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Exchange Rate Insulation Revisited

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Abstract

We confront the notion that flexible rates insulate countries from external disturbances with new evidence for the euro area and 20 of its neighbors. First, we verify that the exchange-rate disconnect puzzle holds in our sample: When countries let their currencies float against the euro, exchange rates are on average much more volatile than when they peg, but their business cycle is no different suggesting lack of insulation. Second, in response to euro-area monetary-policy shocks output reacts also similarly across exchange-rate regimes, seemingly consistent with the disconnect. Yet, bilateral euro exchange rates hardly respond to these shocks while domestic monetary policy tightens, independently of the exchange-rate regime. Conditional on euro-area shocks, lack of insulation thus correlates with a distinct policy response, not with the disconnect. This evidence challenges theory: we show that state-of-the-art models calibrated to account for the disconnect cannot predict lack of insulation under standard monetary policy rules.

Keywords

Exchange-rate regime, Insulation, External shock, Exchange-rate disconnect, Monetary Policy

JEL-Codes

F41, F42, E31

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A flexible exchange rate is not of course a panacea; it simply provides an extra degree of freedom, by removing the balance-of-payments constraints on policy formation. In so doing, it does not and cannot remove the constraint on policy imposed by the limitation of total available national resources and the consequent necessity of choice among available alternatives; it simply brings this choice, rather than the external consequences of choices made, to the forefront of the policy debate.

Harry Johnson (1969)

1 Introduction

How much insulation can flexible exchange rates afford the open economy? The classics argue: a lot—because the exchange rate operates as an automatic shock absorber which adjusts to soften the impact of external shocks. And, as emphasized by Johnson in the quote above, even if the exchange rate does not act as a shock absorber (that is, even if currency movements do not help correcting international relative prices), flexible rates still provide an 'extra degree of freedom' that monetary policy can use to insulate the economy from external shocks (Meade 1951; Friedman 1953; Eichengreen and Sachs 1985).[1]

Yet, skepticism about the virtue of exchange rate flexibility abounds. The role of the exchange rate as a shock absorber may be limited because the price of internationally traded goods and services is insensitive to currency fluctuations, that is, exchange-rate pass through is low (Devereux and Engel, 2003). Moreover, a US-dominated global financial cycle may constrain domestic monetary policy, even when policy is not constrained by an exchange rate target (Rey, 2013). Finally, there is the fundamental observation that business cycle moments look very much alike across exchange-rate regimes—an instance of the "exchange rate disconnect" (Baxter and Stockman, 1989). In this paper we reconsider the insulation properties of flexible exchange-rate regimes empirically and theoretically with a particular focus on foreign monetary policy shocks.

Empirically, we find no evidence for insulation as we study European countries that are highly integrated with the euro area (EA) but operate different exchange-rate regimes vis-à-vis the euro. Key to our analysis is the distinction between the dynamics *conditional* on EA monetary policy shocks and *unconditional* data moments. *Unconditionally*, bilateral exchange rates with the euro tend to be markedly more volatile when countries let their exchange rate float, but business cycles do not differ much across exchange-rate regimes—there is, in other words, an exchange-rate disconnect in our sample, too. *Conditionally on EA monetary shocks*, we find that output and inflation are no more insulated under

[1] Obstfeld (2020) reviews Johnson's case for flexible exchange rates.

floats than under pegs. Taken at face value, this appears to be just another instance of the exchange-rate disconnect. Crucially, however, the response of the exchange rate is also very similar across regimes: In response to EA monetary policy shocks, floats raise interest rates and keep their currencies stable at the cost of a domestic downturn, making them look like pegs. Hence, even as countries allow their currencies to float unconditionally, policymakers tolerate little or no volatility of their currency in the face of EA monetary policy shocks. Lack of insulation arises then, not because of disconnect, but because of the sameness of conditional policy responses across exchange rate regimes. This lack of insulation as a policy choice resonates with Johnson's quote above: Why don't policymakers take full advantage of the extra degree of freedom granted to them by a floating regime?

Theoretically, we take up the issue in a state-of-the-art business cycle model building on earlier work by Gopinath et al. (2020) and Itskhoki and Mukhin (2021a). The latter study, in particular, resolves the disconnect puzzle specifying a combination of financial shocks, financial frictions, and nominal rigidity such that, unconditionally, exchange rates are highly volatile with little effect on floaters' business cycle. When we calibrate a variant of this model to capture the unconditional evidence on the business cycle in the EA and its neighbors, both for pegs and floats, we also obtain the disconnect. However, the calibrated model does predict a very high degree of insulation when floats are confronted with EA monetary policy shocks.[2]

Open-economy macro modelling needs to confront both the *unconditional evidence* under which the exchange rate of floats is exceedingly volatile and the *conditional evidence* under which it is not. As a first attempt to confront this challenge, we assess the extent to which the model predictions can be brought in line with the evidence, by assuming monetary policy rules that differ in the way they resolve the trade-off between inflation and unemployment. In light of the world-wide move toward inflation targeting (and in particular in the sample of countries we use in our empirical analysis), we take this regime as a natural reference point. We show, both by pencil and paper and by simulating a calibrated version of the model, that spillovers are large and, in fact, almost as large as under a peg if policymakers target headline inflation. In this case, monetary policy leans against imported inflation, tolerating very little exchange rate adjustment in the face of an external monetary policy shock (in line with the conditional evidence). However, it does so also in response to any other shock. Hence headline inflation targeting dampens the volatility of the exchange rate more generally, preventing the model from accounting for the unconditional evidence for the floats in our sample.[3] In sum, a unified account of

[2]Figure 2 of Gopinath et al. (2020) also shows that insulation is large for floats: a monetary tightening abroad generates basically no output spillovers.

[3]Currency volatility is higher still, when the inflation target is specified in terms of domestic good inflation—approximating the optimal monetary rule—, but so is the degree of insulation predicted by the model.

the two pieces of evidence, conditional and unconditional, requires a rationale for why—even in a rich club of countries—floats choose to behave like pegs in response to foreign monetary policy shocks, while more generally they do not.

The sample of European countries on which we base our empirical study has several desirable features for studying the insulation properties of flexible exchange rates. First, focusing on the EA as a source of external monetary policy shocks allows us to steer clear of a global financial cycle possibly induced by US monetary policy (Ca'Zorzi et al., 2023). Second, there is significant variation in the exchange-rate regime that the neighbor countries maintain vis-à-vis the euro, both across time and countries. We exploit this variation as we condition spillovers on the currency regime in each neighbor country at different points in time. The sample includes 20 countries neighboring the EA and covers the period of 20-plus years since the inception of the euro in 1999—so that we can rely on more than 5,500 country-month observations for several key macro indicators. Over much of the sample period, the entire region experiences a strong process of trade and economic integration, led by the institutional development of the European Union and several trade agreements with border countries outside the EU. As a result, these countries trade a lot with the EA. What is more, and that is the third desirable feature of our data, countries' exports to/imports from the EA are predominantly priced in euros, thus providing a prime example of the type of dominant currency setting emphasized by Gopinath (2015).

In order to classify the country-month observations in our sample as pegs and floats, we build on Ilzetzki et al. (2019). In our baseline, about one third of the observations qualify as floats and two thirds as pegs. To assess how different economies respond to EA monetary policy shocks and, in particular, if and how the response depends on the exchange-rate regime, we pool the data for the neighboring countries, allowing for country fixed effects and country-based controls. We then estimate impulse responses to the shock, interacting the shock with a (possibly time-varying) exchange-rate regime dummy. We focus much of our analysis on EA monetary policy shocks as identified by Jarociński and Karadi (2020). These shocks are cleaned of information effects that are likely to contaminate high-frequency monetary policy surprises (Melosi, 2017; Nakamura and Steinsson, 2018).

We study the response to EA monetary shocks of industrial production, the unemployment rate, inflation, the short-term interest rate and the exchange rate—finding that they are all very similar, whether a country maintains a peg to the euro or not. In addition to EA monetary policy shocks, however, we also study the spillovers from central bank information shocks and credit spread shocks, both originating in the EA. Remarkably, in both instances we find that floats let their exchange rate absorb some of the impact of these shocks—in contrast to what we find for monetary policy shocks—consistent with the notion that under a float monetary policy lets the exchange rate accommodate some shocks but not others.

To carry out our theoretical analysis, we rely on a New Keynesian two-country model. The model has standard features: there is a large country, representing the EA to which we refer as "Foreign," and a small country, representing a generic neighbor country, "Home"; firms may employ imported inputs in production; exports are priced in Foreign's currency, that is, we assume Dominant Currency Pricing (DCP), reflecting the role of the euro in intra-European trade.[4] In the model, incomplete exchange rate pass-through under DCP means that monetary policy cannot simultaneously stabilize inflation and the output gap in the face of external shocks: there is no "divine coincidence". However, even if currency movements do not contribute to stabilizing the economy, flexible exchange rates still put monetary policy in a position to stimulate domestic demand when foreign demand falters. But preserving a high level of economic activity in the face of (inefficient) foreign shocks comes at the cost of tolerating heightened volatility in exchange rates and inflation. Insulation, then, is not an inherent *automatic* feature of flexible exchange rates; rather, it is a policy choice.[5]

The remainder of the paper is structured as follows. We conclude the Introduction by placing our paper in the context of the literature. Section 2 describes our data set. Section 3 presents the evidence, focusing on differences in the behavior (or the lack thereof) of pegs and floats both, unconditionally and conditional on EA monetary policy shocks. Section 4 outlines the New Keynesian two-country model and presents our analytical and quantitative analysis. A final section concludes.

Related literature. First, there is a vast literature that deals with monetary policy trade-offs in the open economy and the ability of monetary authorities to stabilize the domestic economy in the context of the Mundellian trilemma (Edwards, 2015; Goldberg, 2013; Klein and Shambaugh, 2015; Obstfeld et al., 2005; Shambaugh, 2004). Levy Yeyati and Sturzenegger (2003) analyze empirically how quite generally output performance depends on the exchange-rate regime. In recent work Fukui et al. (2023) compare the economic performance of pegs and floats following a broad-based depreciation of the dollar. They find that pegs show persistently higher economic activity than floats. Our results differ because we document that there is no significant exchange rate movement after EA monetary policy shocks in the first place. There is also work on how the exchange-rate regime alters the transmission of external shocks (Bayoumi and Eichengreen, 1994; Broda, 2004; Giovanni and Shambaugh, 2008).

[4]In our DCP environment, border import prices in the (small) domestic economy are sticky in the currency of the foreign producers (euros), as is the case in the more conventional producer currency-pricing framework in Galí and Monacelli (2005). For the exporters from the small country, local currency pricing applies instead: They price exports in euros, the currency of the export market.

[5]DCP matters. The (near) equivalence of currency pegs and floats under CPI inflation targeting continues to hold in case of Producer Currency Pricing (PCP), but not under Local Currency Pricing (LCP).

Our results differ from, but are consistent with the influential work of Miranda-Agrippino and Rey (2020). They show that contractionary US monetary policy shocks give rise to a global financial cycle that worsens the policy trade-offs faced by foreign central banks, constraining the latter's ability to insulate their economies under flexible rates. As we document empirically below, this channel is absent in the transmission of the EA monetary policy shocks that we focus on. In line with this, focusing on shocks to *non-conventional* monetary policies, Miranda-Agrippino and Nenova (2022) find that EA shocks alter global financial conditions as do US monetary policy shocks, but that the EA shock's global financial spillovers are "sensibly smaller" in magnitude. Jarociński (2022) and ter Ellen et al. (2020) specifically investigate the spillovers from EA monetary policy shocks to the US and to Sweden, Denmark, and Norway, respectively. Consistent with our findings, they find that interest rate spillovers in Norway and Sweden are almost indistinguishable from those to Denmark, even though only the Danish krona is pegged to the euro.

Itskhoki and Mukhin (2021b) reconsider the so-called Mussa puzzle whereby the volatility of both nominal and real exchange rates increased sharply after the end of the Bretton Woods system (Mussa, 1986). Itskhoki and Mukhin build a model with exchange-rate-regime-dependent UIP shocks and show that the model can replicate the Mussa puzzle. At the same time, for other macro variables their model produces unconditional second moments that are broadly similar across exchange-rate regimes, in line with the data. We incorporate regime-dependent UIP shocks in our open-economy macro model and point to a conflict between conditional and unconditional moments.

