. The vagaries of the sea: evidence on the real effects of money from maritime disasters in the Spanish Empire. *Review of Economics and Statistics* .
- Burnette, Joyce. 1999. Labourers at the Oakes: changes in the demand for female day-laborers at a farm near Sheffield during the agricultural revolution. *The Journal of Economic History* 59(1): 41–67.
- Burnette, Joyce. 2005. The wages and employment of female day-labourers in English agriculture, 1740–1850. *The Economic History Review* 57(4): 664–690.
- Cerra, Valerie, and Sweta Chaman Saxena. 2008. Growth dynamics: the myth of economic recovery. *American Economic Review* 98(1): 439–57.
- Céspedes del Castillo, Guillermo. 1996. *Las casas de moneda en los reinos de Indias: Las cecas indianas en 1536-1825*. Museo Casa de la Moneda.
- Charotti, Carlos, Nuno Pedro G. Palma, and João Pereira dos Santos. 2022. American treasure and the decline of Spain. CEPR Discussion Paper No. DP17020.
- Chaudhuri, Kriti N. 1986. World silver flows and monetary factors as a force of international economic integration, 1658–1758. In *The emergence of a world economy, 1500–1914, Part 1*, edited by Fischer, Wolfram. (Stuttgart 1986).
- Chen, Yao, Nuno Palma, and Felix Ward. 2021. Reconstruction of the Spanish money supply, 1492–1810. *Explorations in Economic History* 81.
- Clark, Gregory. 2007. The long march of history: farm wages, population, and economic growth, England 1209–1869. *The Economic History Review* 60(1): 97–135.
- Cochrane, John H. 1998. What do the VARs mean? Measuring the output effects of monetary policy. *Journal of Monetary Economics* 41(2): 277–300.
- Costa, Leonor Freire, Susana Münch Miranda, and Pilar Nogues-Marco. forthcoming. An economic history of the Iberian Peninsula, 700–2000. In *Globalization and the Enlightenment, 1500–1800*, edited by Costa, Leonor Freire, and Regina Grafel. Cambridge University Press.
- Day, John. 1978. The great bullion famine of the fifteenth century. *Past & Present* (79): 3–54.
- de Moor, Tine, and Jan Luiten van Zanden. 2010. Girl power: the European marriage pattern and labour markets in the North Sea region in the late medieval and early modern period. *The Economic History Review* 63(1): 1–33.
- de Vries, Jan. 1994. The industrial revolution and the industrious revolution. *The Journal of Economic History* 54(2): 249–270.
- de Vries, Jan. 2003. Connecting Europe and Asia: a quantitative analysis of the cape-route trade, 1497–1795. In *Global Connections and Monetary History, 1470–1800*, edited by ane Richard von Glahn, Dennis O. Flynn, and Artúro Giraldez. Ashgate.
- de Vries, Jan. 2008. *The industrious revolution: consumer behavior and the household economy, 1650 to the present*. Cambridge University Press.
- de Vries, Jan, and Ad van der Woude. 1997. *The first modern economy: success, failure, and perseverance of the Dutch economy, 1500–1815*. Cambridge University Press.
- Desan, Christine. 2014. *Making money: coin, currency, and the coming of capitalism*. Oxford University Press.
- Drelichman, Mauricio. 2005a. All that glitters: precious metals, rent seeking and the decline of Spain. *European Review of Economic History* 9(3): 313–336.
- Drelichman, Mauricio. 2005b. The curse of Moctezuma: American silver and the Dutch disease. *Explorations in Economic History* 42(3): 349–380.
- Driscoll, John C., and Aart C. Kraay. 1998. Consistent covariance matrix estimation with spatially dependent panel data. *Review of Economics and Statistics* 80(4): 549–560.
- Dyer, Christopher. 2002. *Making a living in the Middle Ages: the people of Britain 850-1520*. Yale University Press.
- Eisenstein, Zillah R. 1979. *Capitalist patriarchy and the case for socialist feminism*. Monthly

- Review Press.
- Engerman, Stanley L. 1972. The slave trade and British capital formation in the eighteenth century: a comment on the Williams thesis. *Business History Review* 46(4): 430–443.
- Federico, Giovanni, Max-Stephan Schulze, and Oliver Volckart. 2021. European goods market integration in the very long run: from the Black Death to the First World War. *The Journal of Economic History* 81(1): 276–308.
- Fernández-Villaverde, Jesús, Pablo Guerrón-Quintana, Juan F. Rubio-Ramírez, and Martin Uribe. 2011. Risk matters: the real effects of volatility shocks. *American Economic Review* 101(6): 2530–61.
- Forsyth, Peter J., and Stephen J. Nicholas. 1983. The decline of Spanish industry and the price revolution: a neoclassical analysis. *Journal of European Economic History* 12(3).
- Frank, Andre Gunder. 1979. *Dependent accumulation and underdevelopment*. NYU Press.
- Frank, Andre Gunder. 2011. *World accumulation*. NYU Press.
- Galí, Jordi. 2022. Insider–outsider labor markets, hysteresis, and monetary policy. *Journal of Money, Credit and Banking* 54(S1): 53–88.
- Galor, Oded. 2011. *Unified growth theory*. Princeton University Press.
- Galor, Oded, and David N. Weil. 1996. The gender gap, fertility, and growth. *American Economic Review* 86(3): 374–387.
- Galor, Oded, and David N. Weil. 2000. Population, technology, and growth: from Malthusian stagnation to the demographic transition and beyond. *American Economic Review* 90(4): 806–828.
- García-Baquero González, Antonio. 2003. American gold and silver in the eighteenth century: from fascination to accounting. In *Global connections and monetary history, 1470-1800*, edited by Dennis O. Flynn, Richard von Glahn, Arturo Giráldez, 107–121. Ashgate.
- Hamilton, Earl Jefferson. 1934. *American treasure and the price revolution in Spain, 1501-1650*, volume 1125. Harvard University Press Cambridge, MA.
- Henriques, Antonio, and Nuno Palma. 2020. Comparative European institutions and the little divergence, 1385-1800. CEPR Discussion Paper No. DP14124 (v.3).
- Hoover, Kevin D., and Òscar Jordà. 2001. Measuring systematic monetary policy. *Federal Reserve Bank of St. Louis Review* 83(4).
- Inikori, Joseph E. 2002. *Africans and the industrial revolution in England: a study in international trade and development*. Cambridge University Press.
- Irigoin, Alejandra. 2020. Rise and demise of the global silver standard. In *Handbook of the History of Money and Currency*, 383–410. Springer.
- Jacks, David S. 2004. Market integration in the North and Baltic Seas, 1500-1800. *Journal of European Economic History* 33(3): 285–329.
- Jacob, William. 1831. *An historical inquiry into the production, and consumption of the precious metals*. Carey & Lea.
- Jordà, Òscar. 2005. Estimation and inference of impulse responses by local projections. *The American Economic Review* 95(1): 161–182.
- Jordà, Òscar, Moritz Schularick, and Alan M. Taylor. 2020a. Disasters everywhere: the costs of business cycles reconsidered. NBER Working Paper No. 26962.
- Jordà, Òscar, Sanjay R. Singh, and Alan M. Taylor. 2020b. The long-run effects of monetary policy. NBER Working Paper No. 26666.
- Kedrosky, Davis, and Nuno Palma. 2021. The Cross of Gold: Brazilian treasure and the decline of Portugal. CAGE Working Paper, 574.
- Keynes, John Maynard. 1936. *The general theory of employment, interest, and money: interest and money*. Harcourt, Brace and company.
- King, Peter. 2020. *A Gazetteer of the British Iron Industry, 1490–1815, Volumes I and II*. BAR publishing.

- Krantz, Olle. 2017. Swedish GDP 1300-1560: a tentative estimate. *Lund Papers in Economic History* (152).
- Le Goff, Jacques. 2012. Money and the Middle Ages: an essay in historical anthropology. *Jean Birrell*.
- Malanima, Paolo. 2011. The long decline of a leading economy: GDP in central and northern Italy, 1300–1913. *European Review of Economic History* 15(2): 169–219.
- Malinowski, Mikołaj, and Jan Luiten Van Zanden. 2017. Income and its distribution in preindustrial Poland. *Cliometrica* 11(3): 375–404.
- Martín, F. Ruiz. 1965. *Lettres marchandes échangées entre Florence et Medina del Campo*, volume 124. S.E.V.P.E.N.
- Milani, Fabio, and John Treadwell. 2012. The effects of monetary policy “news” and “surprises”. *Journal of Money, Credit and Banking* 44(8): 1667–1692.
- Mishkin, Frederic S. 1982. Does anticipated monetary policy matter? An econometric investigation. *Journal of Political Economy* 90(1): 22–51.
- Mokyr, Joel. 1992. *The lever of riches: technological creativity and economic progress*. Oxford University Press.
- Montemayor, Julián. 1996. *Tolède entre fortune et déclin (1530-1640)*. Presses Univ. Limoges.
- Morineau, Michel. 1985. *Incroyables gazettes et fabuleux métaux: les retours des trésors américains d’après les gazettes hollandaises (XVIe-XVIIIe siècles)*, volume 7. Les Editions de la MSH.
- Muldrew, Craig. 2007. Wages and the problem of monetary scarcity in early modern England. In *Wages and currency: global comparisons from antiquity to the twentieth century*, edited by Lucassen, Jan, 391–410. Peter Lang Berlin.
- Mumtaz, Haroon, and Francesco Zanetti. 2013. The impact of the volatility of monetary policy shocks. *Journal of Money, Credit and Banking* 45(4): 535–558.
- Mundell, Robert. 1963. Inflation and real interest. *Journal of Political Economy* 71(3): 280–283.
- Murphy, Kevin M., Andrei Shleifer, and Robert W. Vishny. 1989. Industrialization and the Big Push. *Journal of Political Economy* 97(5): 1003–1026.
- Nef, John Ulrich. 1934. The progress of technology and the growth of large-scale industry in Great Britain, 1540-1640. *The Economic History Review* 5(1): 3–24.
- Nightingale, Pamela. 1990. Monetary contraction and mercantile credit in later medieval England. *The Economic History Review* 43(4): 560–575.
- Nightingale, Pamela. 1997. England and the European depression of the mid-fifteenth century. *Journal of European Economic History* 26(3): 631.
- Nightingale, Pamela. 2010. Gold, credit, and mortality: distinguishing deflationary pressures on the late medieval English economy. *The Economic History Review* 63(4): 1081–1104.
- Nogues-Marco, Pilar. 2011. The microeconomics of bullionism: Arbitrage, smuggling and silver outflows in Spain in the early 18th century. Universidad Carlos III de Madrid. Working Papers in Economic History, WP 11-05.
- North, Douglass C., and Robert Paul Thomas. 1970. An economic theory of the growth of the Western world. *The Economic History Review* 23(1): 1–17.
- O’Brien, Patrick. 1982. European economic development: the contribution of the periphery. *The Economic History Review* 35(1): 1–18.
- Palma, Nuno. 2018. Money and modernization in early modern England. *Financial History Review* 25(3): 231–261.
- Palma, Nuno. 2020. American precious metals and their consequences for early modern Europe. *Handbook of the History of Money and Currency* 363–382.
- Palma, Nuno. 2022. The real effects of monetary expansions: evidence from a large-scale historical experiment. *The Review of Economic Studies* 89(3).
- Palma, Nuno, and Jaime Reis. 2019. From convergence to divergence: Portuguese economic