Lastly, we note that while our theoretical analysis is positive rather than normative, we can compare the monetary rules that we employ to the current work on optimal monetary policy under DCP (Corsetti et al., 2020; Egorov and Mukhin, 2023; Gopinath and Itskhoki, 2022). A robust result emerging from these contributions is that monetary authorities in a small open economy should target domestic marginal costs or equivalently producer price inflation. From our analytical and quantitative results it emerges that if central banks followed rules that approximate the optimal targeting rule characterized in these contributions (target producer price inflation), there would be much more real insulation than what we find in our data. We also speak to a growing literature that emphasizes that the limited ability of the financial sector to bear foreign-exchange risk provides a rationale for monetary policy to lean against exchange-rate movements (for example, Itskhoki and Mukhin, 2023). What we document is that this leaning against exchange rate movements happens for some shocks but not for others; and also happens when excluding periods of great financial strain.

2 Sample and data

We rely on a sample of European countries comprising the EA and 20 of its geographical neighbors. The sample is uniquely suited for our study for three reasons. First, we can focus on monetary shocks that originate in the EA rather than in the US. This is an advantage since US shocks are somewhat special for the world economy. Second, there is a large variation in the exchange-rate regime vis-à-vis the euro, both across the neighbor countries and within neighbor countries over time. We exploit this variation to assess the role of the exchange-rate regime for shaping both, business-cycle moments and monetary spillovers from the EA to its neighbor countries. Third, the 20 neighbor countries in our sample are relatively homogeneous in terms of institutions, economic development, and policy frameworks. In particular, a significant share of their trade is invoiced in euros, the regional dominant currency. This makes the sample chime with the assumptions underlying the theory that we will apply later. In this section, we first describe our sample in some detail, including some descriptive statistics in order to set the stage for the analysis which follows in Section 3.

2.1 The countries in the sample

Our sample includes the EA defined as an aggregate of the 11 countries that formed the monetary union in 1999 (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain) and $N = 20$ EA neighbors. These are Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Greece, Hungary, Iceland, Latvia, Lithuania, Malta, Norway, Poland, Romania, Slovakia, Slovenia, Sweden, Switzerland, and the United Kingdom. At the end of our sample period, the set of EA neighboring countries comprised the European Union (EU, which the UK left only in January 2020), plus the three largest countries of the European Free Trade Association (EFTA), bar Liechtenstein.[6] For all these countries, we collect monthly data on several macroeconomic and financial variables of interest, from the inception of the euro in 1999:M1 through 2021:M12. This gives us at most $T = 276$ observations for each country. The data are seasonally adjusted and the source is Eurostat unless noted otherwise in the data Appendix A. Note that while our sample includes observations for the pandemic period, these do not drive our results below: in the working paper version of this paper the sample ends in 2018:M12 and results are very similar (Corsetti et al., 2021).

[6] The composition of EFTA has been stable over our sample. The EU, instead, saw several waves of accession. Free access to the European single market typically predates EU membership by several years. An example of this is Croatia, which had preferential access to the single market since the year 2000, formalized with signing its Stabilization and Association Agreement with the EU in 2001 and, thus, before it applied for EU membership (2003) or joined the EU (2013). All other neighbors that joined the EU over the course of our sample already had applied for membership prior to 1999:M1.

2.2 Varying exchange-rate regimes

Our methodology (which we formally introduce below) requires us to classify the exchange-rate regime as a "float" ($\mathbb{I}_{n,t} = 1$) or a "peg" ($\mathbb{I}_{n,t} = 0$). For each of the N neighbors in our sample, we need to apply this classification allowing for variation over time (that is, we need to clarify the regime for each period $t = 1, ..., T$). Rather than resorting only to our own judgment, as much as we can, we rely on the careful work of Ilzetzki, Reinhart and Rogoff (2019), to whom we refer as IRR for short. We corroborate their evidence, with our application in mind, based on a reading of central bank communication, communication by the European Commission through its bi-annual "Convergence Reports," and the IMF's Annual Report on Exchange Arrangements. For a large sample of countries (including all the N neighbors analyzed here), IRR finely classify the *de-facto* exchange-rate regime using categories 1 (no separate legal tender or currency union) to 15 (dual market in which parallel market data is missing). We observe no instance of the latter category in our sample. In case of a peg, IRR also provide the reference currency. In case there is an official exchange rate arrangement, they verify if the country's exchange rate against the reference currency actually follows the pre-announced rule. Otherwise, they classify the regime on the basis of its observed exchange rate volatility.[7]

Since we operate under the premise that a flexible exchange rate may provide insulation against external shocks, we use a stringent criterion to classify neighbors as floats (in order to avoid accidentally labeling what is a peg as a float): we classify as floats only those neighbors in IRR's categories 9 through 14. At the one end, this includes neighbors that have broad bands or managed floats against the euro (their category 9). At the other end it includes the 3 percent of our observations (184 out of 5520) that IRR classify as "freely floating" (their category 13) and a few observations of IRR's category 14 "freely falling," namely for Romania in 1999/2000. This definition of floats is narrow in the sense that it allows the neighbor countries room to use the exchange rate as a shock absorber. For example, IRR require of managed floats, arguably the most restricted category among our floats, that the exchange rate does not fluctuate by more than two percent *per month* in 80 percent of months over a five-year window. Clearly, this still allows for exchange-rate movements that are larger than two percent in about two months per year, and for notable cumulative changes in the exchange rate. We verify that we observe a great deal of exchange rate flexibility for country-time observations that qualify as a float according to our criterion, see Figure A.1 in the appendix.

Table 1 provides a compact overview on how we sort country-time observations according to their exchange-rate regime in our baseline specification. Each column refers to one of the 20 neighboring countries in our sample. Each row refers to a month in which the classification for at least one country changes relative to the previous month.

[7] IRR's classification ends in 2019:M12. Based on the evidence we have, we leave the exchange-rate classification for all countries unchanged for the rest of the sample.

Table 1: Exchange-rate regimes 1999–2021

	Bulgaria	Croatia	Cyprus	Czechia	Denmark	Estonia	Greece	Hungary	Iceland	Latvia	Lithuania	Malta	Norway	Poland	Romania	Slovakia	Slovenia	Sweden	Switzerland	United Kingdom
1999M1	0	0	0	0	0	0	0	1	0	1	0	1	1	1	1	0	0	1	1	1
1999M2	0	0	0	0	0	0	0	1	0	1	0	1	1	1	1	0	0	0	1	1
2000M1	0	0	0	1	0	0	0	1	0	1	0	1	1	1	1	0	0	0	1	1
2000M11	0	0	0	1	0	0	0	1	1	1	0	1	1	1	1	0	0	0	1	1
2001M1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	1	0	0	0	1	1
2001M4	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	0	1	1
2001M9	0	0	0	1	0	0	0	1	1	0	0	0	1	1	0	0	0	0	1	1
2004M8	0	0	0	1	0	0	0	1	1	0	0	0	1	1	1	0	0	0	1	1
2005M1	0	0	0	1	0	0	0	1	1	1	0	0	1	1	1	0	0	0	1	1
2006M7	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	0	1	1
2008M9	0	0	0	1	0	0	0	1	1	1	0	0	1	1	0	0	0	1	1	1
2009M4	0	0	0	1	0	0	0	0	1	1	0	0	1	1	0	0	0	1	1	1
2009M7	0	0	0	1	0	0	0	0	1	0	0	0	1	1	0	0	0	1	1	1
2011M9	0	0	0	1	0	0	0	0	1	0	0	0	1	1	0	0	0	1	0	1
2014M1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	0	1
2015M2	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	1	1

Notes: rows report exchange-rate regime in a specific month whenever there is change of the exchange-rate regime in at least one country relative to previous month. Darker cells (1) indicate a floating exchange rate, while lighter cells (0) indicate a peg, including membership in the euro area; floats are categories 9 through 14 in the fine classification of Ilzetzki et al. (2019).

In the table, the darker cells indicate a float, and the brighter cells indicate a peg, including membership in the EA. In total 1937 out of 5520 or 35 percent of our country-time observations qualify as a float under our baseline specification.

2.2.1 Examples

Leaving details on the classification to Appendix A.2, here we discuss a few examples to highlight the nature of our exercise. We are interested in whether the exchange rate of a country is flexible vis-à-vis the euro, or not.[8] Bulgaria is a clear-cut example of a peg. Throughout our sample period it operates a currency board under which its currency is pegged to the euro. The case of Malta, in turn, demonstrates how we deal with a neighbor's transition toward euro membership. In January 2008 Malta joined the EA. We assume throughout that Malta and other late adopters of the euro are too small

[8] In our baseline we also assign Lithuania to the pegs even though it maintained a soft peg vis-à-vis the US dollar up to January 2002. From a theoretical point of view it is crucial that a neighbor country cannot adjust its policy stance in the face of an external (that is, euro-area) shock.

relative to the EA economy as a whole to have notable weight in policy decisions or the EA macro-economy. Rather, we keep Malta and other late adopters of the euro in our sample as having a hard peg with the euro.[9] At the end of the sample, all the late adopters combined accounted for less than four percent of EA GDP. In robustness analysis, we exclude Greece and Cyprus from the sample because they may have had a non-negligible effect on EA policies during the sovereign debt crisis. However, we find that the results are basically unchanged relative to the baseline.

As a stepping stone to euro membership, a country has to engineer a stable exchange rate against the euro for some time. Namely, under the Maastricht Treaty's convergence criteria (now codified in Article 140 (1) of the Treaty on the Functioning of the European Union), adopting the euro requires "the observance of the normal fluctuation margins provided for by the exchange-rate mechanism of the European Monetary System, for at least two years, without devaluing against the euro," where the latter is typically interpreted as a policy-induced devaluation out of intent. In theory, the exchange-rate mechanism allows for the exchange rate to fluctuate in a band of ± 15% around an agreed exchange rate between the euro and the country's currency, and this is what Malta announced on May 2, 2005 when entering the Exchange Rate Mechanism (ERM). In practice, neighbors that aim at eventually adopting the euro operate much tighter bands. Indeed, the exchange rate of the Maltese lira against the euro was basically constant during Malta's membership in the ERM, see Figure A.1 in the appendix. With the exception of Latvia all neighbors that are members of the ERM are defined as operating a peg.

The clearest cases for a floating exchange-rate regime are the UK, Norway, Poland, and, for the largest part of the sample period, also Iceland. The clearest cases for a peg outside of the EA in our sample period in addition to Bulgaria are Croatia (which joined the EA in January 2023) and Denmark, both of which operated hard pegs throughout. Finally, in view of our theoretical analysis below, it is important to stress that throughout most of the sample the neighbors that we classify as having floating exchange rates have operated an inflation targeting regime. The obvious cases are Sweden (since 1993) and the UK (since 1992). Based on the classification by Brito et al. (2018), Switzerland started being an inflation targeter in January 2000, Norway in March 2001. Czechia has been an inflation targeter since 1997, Poland since September 1998, and Hungary started that practice in June 2001. Latvia is the only country in our sample that we classify as having flexible exchange rates for some time but that Brito et al. (2018) do not classify as an explicit inflation targeter.

[9] After 1999:M1, the euro became legal tender in eight countries of our sample: in Greece (2001), Slovenia (2007), Cyprus (2008), Malta (2008), Slovakia (2009), Estonia (2011), Latvia (2014) and Lithuania (2015).

Table 2: Potential determinants of the exchange-rate regime

	Peg	Float
Size in percent of euro area GDP	0.9	5.0
Trade openness vis-à-vis euro area	45.0	38.2
Capital account openness (Chinn-Ito index)	1.9	2.1
Terms of trade volatility	4.0	2.3

Notes: Entries are averages for pegs and floats, size, trade openness, and capital account openness are annual averages and country-years are classified as float if a country floats for at least one month of the year. Trade openness is the sum of exports and imports (to/from the EA) in percent of GDP; capital account openness is measured by the Chinn-Ito index (Chinn and Ito, 2006). Terms of trade volatility is the standard deviation (in percent) over the entire sample period and we classify as floats countries that operate a float in more than 50 percent of the sample. Sample period: 1999–2020.

2.2.2 Determinants of the exchange-rate regime

The choice of the exchange-rate regime is endogenous—a notion that is well understood at least since Mundell (1961) put forward criteria for an optimum currency area. At an empirical level the literature has identified a number of factors that appear to predict the exchange-rate regime in the data (e.g. Levy Yeyati et al., 2010). In what follows, we briefly assess whether in our sample the exchange-rate regime vis-à-vis the EA varies systematically with these factors.

Table 2 shows the results.[10] That countries that float tend to be larger than those that peg is consistent with earlier literature (Levy Yeyati et al., 2010).[11] The terms of trade are on average more volatile for pegs than for floats. At the same time, the trade exposure to the EA and the openness of the capital account are on average very similar. Size and increased volatility of the terms of trade are unlikely to be the main drivers of our results.

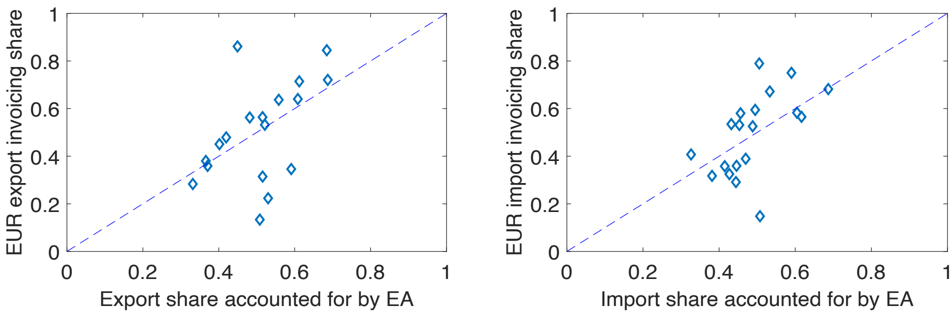
2.2.3 The euro as the dominant currency in trade

We conclude the description of our sample by presenting evidence concerning the invoicing regime of exports and imports in intra-European trade. Specifically, Figure 1 correlates neighbors' trade shares with the EA and the share of their trade that is invoiced in euros. In each panel, the horizontal axis measures the share of, respectively, exports to the EA and imports from the EA for the countries in our sample. The vertical axis measures the share of trade invoiced in euros. The figure illustrates the degree of integration of these economies with the EA and is suggestive of a dominant role of the euro in intra-

[10] Our data source is Eurostat. When we compute trade openness we lack data for Cyprus, Estonia, Greece, Latvia, Lithuania, Malta, Slovakia and Slovenia. When we compute the volatility of the terms of trade we lack data for Iceland, Norway, and Switzerland.

[11] Size to some extent reflects the UK, the GDP of which is equivalent to 20 percent of EA GDP. Excluding the UK reduces the relative economic size of the average floating neighbor to 2.5 percent of EA GDP.

Figure 1: Invoicing and trade shares in the neighbor countries



Notes: share of exports/imports accounted for by EA, and share of invoicing of exports/imports accounted for by the euro. Invoicing shares for all countries in our sample except for Croatia, and, in the case of export invoicing shares, excepting Malta, too. Sources: Gopinath (2015) and IMF Directions of Trade Statistics.

European trade, in line with the evidence put forward elsewhere (Gopinath, 2015; Amiti et al., 2022). This will later be central when we rationalize the empirical findings.

2.3 EA monetary policy shocks

In our analysis below, we study unconditional business-cycle moments as well as the spillovers conditional on structural EA shocks. As far as we can, we wish to rely on measures of such shocks that are identified in earlier work, outside of the scope of the current paper. For the baseline specification, we rely on the EA monetary policy shocks identified by Jarociński and Karadi (2020).[12] These authors combine a high-frequency approach to identification with sign restrictions. Specifically, they capture surprises in 3-month interest-rate forwards around EA monetary policy events. Monetary policy shocks are shocks which generate a positive response of the nominal interest rate and a negative response of the stock market.

The shocks are reasonably well behaved and not dominated by outliers. We display the shock series in Figure A.1 in the Online Appendix. In the robustness analysis we consider a specification where we drop large shocks and find very similar results as for the baseline. Moreover, since these shocks are based on high-frequency data they are unlikely to be contaminated by other shocks, including by monetary policy shocks outside of the EA.[13] Still, we verify that there is no systematic comovement of EA monetary policy shocks and US monetary policy shocks. The same holds for global risk shocks as identified by Georgiadis et al. (2021) as well as the monthly change in the VIX and the excess

[12] We use their updated series which runs up until 2021:M12, downloaded from Marek Jarocinski's webpage.

[13] Specifically, to exclude this possibility Jarociński (2022) considers the "Monetary Event" window as specified by Altavilla et al. (2019). It includes a 30-minute window around the press release and runs until 15 minutes after the end of the press conference if there is one. In addition, he drops three observations for days when the ECB and the Fed made coordinated announcements (for details, see, Jarociński, 2022).

bond premium, both widely used indicators of (global) financial conditions; see Online Appendix A.

3 Evidence

This section provides novel evidence on insulation—or rather, the lack thereof—first by revisiting the disconnect for our sample and, second, conditional on identified shocks. Throughout we compare the neighbor countries, both pegs and floats, to the EA as a (potential) anchor country. For the latter, we focus on the adjustment in the original 11 EA members (EA11) whenever appropriate.[14]

3.1 Exchange-rate disconnect in the sample

We revisit the exchange-rate disconnect in our sample by computing unconditional business cycle moments for the EA and its neighbor countries—disconnect would correspond to a low or zero (unconditional) correlation between exchange rates and other macroeconomic variables (Baxter and Stockman, 1989; Itskhoki and Mukhin, 2021a).

Table 3 reports variances and cyclical properties at quarterly frequency for the EA, for floats and for pegs in the top panels, as well as the comovement of the latter two with the EA in the bottom panels.[15] Focusing on variables of particular interest, we observe that business cycles are more volatile in the small open neighboring countries than in the euro area (first entry in each of the top panels). Comparing business-cycle moments for floats and pegs, the exchange rate is much more volatile for floats. Output volatility is somewhat lower for floats than for pegs but still of the same order of magnitude. The general pattern of the business cycle, too, appears not systematically different across pegs and floats and this includes the comovement of a neighbor's business cycle with that in the EA (bottom panels). In light of this, one may well conclude that the exchange rate disconnect puzzle is alive and well in our sample. But even if one would give weight to the lower output variability among floats, this would only strengthen the case for reconsidering insulation contrasting unconditional and conditional evidence: unconditionally, exchange rate variability would seem to help a country reduce the size of business cycle fluctuations; conditionally, it does not. These observations motivate and set the stage for our analysis below.

[14]The composition of the EA has changed over time. Appendix A discusses how we construct aggregate time series for the EA11. In any case, late adopters of the euro (which are pegs in our classification) have a small weight in EA GDP. Thus, the results for the EA19 series are very similar (and are available on request).

[15]We consider quarterly observations because we use these moments to calibrate the model in Section 4 below.

Table 3: Business cycle moments in the data

Volatility & correlation	euro area			float			peg		
	σ_x	$\rho_{x,gdp}$	$\rho_{x,x_{-1}}$	σ_x	$\rho_{x,gdp}$	$\rho_{x,x_{-1}}$	σ_x	$\rho_{x,gdp}$	$\rho_{x,x_{-1}}$
gdp_t	2.5	1.00	0.68	3.5	1.00	0.79	5.2	1.00	0.90
r_t	0.9	0.56	0.93	2.1	0.40	0.90	1.6	0.29	0.88
π_t	0.4	0.39	0.34	0.7	0.31	0.42	0.7	0.35	0.35
Δe_t	–	–	–	3.9	-0.01	0.14	0.8	-0.04	0.12

Comovement with EA	float		peg	
	ρ_{x,x^*}	ρ_{x,gdp^*}	ρ_{x,x^*}	ρ_{x,gdp^*}
gdp_t	0.75	0.75	0.67	0.67
r_t	0.60	0.27	0.47	0.18
π_t	0.44	0.24	0.58	0.35
Δe_t	–	-0.02	–	-0.04

Notes: unconditional moments after applying a quadratic trend. Quarterly data from 1999:Q1 to 2021:Q4. Average moments across countries in the respective group, weighted by number of observations in the regime per country. Only countries that peg or float, respectively, for at least half of the sample. From left to right, for the euro area; for neighbors that float; and for neighbors that peg. Δe_t is the quarter-on-quarter percent change of the nominal exchange rate, gdp_t is the log of gross domestic product, r_t the nominal interest rate (annualized), and π_t quarter-on-quarter consumer-price inflation. x indicates a variable and the table reports its standard deviation (σ_x), its correlation with the country's GDP ($\rho_{x,gdp}$), the first-order autocorrelation, $\rho_{x,x_{-1}}$ and, where applicable in the bottom panel, the contemporaneous correlation with the same variable at the euro-area level (ρ_{x,x^*}), or the contemporaneous correlation of the variable with euro-area GDP (ρ_{x,gdp^*}).

3.2 Adjustment to EA monetary policy shocks

In what follows we first outline in general terms the empirical strategy we employ to identify the effect that shocks in the large country (the EA in our application) have on its smaller neighbors and how the neighbor's choice of exchange-rate regime shapes those effects. We then present and discuss our empirical results.

3.2.1 Methodology

We use a panel of N neighbor countries, indexed by $n \in \{1, ..., N\}$. And let $t = 1, ..., T$ denote time. Although for most of our results the panel is balanced, it need not be. In terms of the notation that follows, let variables with a subscript n indicate variables specific to each neighboring country. Let variables with a star pertain to the source country. Define a time-dependent indicator variable $\mathbb{I}_{n,t-1}$ that indicates the exchange-rate regime of neighbor n at time $t-1$. $\mathbb{I}_{n,t-1} = 1$ when neighbor n operates a flexible exchange-rate regime vis-à-vis the large source country, and $\mathbb{I}_{n,t-1} = 0$ otherwise.

We estimate local projections à la Jordá (2005) for a pooled sample of observations for the neighbors while conditioning on the exchange-rate regime.Toward this end, let $h = 0, 1, ..., H$ mark the forecast horizon for the local projection. Let ϵ_t^* be a time series of identified structural shocks that originate in the source country. Let $x_{n,t+h}$ be the dependent variable of interest for neighbor n in period $t + h$. For each horizon $h = 0, 1, ..., H$ we estimate the empirical specification

$$x_{n,t+h} = \alpha_{n,h} + \mathbf{z}'_{n,t} \cdot \boldsymbol{\beta}_h + \gamma_h^p \left(1 - \mathbb{I}_{n,t-1}\right) \epsilon_t^* + \gamma_h^f \, \mathbb{I}_{n,t-1} \, \epsilon_t^* + u_{n,t+h}, \tag{1}$$

with $n = 1, ..., N$, $t = 1, ..., T$. Here $\alpha_{n,h}$ is a neighbor-country fixed effect for horizon h. $\mathbf{z}_{n,t}$ is a vector of controls for each neighbor country n. The time series of the controls are neighbor-specific, but we apply the same number and type of controls to each neighbor. Accordingly, $\boldsymbol{\beta}_h$ is a conforming vector that is identical for all neighbors. Our object of interest are the impulse responses of neighboring countries to the shock in the large country, ϵ_t^*, distinguishing neighbors that peg to the large country's currency $\{\gamma_h^p\}_{h=0}^H$ and neighbors that float $\{\gamma_h^f\}_{h=0}^H$. Toward having consistent estimates of these terms, we assume that the relation captures the entire effect of the shock on the dependent variable. That is, we assume that the error term, $u_{n,t+h}$, is uncorrelated with the regressors in ϵ_t^* and $\mathbb{I}_{n,t-1}\epsilon_t^*$ at all leads and lags. At the same time, the error terms are allowed to be heteroskedastic and to be correlated both in the cross section of neighbors and over time. We compute Driscoll and Kraay (1998) robust standard errors. Note that the estimated impulse responses will be economically meaningful as long as the choice of exchange-rate regime is not based on foresight about future shocks to the large source country. We wish to stress that our specification clearly does not rule out that the regimes $\mathbb{I}_{n,t-1}$ evolve over time. Our estimates capture the average response of floats or pegs, conditional on the pre-shock regime. Likewise, we emphasize that our shock measure ϵ_t^* is a generated regressor. The standard errors that we show later are asymptotically valid under the null hypothesis that the coefficients γ_h^p and γ_h^f are zero (Pagan 1984, Coibion and Gorodnichenko 2015).