- growth, 1527–1850. *The Journal of Economic History* 79(2): 477–506.
- Palma, Nuno, and André C. Silva. 2022. Spending a windfall. CEPR Discussion Paper No. DP16523.
- Pesaran, M. Hashem, and Ron Smith. 1995. Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics* 68(1): 79–113.
- Pfister, Ulrich. 2021. Economic growth in Germany, 1500–1850. Unpublished manuscript.
- Pomeranz, Kenneth. 2000. *The Great Divergence: China, Europe, and the making of the modern world economy*. Princeton University Press.
- Ridolfi, Leonardo, and Alessandro Nuvolari. 2021. L’histoire immobile? A reappraisal of French economic growth using the demand-side approach, 1280–1850. *European Review of Economic History* 25(3): 405–428.
- Rosenstein-Rodan, Paul N. 1943. Problems of industrialisation of Eastern and South-Eastern Europe. *The Economic Journal* 53(210/211): 202–211.
- Rössner, Philipp Robinson. 2018. Monetary theory and cameralist economic management, c. 1500–1900 AD. *Journal of the History of Economic Thought* 40(1): 99–134.
- Schneider, Jürgen. 1986. The significance of large fairs, money markets and precious metals in the evolution of a world market from the middle ages to the first half of the nineteenth century. In *The emergence of a world economy, 1500–1914, Part 1*, edited by Fischer, Wolfram. (Stuttgart 1986).
- Schön, Lennart, and Olle Krantz. 2012. Swedish historical national accounts 1560–2010. *Lund Papers in Economic History* (123).
- Schularick, Moritz, Lucas ter Steege, and Felix Ward. 2021. Leaning against the wind and crisis risk. *American Economic Review: Insights* 3(2): 199–214.
- Spufford, Peter. 1989. *Money and its use in medieval Europe*. Cambridge University Press.
- Stock, James H., and Mark W. Watson. 2018. Identification and estimation of dynamic causal effects in macroeconomics using external instruments. *The Economic Journal* 128(610): 917–948.
- Sussman, Nathan. 1998. The late medieval bullion famine reconsidered. *The Journal of Economic History* 58(1): 126–154.
- Teulings, Coen N., and Nikolay Zubanov. 2014. Is economic recovery a myth? Robust estimation of impulse responses. *Journal of Applied Econometrics* 29(3): 497–514.
- Tobin, James. 1965. Money and economic growth. *Econometrica* 671–684.
- van Bavel, Bas. 2016. Rural development and landownership in Holland, c. 1400–1650. In *The political economy of the Dutch Republic*, 183–212. Routledge.
- van Zanden, Jan Luiten. 2009. *The long road to the industrial revolution: the European economy in a global perspective, 1000-1800*. Brill.
- van Zanden, Jan Luiten, and Bas van Leeuwen. 2012. Persistent but not consistent: The growth of national income in Holland 1347–1807. *Explorations in Economic History* 49(2): 119–130.
- Wallerstein, Immanuel. 1974–1980. *The modern world-system. 3 Volumes*. New York: Academic Press.
- Williams, Eric. 1944 [1994]. *Capitalism and Slavery*. Chapel Hill: University of North Carolina Press.
- Wrigley, Edward Anthony. 1988. *Continuity, chance and change: the character of the Industrial Revolution in England*. Cambridge University Press.

Appendix

to “*Goldilocks: American precious metals and the Rise of the West*”

Yao Chen¹ Nuno Palma² Felix Ward³

¹Erasmus School of Economics, Erasmus University Rotterdam; CEPR; Tinbergen Institute; (y.chen@ese.eur.nl)

²Department of Economics, University of Manchester; Instituto de Ciências Sociais, Universidade de Lisboa; CEPR; (nuno.palma@manchester.ac.uk)

³Erasmus School of Economics, Erasmus University Rotterdam; Tinbergen Institute; (ward@ese.eur.nl)

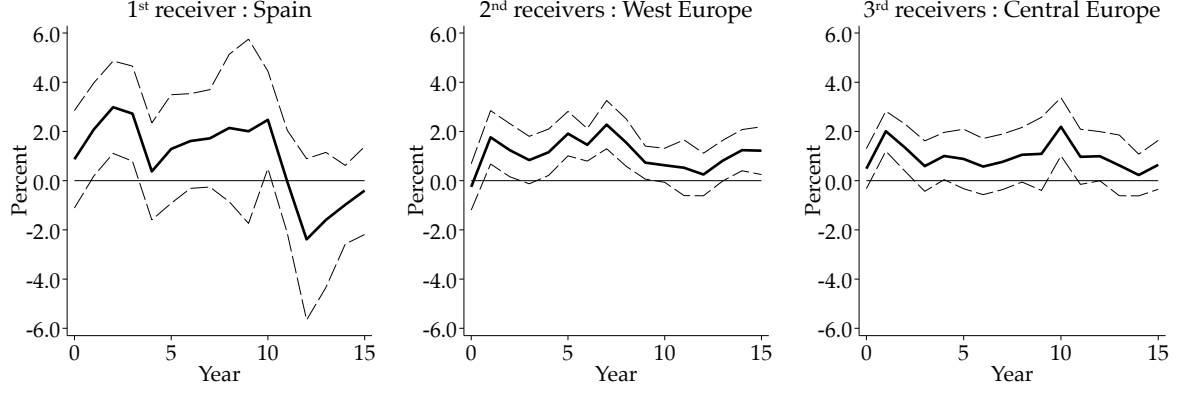
CONTENTS

A Additional results	2
A.1 No urbanization rate data	2
A.2 Parsimonious specification	3
A.3 Mean group estimator	4
A.4 Disaggregated industry responses	6
A.5 Interest rate results	10
A.6 Including Portugal as 1 st stage receiver	11
A.7 Other results	12