We will compare the estimated impulse responses $\{\gamma_h^p\}_{h=0}^H$ and $\{\gamma_h^f\}_{h=0}^H$ with the impulse responses that we obtain from the corresponding local projections in the source country:

$$x_{t+h}^* \quad = \quad \alpha_h^* + \mathbf{z}_t^{*\prime} \, \boldsymbol{\beta}^* + \gamma_h^* \, \epsilon_t^* + u_{t+h}^*, \tag{2}$$

where again we assume that the errors u_{t+h}^* are uncorrelated with ϵ_t^* at all leads and lags. The error terms themselves can be heteroskedastic and serially correlated. Before proceeding, we find it important to be clear about the heterogeneity between neighbors that we allow for when we estimate model (1). In particular, we allow for neighbor fixed effects (the $\alpha_{n,h}$), and we allow for heterogeneity unrelated to the shock through allowing for potential serial and cross-sectional correlation as well as heteroskedasticity in the error terms. At the same time, we have to impose some homogeneity across neighbor countries to be able to conduct inference in a small sample. Namely, we assume homogeneity across countries in the coefficients $\boldsymbol{\beta}_h, \gamma_h^f$, and γ_h^p. That is, shocks can have different effects on neighbors that float and neighbors that peg, but all neighbors that float are affected by the shock in the same way. We revisit this in the robustness analysis.

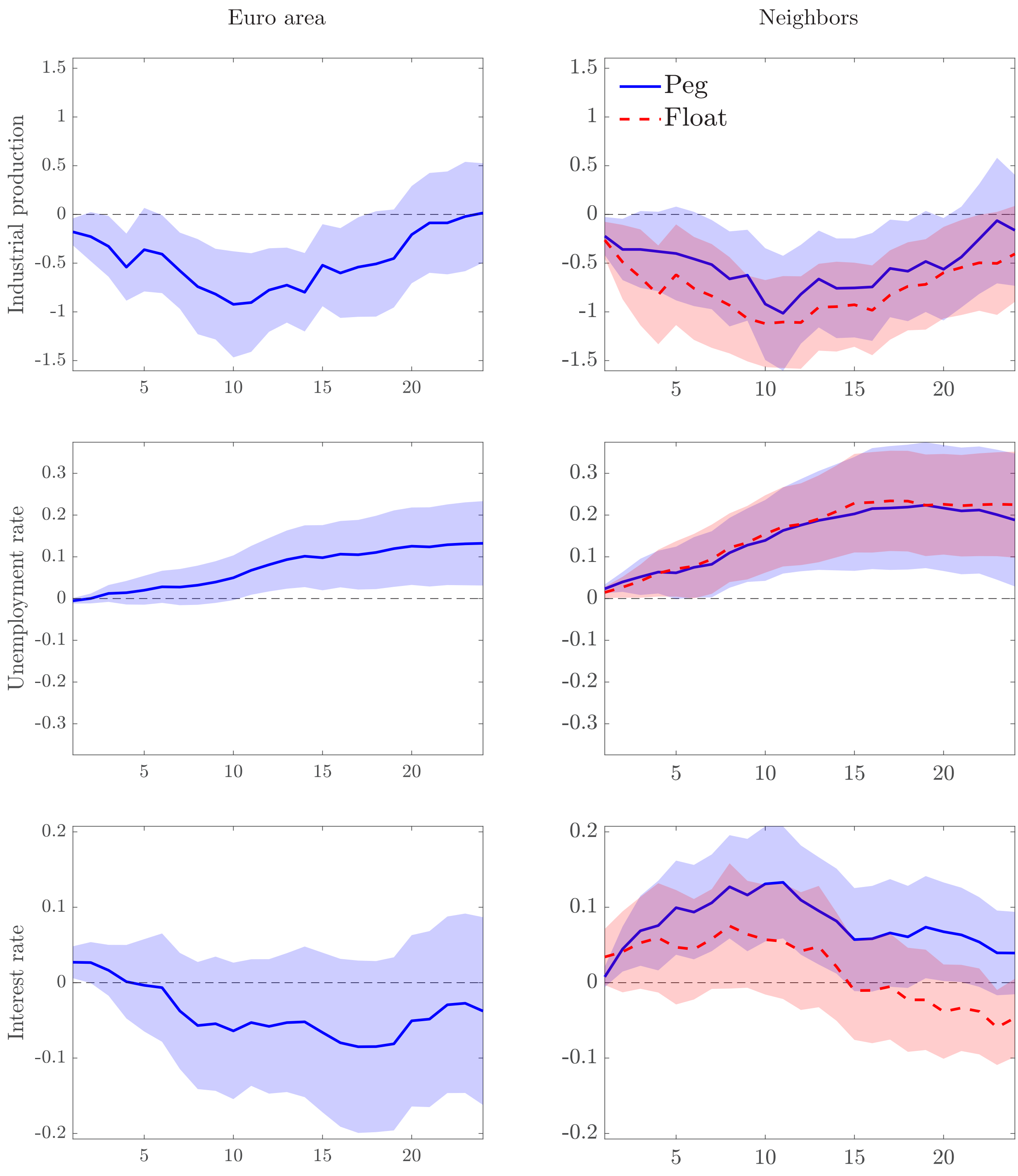
3.2.2 Conditional evidence of insulation

Figures 2.A and 2.B shows the results for our baseline, where include 12 lags each of the shock and the dependent variable in the vector of controls. These figures compare responses of selected macroeconomic and financial variables in the EA, shown in the left column, to the responses in the neighboring countries, shown in the right column. Here the (blue) solid line shows the response for pegs and the (red) dashed line the response for floats. Shaded areas indicate 90 percent confidence bounds computed based on Driscoll and Kraay (1998) robust standard errors.

We show the responses to a contractionary one-standard deviation monetary policy shock. In each panel of the figures, the horizontal axis measures time in months while the vertical axis measures the deviation of a variable from its pre-shock level in percent or in percentage points. The first two rows of Figure 2.A show the response of two key indicators of real activity that are available at a monthly frequency: industrial production and the unemployment rate. According to the point estimates, a one-standard deviation monetary contraction in the EA reduces EA industrial production by about one percent (top-left panel) and the unemployment rate rises by about 0.1 percentage point (second row, left). Not surprisingly, perhaps, the shock affects neighbors that peg to the euro, shown in the right column, in much the same way as the EA itself. What is surprising, though—certainly against the received wisdom—is that there are, too, sizable spillovers to the neighbors that have flexible exchange rates. Indeed, there is no evidence that the flexible exchange rate insulates economic activity in the neighbor countries: The contraction for floats is no weaker than for pegs.

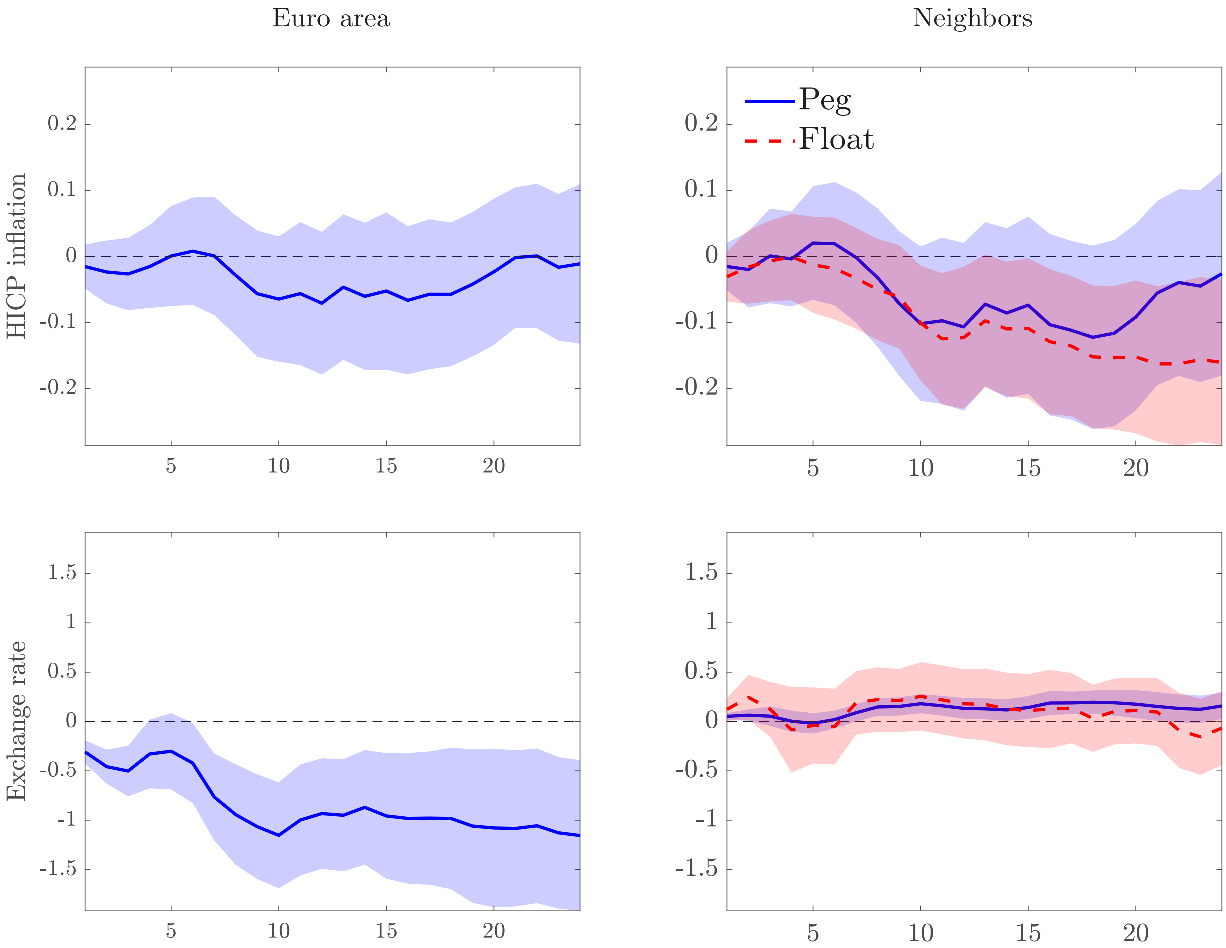
The bottom row of Figure 2.A shows the interest rate response. Jarociński and Karadi (2020) identify the monetary policy shock based on an event study combined with sign restrictions. It should be noted that their sample, as ours, features a decade of a varied range of unconventional monetary policies in the EA, including asset purchase programs and forward guidance, in an area where there is no common safe asset (Gertler and Karadi, 2015). Arguably for these reasons, the empirical mapping of the monetary shock to a single measure of EA interest rates is not clear cut. In particular, the bottom-left panel shows the response of one interest rate in the EA, the one-year rate on German bunds (in

Figure 2.A: Adjustment to euro-area monetary policy shock



Notes: one-standard deviation shock identified by Jarociński and Karadi (2020); lines and shaded areas represent point estimate and 90 percent confidence bounds based on Driscoll and Kraay (1998) robust standard errors, respectively. Horizontal axis is time in months, vertical axis measures deviation in percent/percentage points. Right column: solid (blue) line is estimate for peg, dashed (red) line is estimate for float. Bottom panel shows response of interest rates (annualized pp.); left: one-year bund rate; right: difference between neighbor's rate and EA short rate.

Figure 2.B: Adjustment to euro-area monetary policy shock c'd



Notes: same as Figure 2.A. The bottom panel shows the response of the effective euro exchange rate (left) and the neighbors' bilateral euro exchange rate (right): price of foreign currency expressed in domestic currency.

annualized percentage points). This rises on impact, but the response is not persistent.[16] The effect of a change in the EA's monetary stance is, however, clearly detectable through its spillovers on the interest rates of neighboring countries that peg to the euro. Indeed, interest rates there rise vis-à-vis the level of measured short-term interest rates in the EA (bottom-right panel). Initially, the interest rates of pegs and floats evolve comparably, rising in a fairly synchronized manner above the measured short-term rate in the EA. In the medium run the interest rate rises more strongly for pegs.

Figure 2.B shows the response of two additional variables. The top row displays the adjustment of consumer-price inflation, measured by the log-change of the harmonized consumer-price index (HICP) on a year-on-year basis and expressed in percent. In response to the shock, consumer-price inflation falls somewhat in the EA. But the response is weak and not significant. A similar pattern characterizes neighbor countries, whether

[16]The same is true of Jarociński and Karadi (2020); see their Figure 8.A, panel B.

they peg or float their currencies, although the decline becomes significant at some point for floats.

The second row of Figure 2.B shows the response of the exchange rate, measured in percentage deviations from the pre-shock level. In the left panel we show the effective exchange rate of the euro against the currencies of all trading partners of the euro area, including the neighbors and the other trading partners (most importantly the US). This is measured as the price of foreign currency expressed in terms of euros. In response to the contractionary monetary shock in the EA, the euro appreciates persistently (that is, it declines in the figure); another clear indication of the EA monetary tightening that underlies the scenario. In the right panel, instead, we report the bilateral exchange rate of the national currency of the neighbor countries with the euro. A rise here corresponds to a depreciation against the euro. In line with the construction of our sample, there is virtually no response of the exchange rate among neighbors that maintain a (hard or soft) peg. What is surprising, though, is the response of the exchange rate of the neighbors that have a flexible exchange rate: the depreciation against the euro does not exceed 0.2 percent and is not statistically significant. Hence, not only is there lack of insulation under a float, but the neighbors' exchange rate itself moves little in response to the EA monetary policy shock. And the exchange rate moves much less for neighbors than for trading partners of the EA more generally (recall the left panel).[17] It should be clear that the methodology would certainly allow the exchange rate in a float to respond. As a proof of concept, Online Appendix B looks at two altogether different EA shocks: a central bank information shock in the EA (also identified by Jarociński and Karadi (2020)) and euro-area credit spread shocks (Gilchrist and Mojon, 2018). For both of these shock series the exchange rate of floats moves more than for pegs, and economic activity is relatively more insulated.

We also verify that EA monetary policy shocks do not induce movements in the global financial cycle in the way that has been documented for US monetary policy shocks (Miranda-Agrippino and Rey, 2020; Rey, 2013). Specifically, in Online Appendix C we show that our shock series does not cause a significant or lasting movement of the VIX or the VSTOXX.

3.2.3 Robustness analysis

We conduct ample robustness analysis of our results for the spillovers of EA monetary policy shocks. Online Appendix D reports details. First, the conditional comovement of the EA and its floating and pegging neighbors might originate from a common impulse that is external to both the euro area and its neighbors. Therefore, we control for US

[17] In the working paper version of this paper we also report the responses of PPI inflation and the export-import ratio. In both instances the adjustment is very similar for pegs and floats (Corsetti et al., 2021).

monetary policy shocks (Jarociński and Karadi, 2020) and for global financial developments measured by the VIX and VSTOXX (Miranda-Agrippino and Rey, 2020; Rey, 2013). In this context we also explore whether the results are driven by large shocks. In all instances we find that the spillovers to floaters remain at least as large as the spillovers to neighbors that peg; see Online Appendix D.1.

Second, we assess the robustness of the above results with regard to the classification of the exchange-rate regime. We omit intermediate regimes (the 15% of country-month observations from our sample for which the classification of IRR is between 5 and 9) or use ERM2 membership as a criterion. We find that differences relative to the baseline are moderate only—as one would expect when the exchange-rate regime has little bearing on the extent of spillovers; see Online Appendix D.2.

Third, we look at different subsets of countries. First, we select countries that consistently peg or float throughout the entire sample period and compute the mean group estimate. Next, we exclude all EMU accession countries or run the regressions on a subsample of only Central and Eastern European countries as well as on a subsample which excludes precisely these countries. The results in all these cases are very similar to the baseline; see Online Appendix D.3.

Fourth, we consider the role of the sample period and the specification. The results are very similar when we exclude Cyprus and Greece from the sample. Their role in the EA sovereign debt crisis, therefore, is not a driving force behind our results. In another specification, we drop observations for the years 2008–09, years that are dominated by the global financial crisis. The output responses are generally smaller, but both pegs and floats continue to track the EA's response. We also document that the lag length chosen for the controls is inconsequential. Online Appendix D.4 provides details.

Finally, we verify that other measures of EA monetary policy shocks yield results similar to our baseline; see Online Appendix D.5.

In sum, we find that our main result regarding (the lack of) insulation in the face of EA monetary policy shocks is robust across a wide range of alternative specifications: spillovers from EA monetary policy shocks on its neighbor countries are no smaller for countries with flexible exchange rates than for countries which peg their currencies to the euro.

4 A model of the euro area and its neighbors

Can the empirical results be reconciled with state-of-the-art international macro theory? To answer this question, we resort to a workhorse open-economy macro model, which rests on dominant currency pricing. The first part of this section presents the main blocks of the model, and the second part describes how the model is calibrated to the EA and its neighbors. Thereafter we use the model to consider the spillovers of euro-area shocks to its neighbors.

We will show, first, that the full-scale model predicts an abundance of output insulation under flexible exchange rates when compared to the empirical results. Second, resorting to a stripped-down analytical version of the model, we will document how output spillovers—or the lack thereof—are shaped by policy choices in neighboring countries. In light of these analytical results, we will return to the full-scale, calibrated model, to unveil a fundamental tension between a strict policy focus on consumer-price inflation that could explain lack of insulation in response to foreign (monetary) shocks, and the monetary policy regime calibrated based on the unconditional business cycle evidence—pointing to a much higher degree of flexibility in inflation targeting.

4.1 Model layout

There are two countries, Home and Foreign; which the reader may think of as a neighbor country and the EA, respectively. There is a mass n of households that resides in Home and a mass $1-n$ of Foreign households. Foreign has the currency (the euro) that is dominant in bilateral trade, in the sense of Gopinath et al. (2020). That is, both the imports from and the exports to Foreign are priced and rigid in Foreign's currency unit. The core of the model is standard and well-known. We thus provide a compact exposition that focuses on Home. We refer to Foreign variables when necessary by means of an asterisk.

4.1.1 Households

In each country, there is a representative household. Letting C_t denote a consumption index (defined below) and H_t labor supply, the objective of the household is to maximize expected life-time utility

$$E_t \sum_{k=0}^{\infty} (\xi_{t+k}\beta^k) \left(\ln C_{t+k} - \frac{H_{t+k}^{1+\varphi}}{1+\varphi} \right), \tag{3}$$

$\beta \in (0,1)$ is the discount factor and ξ_t is a unit-mean shock to the time-discount factor, a "demand shock" for short. $\varphi > 0$ is the inverse of the Frisch elasticity of labor supply, and E_t is the expectations operator.

The household's budget constraint is given by $R_t^{-1}B_{t+1} - B_t + P_tC_t = W_tH_t + \Upsilon_t - T_t$. Here, R_t is the nominal interest rate between periods t and $t+1$, B_{t+1} is the quantity of one-period risk-free nominal bonds purchased in period t and paying one unit of domestic currency in period $t+1$ (foreign-currency bonds are traded via financial intermediaries, as discussed below). W_t is the nominal wage, Υ_t are the domestic firms' nominal profits, T_t are lump-sum taxes, and P_t is the consumption-based price index. The consumption index C_t is defined as a Dixit-Stiglitz aggregator of Home and Foreign bundles of goods

$$C_t = \left[(1-(1-n)\upsilon)^{\frac{1}{\eta}} C_{H,t}^{\frac{\eta-1}{\eta}} + ((1-n)\upsilon)^{\frac{1}{\eta}} C_{F,t}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}. \tag{4}$$

Here $C_{H,t}$ and $C_{F,t}$ are the Home-produced and Foreign-produced bundles consumed in Home. $\eta > 0$ is the elasticity of substitution between the two bundles and $\upsilon \in [0,1]$ measures the home bias in consumption.[18]

The bundles of Home- and Foreign-produced goods are defined as follows

$$C_{H,t} = \left[\left(\frac{1}{n}\right)^{\frac{1}{\epsilon}} \int_0^n C_{H,t}(j)^{\frac{\epsilon-1}{\epsilon}} dj\right]^{\frac{\epsilon}{\epsilon-1}}, \quad C_{F,t} = \left[\left(\frac{1}{1-n}\right)^{\frac{1}{\epsilon}} \int_n^1 C_{F,t}(j)^{\frac{\epsilon-1}{\epsilon}} dj\right]^{\frac{\epsilon}{\epsilon-1}}, \tag{5}$$

where $C_{H,t}(j)$ and $C_{F,t}(j)$ denote differentiated intermediate goods produced in Home and Foreign, respectively, and $\epsilon > 1$ measures the elasticity of substitution between intermediate goods produced within the same country. All the intermediate goods are traded across borders. The consumer-price index in Home is given by

$$P_t = \left[(1-(1-n)\upsilon) P_{H,t}^{1-\eta} + ((1-n)\upsilon) P_{F,t}^{1-\eta}\right]^{\frac{1}{1-\eta}}, \tag{6}$$

where $P_{H,t}$ is the price of the bundle of domestic goods and $P_{F,t}$ is the price of the bundle of imported goods.[19] In maximizing utility, the household takes prices as given. Letting $P_{H,t}(j)$ and $P_{F,t}(j)$ denote the domestic currency price of a generic domestically produced and a generic import good, respectively, the price indices for the bundle of domestically produced goods and for imported goods, respectively, are given by

$$P_{H,t} = \left[\frac{1}{n} \int_0^n P_{H,t}(j)^{1-\epsilon} dj\right]^{\frac{1}{1-\epsilon}}, \quad P_{F,t} = \left[\frac{1}{1-n} \int_n^1 P_{F,t}(j)^{1-\epsilon} dj\right]^{\frac{1}{1-\epsilon}}. \tag{7}$$

4.1.2 The exchange rate and the terms of trade

Let $P^*_{H,t}(j)$ denote the foreign-currency price that the producer in Home charges for its good in Foreign. We define the price index for export goods $P^*_{H,t}$ analogously to $P_{H,t}$. Let $\mathcal{E}_t$ be the nominal exchange rate measured as the price of foreign currency in terms of domestic currency. A rise in $\mathcal{E}_t$, thus, represents a nominal depreciation of Home's currency. We assume that Home's export prices are sticky in foreign currency units ("euros"). The law of one price, thus, does not necessarily hold. Foreign exports, too, are sticky in Foreign's currency, making Foreign's currency "dominant" for international

[18]This specification of home bias follows Sutherland (2005) and De Paoli (2009). With $\upsilon = 1$, there is no home bias. If $\upsilon = 0$, there is full home bias. The Foreign consumption basket is defined as $C^*_t = \left[(n\upsilon)^{\frac{1}{\eta}} {C^*_{H,t}}^{\frac{\eta-1}{\eta}} + (1-n\upsilon)^{\frac{1}{\eta}} {C^*_{F,t}}^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$.

[19]The consumer-price level in Foreign is given by $P^*_t = \left[n\upsilon {P^*_{H,t}}^{1-\eta} + (1-n\upsilon) {P^*_{F,t}}^{1-\eta}\right]^{\frac{1}{1-\eta}}$.

trade in the sense of Gopinath et al. (2020). We define M_t as the resulting law-of-one-price gap for domestic goods such that:

$$M_t P_{H,t} = \mathcal{E}_t P^*_{H,t}. \tag{8}$$

For imported goods in Home, the law of one price holds, $P_{F,t} = \mathcal{E}_t P^*_{F,t}$. We define the Home terms of trade, S_t, as the price of imports in Home relative to the price of exports, both measured in Foreign currency:

$$S_t = \frac{P^*_{F,t}}{P^*_{H,t}} = \frac{\mathcal{E}_t P^*_{F,t}}{M_t P_{H,t}}. \tag{9}$$

4.1.3 Firms

Intermediate goods producers sell under monopolistic competition and employ labor and intermediate inputs in production:

$$Y_t(j) = Z_t H_t(j)^{1-\alpha} X_t(j)^{\alpha}, \tag{10}$$

where $H_t(j)$ denotes labor services employed by firm $j \in [0, n]$ in period t. $X_t(j)$ is an aggregator of intermediate inputs employed by firm j, and Z_t is a stationary aggregate productivity shock. The intermediate inputs are produced domestically and abroad, and the intermediate input aggregator $X_t(j)$ takes the same functional form as the consumption aggregator in equation (4). Likewise, the bundle of Home (Foreign) intermediate inputs $X_{H,t}(j)$ ($X_{F,t}(j)$) takes the same functional form as the Home-produced (Foreign-produced) bundle of final goods consumed in Home $C_{H,t}$ ($C_{F,t}$).