A. ADDITIONAL RESULTS

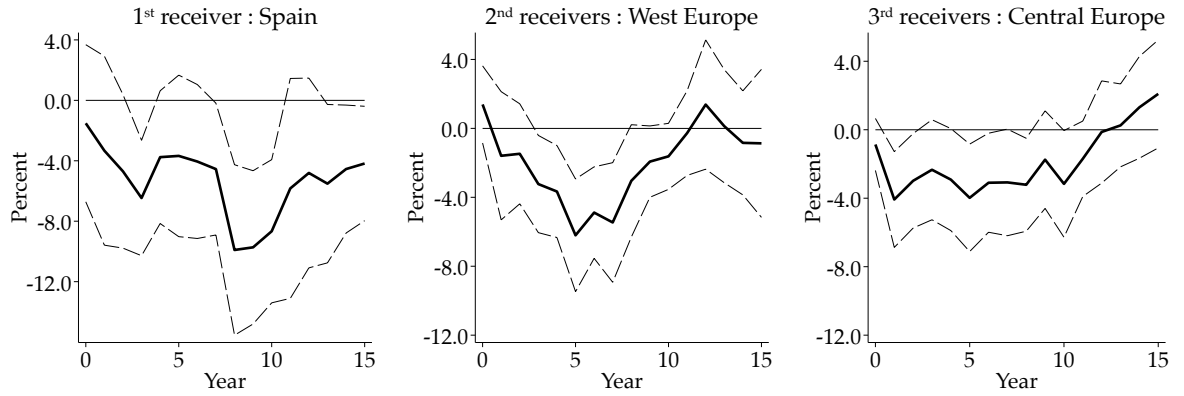
A.1. No urbanization rate data

Figure A.1: Real GDP response to doubling in money inflow-to-stock ratio (no urbanization rate)



Notes: Dashed lines – 90% confidence interval. Interpolated urbanization rate data excluded.

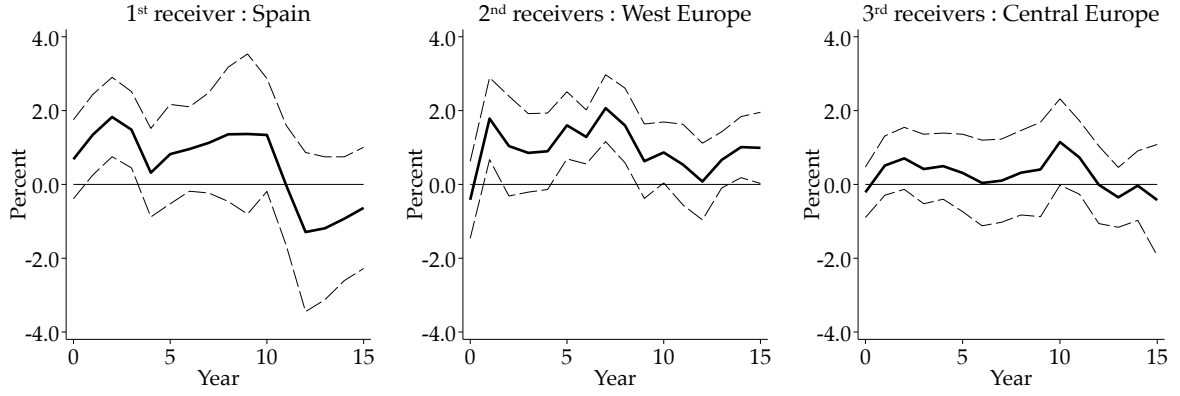
Figure A.2: Real GDP response to negative 1 percentage point maritime disaster shock (no urbanization rate)



Notes: Dashed lines – 90% confidence interval. Interpolated urbanization rate data excluded.

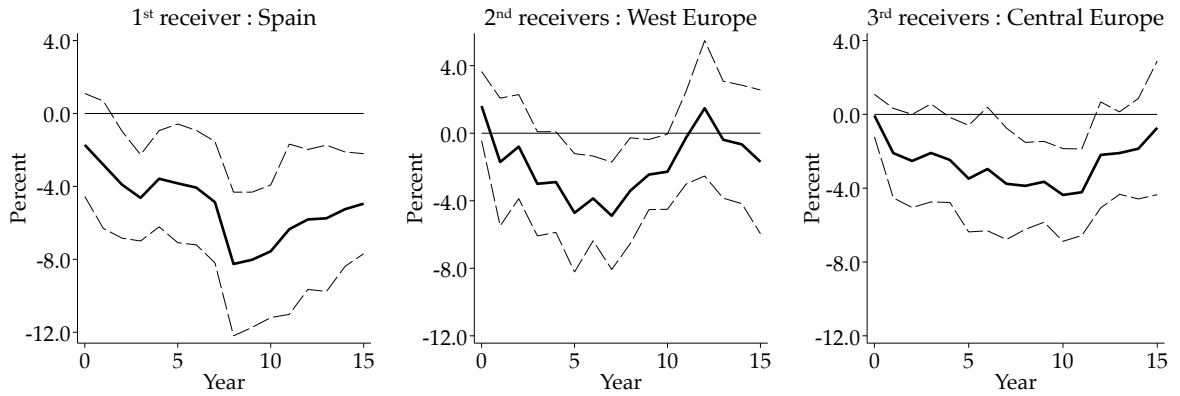
A.2. Parsimonious specification

Figure A.3: Real GDP response to doubling in money inflow-to-stock ratio



Notes: Dashed lines – 90% confidence interval. Parsimonious specification, excluding all controls $X_{i,t}$.