Total domestic demand for a generic intermediate good produced in Home consists of the demand from domestic consumers and the demand from domestic producers

$$Y^D_t(j) = \left(\frac{P_{H,t}(j)}{P_{H,t}}\right)^{-\epsilon} \left[\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} (1-(1-n)\upsilon)\left(C_t + X_t\right)\right], \tag{11}$$

where we made use of the assumption that consumption bundles and intermediate-input bundles are isomorphic. Total foreign demand for a generic intermediate good produced in Home consists of the demand from foreign consumers and the demand from foreign producers

$$Y^{D*}_t(j) = \left(\frac{P^*_{H,t}(j)}{P^*_{H,t}}\right)^{-\epsilon} \left[\left(\frac{P^*_{H,t}}{P^*_t}\right)^{-\eta} (1-n)\upsilon\left(C^*_t + X^*_t\right)\right], \tag{12}$$

where X^*_t has the same functional form as C^*_t.

Under a regime of dominant currency pricing, Home producers solve separate price-setting problems for the domestic and the foreign markets. For the domestic market the problem is to

$$\max_{\{P_{H,t+k}(j)\}_{k=0}^{\infty}} \sum_{k=0}^{\infty} E_t \rho_{t,t+k} \Bigg\{ \left[(1+\nu)P_{H,t+k}(j) - MC_{t+k}\right] Y_{t+k}^{D}(j)$$
$$- \frac{\omega}{2}\left[(1-(1-n)\upsilon)\left(\frac{P_{H,t+k}(j)}{P_{H,t+k-1}(j)} - 1\right)^2 P_{H,t+k} Y_{t+k}^{D}\right]\Bigg\}$$
$$\text{s.t. (11).}$$

Here, $\rho_{t,t+k}$ is the nominal stochastic discount factor between periods t and $t+k$, and MC_t are nominal marginal costs in period t.[20] The price in the foreign market is determined through

$$\max_{\{P_{H,t+k}^{*}(j)\}_{k=0}^{\infty}} \sum_{k=0}^{\infty} E_t \rho_{t,t+k} \Bigg\{ \left[(1+\nu)\mathcal{E}_{t+k} P_{H,t+k}^{*}(j) - MC_{t+k}\right] Y_{t+k}^{D*}(j)$$
$$- \frac{\omega}{2}\left[(1-n)\upsilon\left(\frac{P_{H,t+k}(j)^{*}}{P_{H,t+k-1}(j)^{*}} - 1\right)^2 P_{H,t+k} Y_{t+k}^{D*}\right]\Bigg\}$$
$$\text{s.t. (12).}$$

In both cases, $\omega > 0$ indexes the extent of price adjustment costs.

4.1.4 Monetary policy

Monetary policy is conducted by adjusting the short-term nominal interest rate R_t. When Home pursues a flexible exchange-rate regime, monetary policy in Home follows a Taylor rule. In linearized terms, and using small letters to refer to the percentage deviation of a variable from the deterministic steady state

$$r_t = \rho_r r_{t-1} + (1-\rho_r)\left(\alpha_\pi \pi_t + \alpha_y y_t\right) + \boldsymbol{\varepsilon}_t, \rho_r \in [0,1), \alpha_\pi \geq 1, \alpha_y \geq 0. \tag{13}$$

$\boldsymbol{\varepsilon}_t$ is an i.i.d. monetary policy shock. Foreign monetary policy follows the same type of rule (but responds to foreign variables and has its own monetary policy shock), with coefficients $\rho_r^* \in [0,1)$, $\alpha_\pi^* \geq 1$, and $\alpha_y^* \geq 0$.

When, instead, Home pegs its exchange rate to Foreign, it sets the short-term nominal interest rate such that $\Delta e_t = 0$ for all t.

[20] Marginal costs are not firm-specific. Rather $MC_t(j) = \left(\frac{1}{\alpha}\right)^{\alpha}\left(\frac{1}{1-\alpha}\right)^{1-\alpha}\frac{P_t^{\alpha} W_t^{1-\alpha}}{Z_t}$ for all firms j, and, therefore, $MC_t(j) = MC_t$.

4.1.5 International financial markets

Financial markets are segmented as in Itskhoki and Mukhin (2021a). Home and Foreign households cannot trade assets directly with each other. However, households can trade domestic assets with noise traders and risk-averse financial intermediaries. This setup gives rise to a modified uncovered interest rate parity condition.[21] Namely, in linearized terms

$$r_t - r_t^* = E_t\left\{\Delta e_{t+1}\right\} + \zeta_t^* - \gamma b_t,\ \gamma \geq 0, \tag{14}$$

where ζ_t^* is a financial shock, and b_t is the net foreign asset position of the Home economy as a share of steady-state output in Home.[22] Following Itskhoki and Mukhin (2021b), the standard deviation of the financial shock and parameter γ both depend on the exchange-rate regime and are increasing in the volatility of the nominal exchange rate.

4.1.6 Market clearing and equilibrium

In equilibrium, the domestic prices and foreign sales prices, respectively, of all firms will be identical. Therefore, the demand from domestic households is $Y_t^D = (1 - (1-n)\upsilon)\left(\frac{P_{H,t}}{P_t}\right)^{-\eta}(C_t + X_t)$, and the demand from foreign households is $Y_t^{D*} = (1-n)\upsilon\left(\frac{P_{H,t}^*}{P_t^*}\right)^{-\eta}(C_t^* + X_t^*)$. Total demand for goods is

$$\begin{aligned} Y_t \ = \ & \left[\left(\frac{P_{H,t}}{P_t}\right)^{-\eta}(1-(1-n)\upsilon)(C_t + X_t)\right]\left(1 + \frac{\omega}{2}\left(\frac{P_{H,t+k}}{P_{H,t+k-1}} - 1\right)^2\right) \\ + & \left[\left(\frac{P_{H,t}^*}{P_t^*}\right)^{-\eta}(1-n)\upsilon(C_t^* + X_t^*)\right]\left(1 + \frac{\omega}{2}\left(\frac{P_{H,t+k}^*}{P_{H,t+k-1}^*} - 1\right)^2\right). \end{aligned} \tag{15}$$

The labor market clears if $H_t = \left(\frac{Y_t}{Z_t X_t^{1-\alpha}}\right)^{\frac{1}{\alpha}}$.

4.2 Calibration

We calibrate the model to the EA (Foreign country) and to a prototypical neighboring small open economy (Home). In doing so, we consider a linear approximation of the model around a deterministic and symmetric zero-inflation steady state.[23] Throughout, we will focus on the limiting case $n \to 0$. The Foreign consumption basket will almost

[21]See Itskhoki and Mukhin (2021a) for details.

[22]Once linearized, the net foreign asset position evolves according to

$$\beta b_t - b_{t-1} = \upsilon\left((\eta(2-\upsilon)-1)s_t + \eta(1-\upsilon)m_t + (1-\alpha)(c_t^* - c_t) + \alpha(x_t^* - x_t)\right).$$

[23]The market value of initial wealth in Home and Foreign, respectively, is influenced by all shocks that affect the economies, the structural features, as well as by the monetary regime(s). In a linear approximation, however, initial wealth has no material consequences for the dynamics of the model economy in response to shocks. Therefore, we focus on a symmetric steady state so as to keep the exposition tractable.

Table 4: Resulting parameters

Parameters	Description	Values
ρ_ξ, ρ_{ξ^*}	AR(1) time-preference shocks Home, Foreign	.88
σ_ξ, σ_{ξ^*}	Std. deviation preference shock Home, Foreign	.062, .020
σ_Z, σ_{Z^*}	Std. deviation productivity shock Home, Foreign	.0015, .0018
ρ_{ζ^*}, σ_{ζ^*}	AR(1) and standard dev. intern. financial shock	.78, .0086
α_π	Response to consumer-price inflation, Home	2.58

Notes: parameters calibrated by minimum distance between model and data moments. The root mean-squared error between data and model moments is 0.221.

exclusively contain Foreign-produced goods. Effectively, the Foreign economy operates like a closed economy. From the perspective of the small open Home economy, Foreign can be an important source of shocks, though, shocks being transmitted across borders through financial markets and trade.

One period in the model is a quarter. We set $\beta = 0.995$, $\varphi = 0.5$, and $\epsilon = 10$, all customary values. Following Gopinath et al. (2020), we set $\eta = 2$, and $\alpha = 2/3$. We set $\upsilon = 0.1$, matching an average trade share of the neighbor country vis-à-vis the EA of 30 percent. We set $\omega = 400$, which implies a reasonable slope of the European Phillips curve. Monetary policy in Foreign is parameterized as $\rho_r^* = 0.85$, $\alpha_\pi^* = 1.25$, and $\alpha_y^* = 0.025$, all within the range of customary values. ρ_r and α_y are set to the same values as in Foreign. The calibration of α_π will be discussed further below. Monetary policy shocks in either country have a standard deviation of 40bps annualized. All other shocks have an AR(1) structure; see Online Appendix E.1 for details. In light of the close integration of the EA with its neighbors, we allow productivity and time-preference shocks to spill over from Foreign to Home. Productivity shocks in Home and Foreign have an autocorrelation of 0.935, in line with the EA estimates of Adolfson et al. (2007). 70% of Foreign productivity directly is reflected in Home, a reasonably standard value for comovement (Backus et al., 1992; Heathcote and Perri, 2002; Itskhoki and Mukhin, 2021a). Comovement is of the same size for time-preference shocks. Last, we assume that moving to a peg reduces the standard deviation of shocks to international portfolio demand by 75 percent.

This leaves nine parameters to be determined: the persistence of time-preference shocks (which is assumed to be the same in Home and Foreign), the standard deviation and persistence of the shocks to international portfolio demand, the standard deviations of productivity and time-preference shocks in each country, and the inflation response of monetary policy in Home, α_π. The latter we include because the monetary rule is important for spillovers. We set these parameters by minimizing the root mean square difference between the model moments and the corresponding moments in the data (Table 3).

We set the parameters based on all the moments in the table, bar those that are not applicable ('–'), are unity by definition (such as the correlation of gdp with gdp), are duplicate entries, and those referring to the exchange rate for neighbors that peg. The model treats the peg as a hard peg. The resulting parameters are summarized in Table 4.

The parameters seem reasonable. In particular, the international financial shocks are somewhat serially correlated, as in Itskhoki and Mukhin (2021a). Also witness that $\alpha_\pi = 2.58$ meaning that among floats monetary policy in Home responds more to inflation than in Foreign. Most crucially, the moments replicate the patterns in the unconditional evidence given by Table 3 rather well, see Online Appendix E.2 which reports the resulting model moments after setting the parameters.