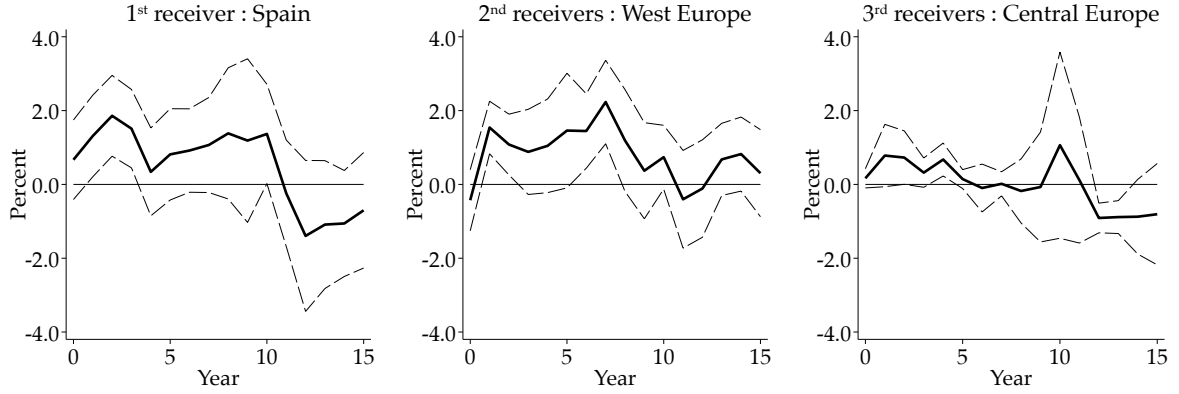
Figure A.4: Real GDP response to 1 percentage point maritime disaster shock



Notes: Dashed lines – 90% confidence interval. Parsimonious specification, excluding all controls $X_{i,t}$.

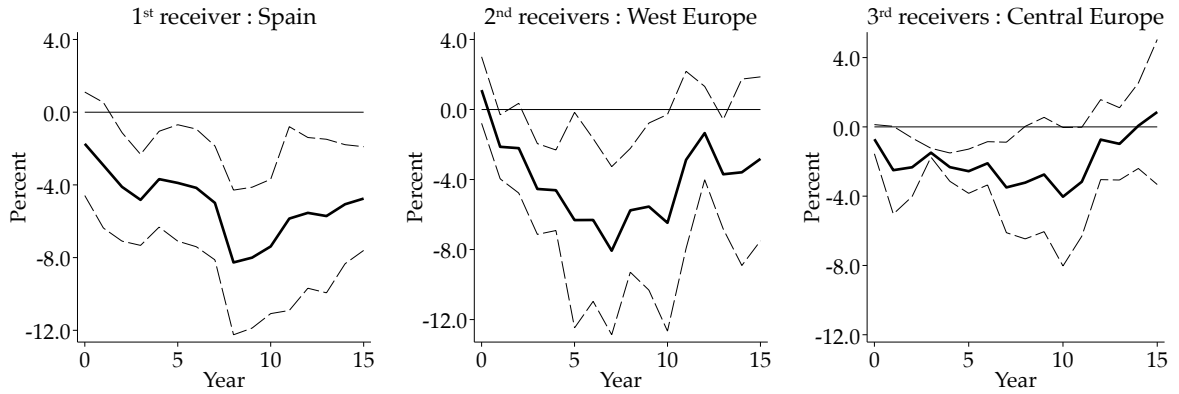
A.3. Mean group estimator

Figure A.5: Real GDP response to doubling in money inflow-to-stock ratio



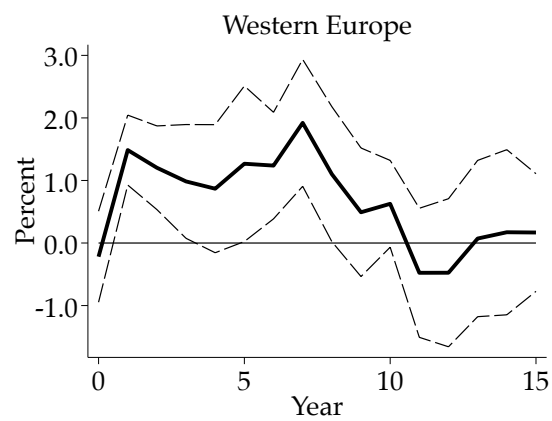
Notes: Dashed lines – 90% confidence interval. Local projections for West Europe and Central Europe groups based on mean group estimator (Pesaran and Smith, 1995).

Figure A.6: Real GDP response to 1 percentage point maritime disaster shock



Notes: Dashed lines – 90% confidence interval. Local projections for West Europe and Central Europe groups based on mean group estimator (Pesaran and Smith, 1995).

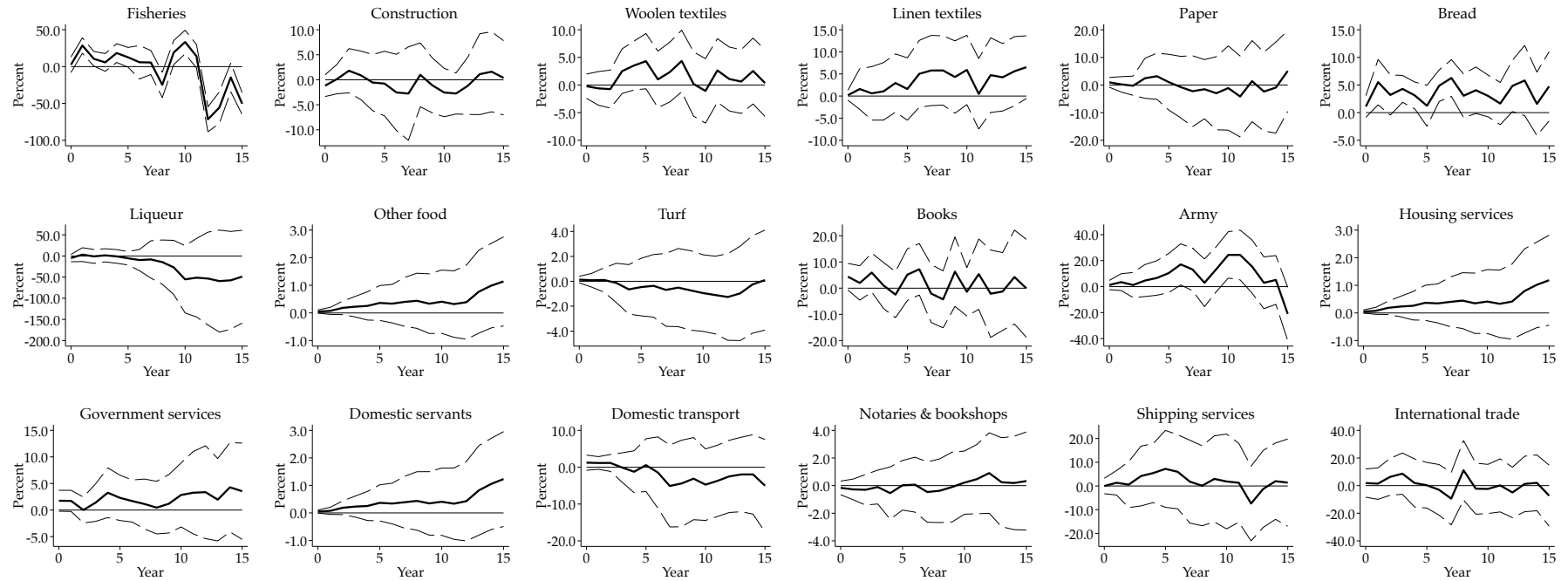
Figure A.7: Real GDP response to doubling in money inflow-to-stock ratio



Notes: Dashed lines – 90% confidence interval. Mean group estimator local projections for all West European countries (Pesaran and Smith, 1995).

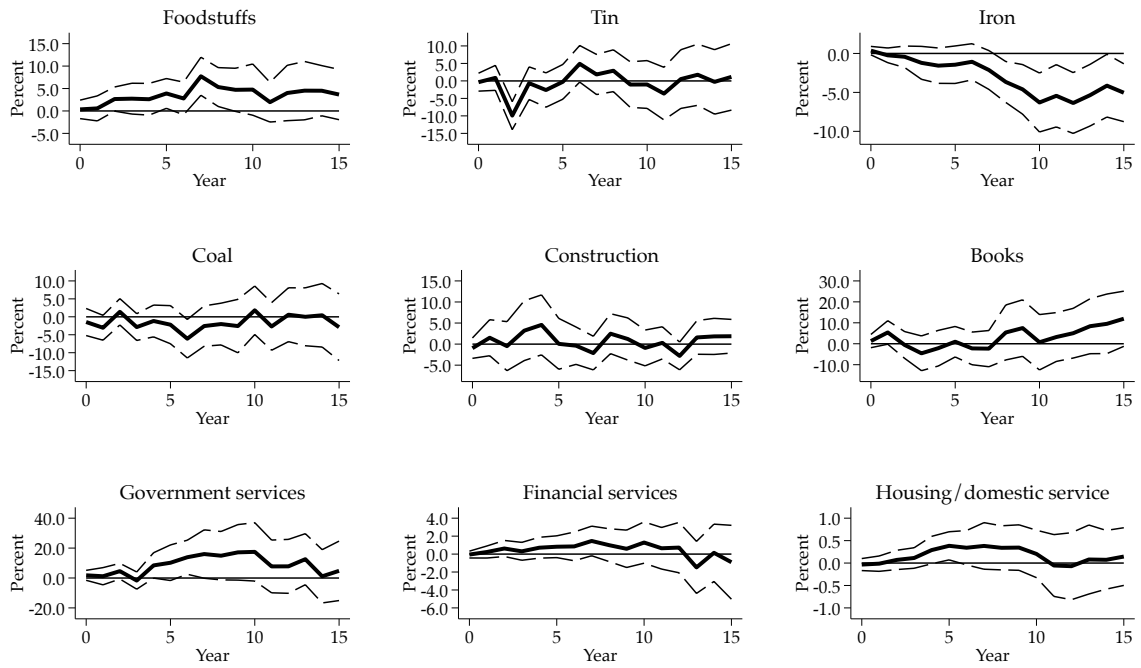
A.4. Disaggregated industry responses

Figure A.8: Disaggregated output responses to doubling in money inflow-to-stock ratio – Holland