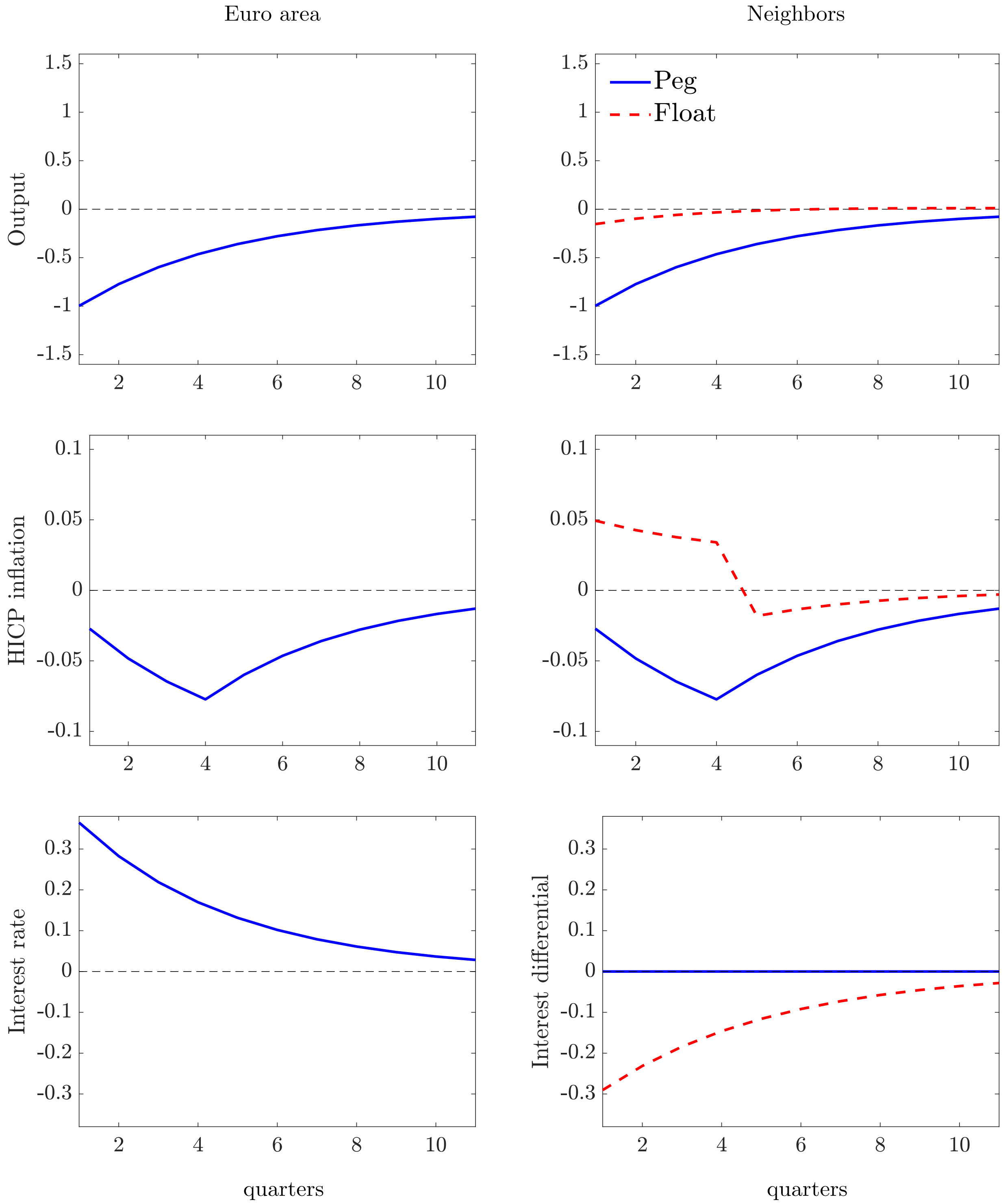
4.3 Spillovers in the model

The rest of this section provides a model-based assessment of monetary spillovers, articulated in three steps. We start by showing that the full-scale, calibrated model designed to address the exchange rate disconnect nonetheless predicts output insulation under flexible exchange rates. Our conditional evidence is thus not only puzzling in light of the classics but also in light of a state-of-the-art model. Next, we show analytically that stabilizing headline CPI inflation would invite strong output spillovers—but at the same time would keep exchange rate variability low. Hence, as a final step, we show that re-calibrating monetary policy by prescribing a strict focus on CPI inflation would bring the model closer in line with the conditional evidence on lack of insulation from external (monetary) shocks—but only at the cost of failing to match the unconditional evidence on exchange rate variability. Lack of insulation to monetary shocks appears a policy choice.

4.3.1 Abundant real insulation: a counterfactual result

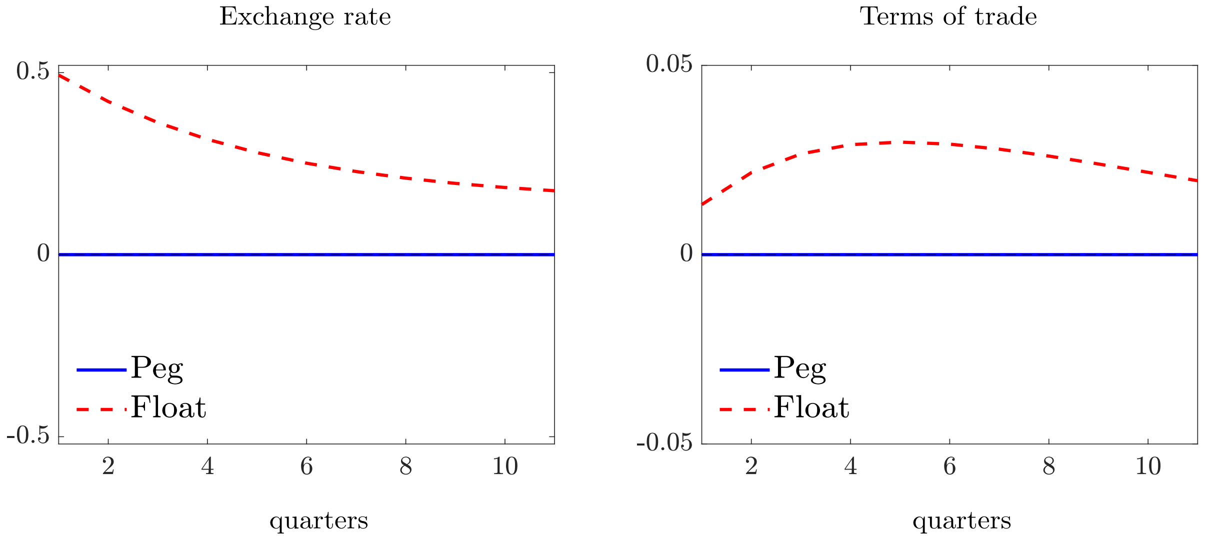
Figure 4.A shows impulse responses to a Foreign monetary shock in the full-scale calibrated model. The left column shows the response in Foreign (EA) itself. Foreign output contracts and Foreign inflation declines. The right column shows the response in Home (neighboring country) for fixed and flexible exchange rates. Under a peg (solid blue lines), the Home economy has to align its monetary stance with the Foreign one, and the responses of Home output and inflation mimic those of their Foreign counterparts. Under a float (red dashed lines), the Home interest rate is governed by Home's Taylor rule. In this case, the monetary authority in Home engineers a monetary stance that remains more accommodative than in Foreign. As a result, output in Home falls only about 1/10 as much as it does under a peg. This high degree of insulation of real activity, clearly, is in sharp contrast to the lack of insulation that we document empirically in Section 3. The insulation of output observed in the model is achieved at the cost of a temporary

Figure 4.A: Adjustment to Foreign monetary policy shock



Note: response to a Foreign monetary policy shock. Left: response in Foreign (solid blue line). Right: response in Home for two monetary regimes. A solid blue line marks the response in Home if Home pegs (same as the response in Foreign). A dashed red line marks the response in Home if Home floats under the Taylor rule. Top row: response of output (y_t^* and y_t) in percent. Middle row: consumer-price inflation (π_t^* and π_t), year-on-year in percent. Bottom row: response of the interest rate (r_t^* and r_t) in annualized percentage points.

Figure 4.B: External adjustment to Foreign policy shock



Note: response to the same monetary shock shown in Figure 4.A of the exchange rate ($\mathcal{E}_t$, left) and Home's terms of trade (S_t, right) in percent. Solid blue line: Home pegs to Foreign; dashed red line: Home floats under the Taylor rule. A rise means a depreciation from the perspective of Home.

increase in consumer-price inflation.

Figure 4.B shows the responses of two external variables, the nominal exchange rate and the terms of trade. Under the model's floating regime, the Home exchange rate depreciates by 0.5 percent—again, in sharp contrast to our empirical results, in which the exchange-rate responses of pegs and floats are indistinguishable. The terms of trade deteriorate.

Online Appendix F suggests that this result of abundant real insulation is generic to the current vintage of workhorse models of international macroeconomics. In particular, the appendix shows that the models of Gopinath et al. (2020) and Itskhoki and Mukhin (2021a)—two prominent papers in the literature—also imply that Foreign monetary policy has a much smaller effect on Home output than our empirical evidence suggests.

4.3.2 Insulation as a policy choice: analytical insights

We now show analytically that dominant currency pricing *by itself* neither mandates nor prevents insulation of real economic activity from foreign (monetary) shocks. Instead, under DCP the degree of insulation of output vs. inflation is a non-trivial choice for monetary policy.

For tractability, we omit roundabout production of intermediate goods (that is, we set $\alpha = 0$), set the trade elasticity to unity, $\eta = 1$ and assume an infinitely elastic labor supply, $\varphi = 0$. Furthermore, we assume that there are complete international financial markets so that the standard UIP condition holds. A key implication of these assumptions is that, up to the first order, the terms of trade are exogenous and constant. Furthermore, we set the interest-rate smoothing coefficient ρ_r^* in the Foreign monetary policy rule equal to zero. Thus, we obtain a tractable variant of our model that has only one endogenous state variable (M_{t-1}). The monetary regime in Home will be defined further below on a case-by-case basis. For ease of exposition, here we also focus on the limit $\beta \to 1$. As before, we focus on the case where $n \to 0$, and we consider a linear approximation of the model around a deterministic and symmetric zero-inflation steady state and use small letters to refer to the percentage deviation of a variable from the non-stochastic steady state.[24]

In accordance with the previous sections, we focus our analysis exclusively on monetary shocks $\boldsymbol{\varepsilon}_t^*$ that originate in Foreign.[25] In period $t = 0$, there is a unitary monetary shock, that is, $\boldsymbol{\varepsilon}_0^* = 1$ (a foreign monetary tightening). In the next period, the shock remains present at that level with probability μ. Else, the shock ceases, being equal to zero forever after. As the same applies to each subsequent period, this shock induces a Markov structure for Foreign output, inflation, and the interest rate. While the shock lasts (indexed with subscript "L") we have constant values for Foreign output and inflation:

$$y_L^* = -(1-\mu) \cdot \mathbf{A} < 0 \quad \text{and} \quad \pi_L^* = -\kappa \cdot \mathbf{A} < 0, \tag{16}$$

where $\mathbf{A} := [(1 + \alpha_y^* - \mu)(1-\mu) + \kappa(\alpha_\pi^* - \mu)]^{-1} > 0$. For the derivation, see Online Appendix G.3. Observe that in these expressions, parameter κ denotes the slope of the New Keynesian Phillips curve and is itself a convolute of structural parameters of the model. The Foreign monetary shock results in a contraction of economic activity and inflation in Foreign. Once it ends, foreign variables immediately return to their steady-state value of zero.

A central insight is that when international pricing involves a dominant currency, there is no "divine coincidence:" Monetary policymakers in Home face a trade-off between stabilizing the output gap and inflation; see Online Appendix G.4.1. The propositions below show the equilibrium allocations under the two polar cases: if policy keeps the output gap completely closed (Proposition 1), or if policy stabilizes CPI inflation at zero (Proposition 2).

Proposition 1. ***Output insulation: targeting natural output.*** *Consider the model of Section 4.1 with the assumptions of Section 4.3.2. Suppose that Home monetary policy chooses to stabilize output at its natural level. Then, amid the Foreign monetary tightening, while the shock lasts,*

[24] For expositional ease, and without loss, we focus on the symmetric case in which prices are equally rigid in Home and in Foreign. Online Appendix G.1 provides the linearized model equations. Online Appendixes G.2 through G.4 provide the proofs of all the propositions in the current section and, as a reference point, a characterization of the natural rate allocation.

[25] Online Appendix G provides analytical solutions also for demand and productivity shocks, and for less restrictive parameterizations.

1. *Home output is perfectly insulated:* $y_{t,L} = 0$.
2. *Home consumer-price inflation is positive*

$$\pi_{0,L} = -\frac{\upsilon}{1-\upsilon}[y_L^* + \pi_L^*] > 0,$$

and

$$\pi_{t,L} = -\frac{\upsilon}{1-\upsilon}\pi_L^* > 0, \ t > 0.$$

3. *The nominal exchange rate depreciates*

$$e_{t,L} = -\frac{1}{1-\upsilon}y_L^* - (t+1)\frac{1}{1-\upsilon} \cdot \pi_L^* > 0. \tag{17}$$

Proof. See Online Appendix G.4.2. □

In the natural allocation (that is, under price flexibility in Home), the terms of trade would move to completely insulate Home economic activity from Foreign monetary shocks (Online Appendix G.2 derives this result). However, with rigid prices, a regime of dominant-currency pricing prevents this stabilizing movement of the terms of trade. Instead, in the current setting price rigidity means that the terms of trade do not move whatsoever (a result derived in Online Appendix G.4.1). Any insulation of the Home economy will, therefore, have to come from additional domestic absorption. That is, stabilization of output requires a monetary accommodation that leads to a depreciation of the currency and to consumer-price inflation, as stated in the proposition. Note that the inflation that comes with real insulation is higher in more open economies (the larger υ).