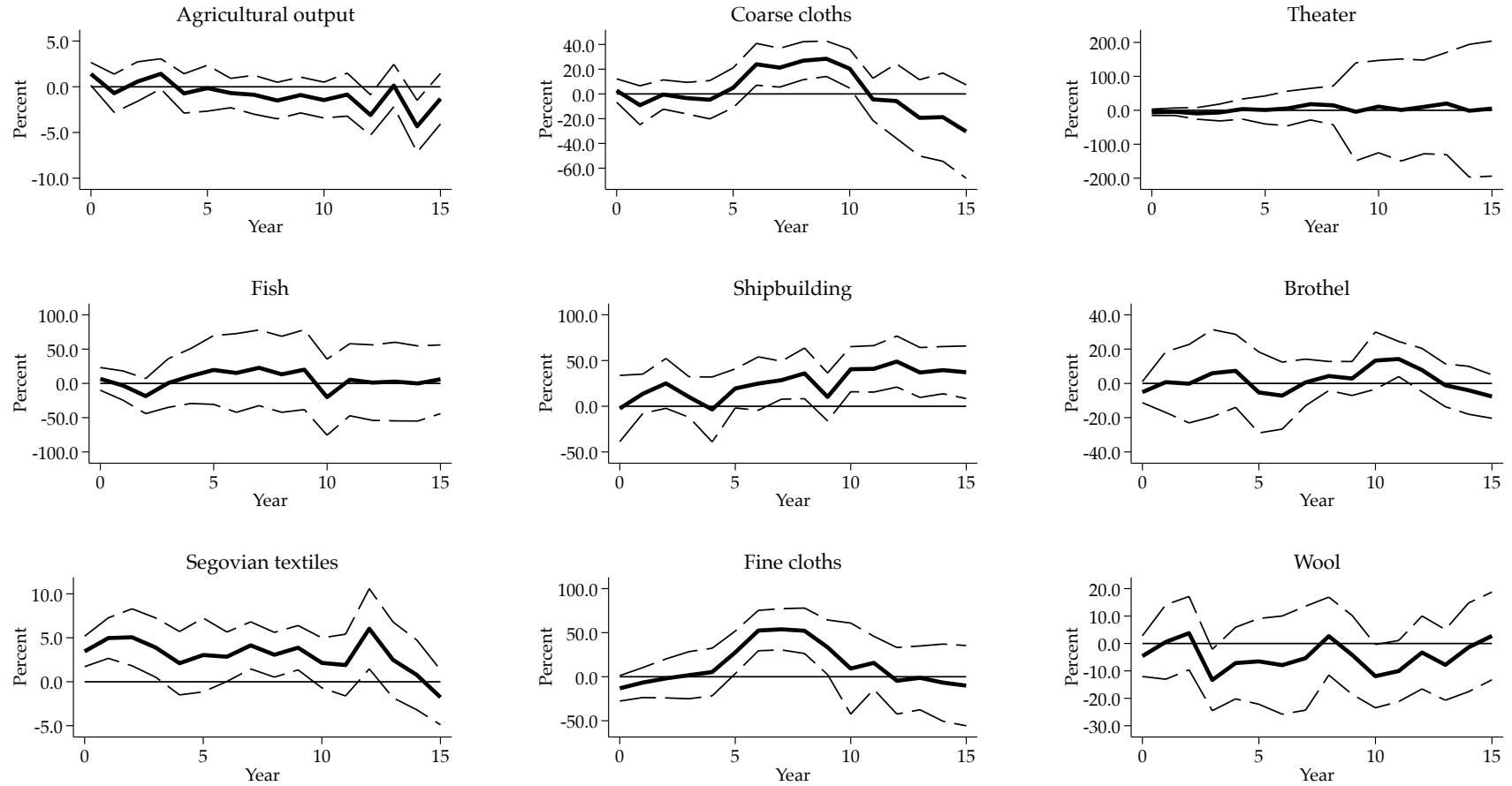
Notes: Dashed lines – 90% confidence interval. Time series too short to include: banking (only important after 1750), sugar. Outliers in the following variables: fisheries, books, woolen textiles, linen textiles, army, international trade. We winsorize these time series and downweigh the remaining outliers.

Figure A.9: Disaggregated output responses to doubling in money inflow-to-stock ratio – England



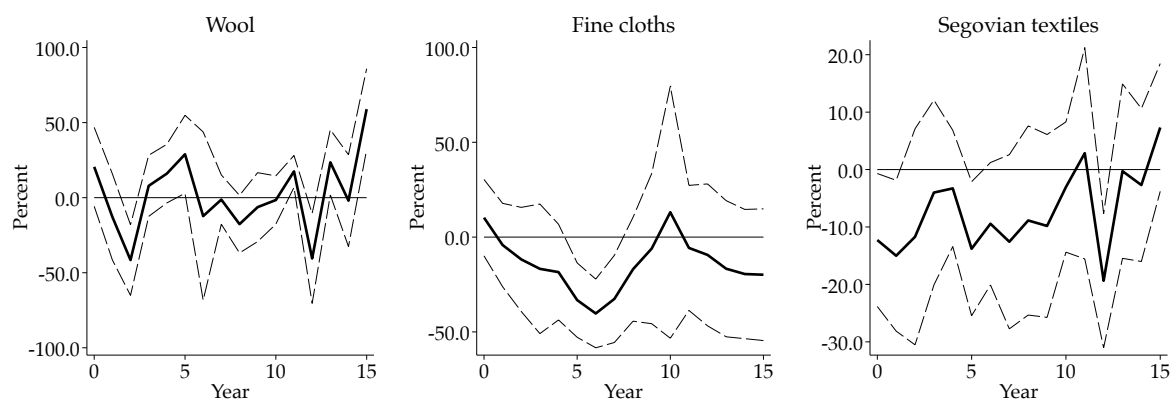
Notes: Dashed lines – 90% confidence interval. Outliers in the following variables: tin, financial services. We winsorize these time series and downweigh the remaining outliers.

Figure A.10: Disaggregated output responses to a doubling in the money inflow-to-stock ratio – Spain



Notes: Dashed lines – 90% confidence interval. Outliers in the following variables: fish, wool. We winsorize these time series and downweigh the remaining outliers.

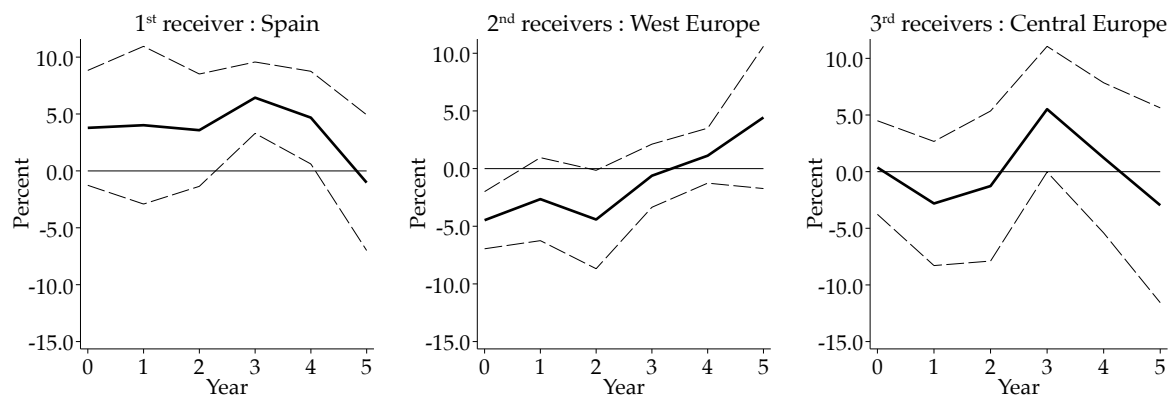
Figure A.11: Additional output responses – Spain



Notes: Dashed lines – 90% confidence interval.

A.5. Interest rate results

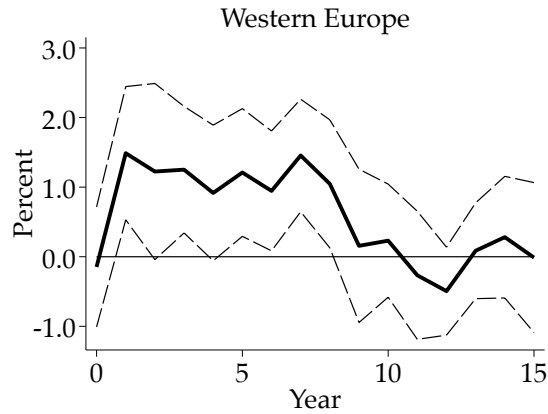
Figure A.12: Lending rate response to negative 1 percentage point maritime disaster shock



Notes: Dashed lines – 90% confidence interval.

A.6. Including Portugal as 1st stage receiver

Figure A.13: Real GDP response to doubling of money inflow-to-stock ratio



Notes: Dashed lines – 90% confidence interval. Results including Portugal.

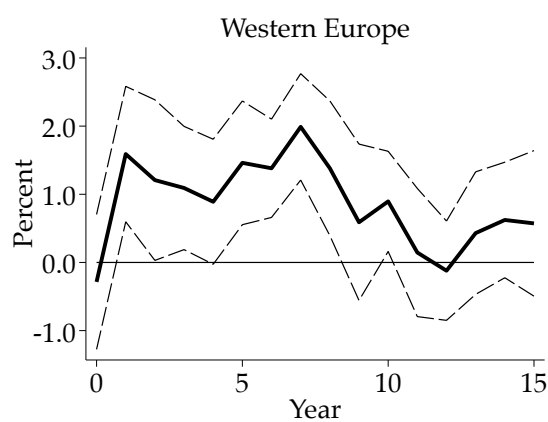
Table A.1: Monetary origins of the early Great Divergence

	Western Europe	East Asia
Monetary effect	26%	1%
GDP change	80%	23%
% of early <i>Great Divergence</i>	44%	

Notes: % of early Great Divergence calculated as $(\Delta Y_{Europe,1780}^M - \Delta Y_{Asia,1780}^M) / (\Delta Y_{Europe,1780} - \Delta Y_{Asia,1780})$. Italics: monetary effect for East Asia based on West European IRF estimate, scaled down by East Asia's large GDP share and small share of direct American precious metal inflows across the Pacific. Results including Portugal.

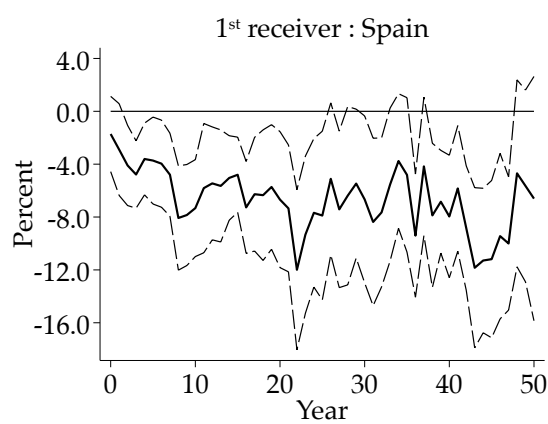
A.7. Other results

Figure A.14: Real GDP response to doubling in money inflow-to-stock ratio



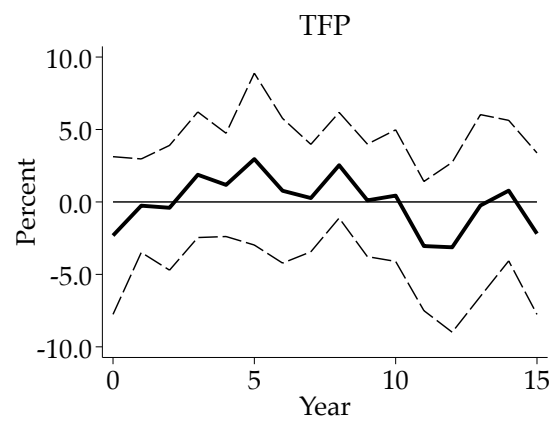
Notes: Dashed lines – 90% confidence interval.

Figure A.15: Real GDP response to negative 1 percentage point maritime disaster shock (long horizon)



Notes: Dashed lines – 90% confidence interval.

Figure A.16: Dutch TFP response to doubling in money inflow-to-stock ratio



Notes: Dashed lines – 90% confidence interval.

APPENDIX REFERENCES

- Pesaran, M. Hashem, and Ron Smith. 1995. Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics* 68(1): 79–113.