Our second proposition shows the effects of a policy that stabilizes consumer-price inflation in a DCP environment.

Proposition 2. *Inflation insulation under consumer-price inflation targeting*. *Consider the same conditions as in Proposition 1, but suppose that Home monetary policy targets stable consumer prices ($\pi_t := p_t - p_{t-1} = 0$). Then, amid the Foreign monetary tightening, while the shock lasts,*

1. *Home output is given by*

$$y_{t,L} = y_L^* - (1-\upsilon)\frac{1-\chi^{t+1}}{1-\chi}\frac{(1-\mu)}{\upsilon[2-\chi-\mu]+\kappa}\pi_L^*, \ \textit{so } y_{0,L} < 0.$$

Here $\chi = 1 + \kappa/(2\upsilon) - \sqrt{[1+\kappa/(2\upsilon)]^2 - 1}$, *so* $\chi \in (0,1)$.

2. *Home consumer-price inflation is perfectly insulated:* $\pi_{t,L} = 0$.
3. *The nominal exchange rate is given by*

$$e_{t,L} = -(1-\upsilon)\frac{1-\chi^{t+1}}{1-\chi}\frac{\kappa}{\upsilon[2-\chi-\mu]+\kappa}\ y_L^* - (t+1)\ \pi_L^* > 0.$$

Proof. See Online Appendix G.4.4. □

Keeping consumer-price inflation at target amid the recession in Foreign comes at the cost of an unambiguous fall of output in Home. The more open the economy is (the larger υ), or the more rigid prices are (the smaller κ), the more synchronized is domestic output with foreign output under this policy; see item 1 of the proposition. In fact, as prices become perfectly rigid, *a policy to target consumer-price inflation becomes entirely isomorphic to a peg* (Online Appendix G.4.5 gives the evolution of the Home economy under a peg). In line with this, under headline inflation targeting, the nominal exchange rate depreciates by less than it would under output gap targeting.[26] Note that under consumer-price inflation targeting, the exchange rate perfectly absorbs any purely *nominal* drift abroad (see the term $(t+1)\pi_L^*$ in item 3 of Proposition 2). This alone is not nearly sufficient to fully insulate real economic activity. But it clearly shows that accounting for alternative policy options under flexible exchange rates—the extra degree of freedom—adds a nuance to our question.[27]

4.3.3 Can inflation targeting reconcile theory with evidence?

Against the background of the analytical results above, it is natural to use our model to analyze the quantitative role of the policy choice under a float for the observable spillovers. Hereafter, we assess whether a stricter focus on headline inflation by monetary policy can rationalize the monetary spillovers that we present in Section 3.

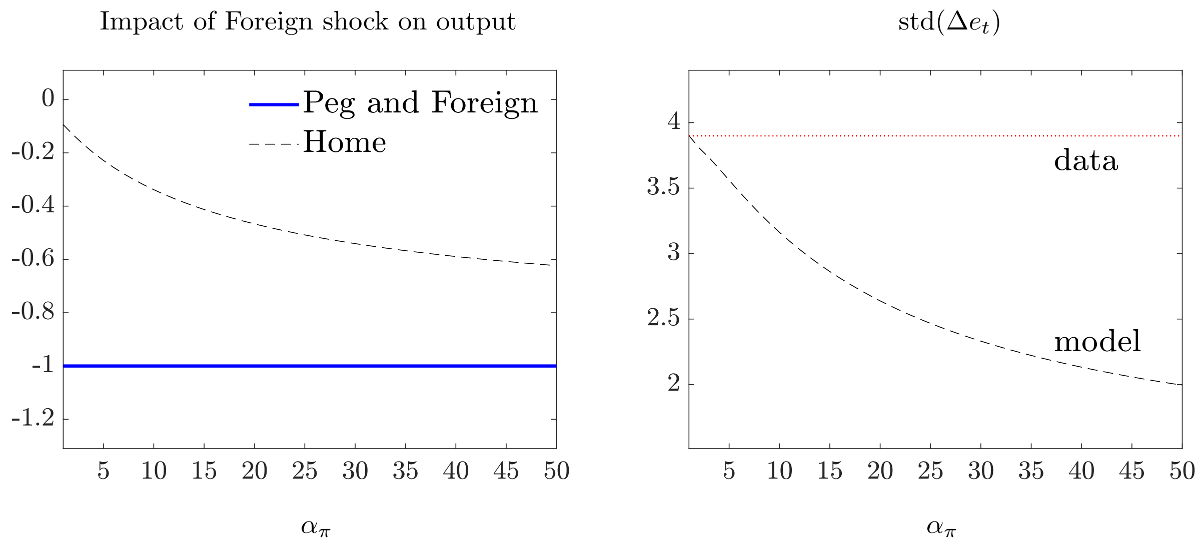
Toward this end, Figure 4.C varies the response parameter to inflation in Home (α_π, x-axes) in the full-scale, calibrated model. The left panel shows the impact (period-1) response of output to the external monetary shock. Indeed, the more inflation-averse the Home central bank is the larger are the spillovers. For the calibrated parameters, a strict focus on inflation could account for about 3/5 of the spillovers that we witness empirically. However, the response to inflation would need to be much larger than the literature usually entertains (a response parameter $\alpha_\pi > 40$). The key to the spillovers is that a focus on headline inflation makes the central bank lean against the pass-through of the exchange rate to headline inflation and, thus, implicitly against exchange rate movements themselves.

One implication of this explanation, however, is that a policy that stabilizes consumer-price inflation under all circumstances also stabilizes the exchange rate under all circum-

[26]This generalizes beyond the assumption of a dominant currency. Under producer currency pricing a central bank that targets consumer-price inflation also invites output spillovers when faced with a Foreign monetary policy shock. We show this analytically in Online Appendix G.5 and in simulations in Online Appendix H.

[27]An intermediate degree of insulation of both economic activity and inflation is achievable under a monetary policy that stabilizes producer price inflation. Online Appendix G.4.3 shows the analytics of this case and Online Appendix H impulse responses for the full-fledged model. Such policy is shown to be optimal under DCP in recent open-economy literature (see Corsetti et al 2020, Egorov and Mukhin 2023). Such policy, too, implies much more real insulation than we witness empirically.

Figure 4.C: Varying the response to inflation α_π



Note: Varying the response of Home monetary policy to inflation (under the float) in the baseline calibration. Left: impact response of Foreign monetary shocks on Home and Foreign output. Right: standard deviation of the exchange rate in model and data.

stances. This violates the unconditional evidence of a volatile exchange rate—a fact that is illustrated in the right panel of Figure 4.C, which plots the exchange rate volatility for different values of the central bank's response to inflation.[28]

5 Conclusions

In this paper we show empirically that spillovers from euro-area monetary shocks to neighbors that float are large and of the same size as for neighbors that peg; floaters let their exchange rate move surprisingly little in response to these shocks in the EA. In other words, we offer novel conditional evidence of lack of insulation that is not disconnect—the exchange rate does not move—but is associated to the sameness of policy—the currency interest rate and inflation go the same way.

To shed light on this lack of insulation, we resort to the latest vintage of international macroeconomic theory that underpins the recent "flexibility pessimism." Namely, we study cross-border spillovers in a New Keynesian two-country model, where shocks originate in a large country that issues the currency that is dominant in cross-border trade. For its neighbors, dominant currency pricing results in a trade-off between stabilizing output and inflation, which may induce central banks to *choose* not to insulate domestic output from external shocks in order to keep inflation on target. We show that the pre-

[28]Quantitatively similar results emerge when recalibrating also the shock-related parameters (including the standard deviation of international financial shocks) when changing the inflation response, see Online Appendix E.3.

dictions of this theory align surprisingly well with the response to monetary shocks (lack of real insulation) if floaters engage in consumer-price (CPI) inflation targeting. Since inflation targeting is the dominant monetary regime in the European context, this result may suggest a new, industrialized-country perspective on the notion of "fear of floating," which was originally put forward by Calvo and Reinhart (2002) primarily in the context of monetary policies pursued by emerging economies.

The lack of insulation would nonetheless remain theoretically challenging. Unconditionally, the nominal exchange rates *are* much more volatile under floating exchange rates, while business cycles of pegs and floats look quite similar—an exchange rate disconnect documented by Baxter and Stockman (1989) that also holds in our sample. The disconnect questions policy-based explanations such as CPI inflation targeting, to the extent that such policies dampen exchange rate volatility both conditionally and unconditionally. The challenge to existing international macro theory is why central banks quite generally seem willing to allow exchange rates to float, but would be unwilling to float *conditional* on certain external shocks.

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A Data and exchange-rate classification

A.1 Data sources

Unless noted otherwise our data source is Eurostat and the sample runs from 1999:M01–2021:M12. In what follows we list details and exceptions.

Industrial production: manufacturing (series: `sts_inpr_m`), Index (2015 = 100), seasonally adjusted. First observation: 2000:M01, except for euro area, Croatia, Lithuania, Slovenia, United Kingdom, and Norway (all 1999:M01), Switzerland (2010:M10). For Iceland no data from Eurostat, use OECD (series: `PRMNTO01`) instead (only available up to 2018:M02). To construct an aggregate series for EA11 we use the 2015 weights reported by Eurostat for the construction of the EA19 series and reweigh series accordingly. In some instances we use OECD data for 1999 as Eurostat data not available for that year. There is no data for Ireland after 2010. So we omit it in the construction of the EA11 series for industrial production. We take logs and remove a linear trend from the series prior to the estimation.

Unemployment rate: harmonized unemployment rate according to ILO definition (series: `ei_lmhr_m`), seasonally adjusted. First observation is 1999:M01, except for Bulgaria (2000:M01), Estonia (2000:M02), Croatia (2000:M01), Cyprus (2000:M01), Malta (2000:M01), Iceland (2003:M01), Switzerland (2010:M01). To construct an aggregate times series for EA11 we use the 2015 weights reported by Eurostat for the construction of the EA19 series and reweigh series accordingly.

Interest rates: short-term interest rates provided by OECD, Monthly Monetary and Financial Statistics (MEI), annualized and in percent. First observation: 1999:M01, expect for Bulgaria (2004:M02), Croatia (2002:M09), Slovenia (2002:M01), Switzerland (1999:M07). No OECD data for Malta and Cyprus. In this case we use the EA short rate from 2008:M01 onward. For the period before we use the T-Bill rate for Malta (source: IMF) and the overnight interest rate for Cyprus (source: Central bank of Cyprus). In our analysis we also use the interest rate on German government bonds with one year maturity from the Bundesbank (Term structure of interest rates on listed Federal securities (method by Svensson)/residual maturity of 1.0 year/monthly data).

Inflation. 100 times yoy log change of all-items HICP (series: `prc_hicp_midx`), 2015=100. First observation: 1999:M01, except for Switzerland (2005:M12). Series for UK ends in 2020:M12. We construct the series for EA11 using the annual HICP country weights reported by Eurostat for the computation of the EA19 series.

Euro-exchange rates: for neighbor countries national currency per euro (monthly average). For countries that adopt euro in sample we use historical series (series: `ert_h_eur_m`) available up to 2015:M12, afterwards euro exchange rate is irrevocably fixed. For other countries we use the series `ert_bil_eur_m`. For the euro area we use the effective exchange rate of the euro from FRED Economic Data (series: `NBXMBIS`).

Real gross domestic product at market prices from Eurostat. Chain-linked volumes (2010), million euro. For the euro area: EA12. Quarterly. Seasonally adjusted and calendar adjusted. For Iceland: only seasonally adjusted. For the UK, gross domestic product, national currency, chained volume estimates, national reference year, quarterly levels, seasonally adjusted, from the OECD.

A.2 Exchange rate polices in neighbor countries

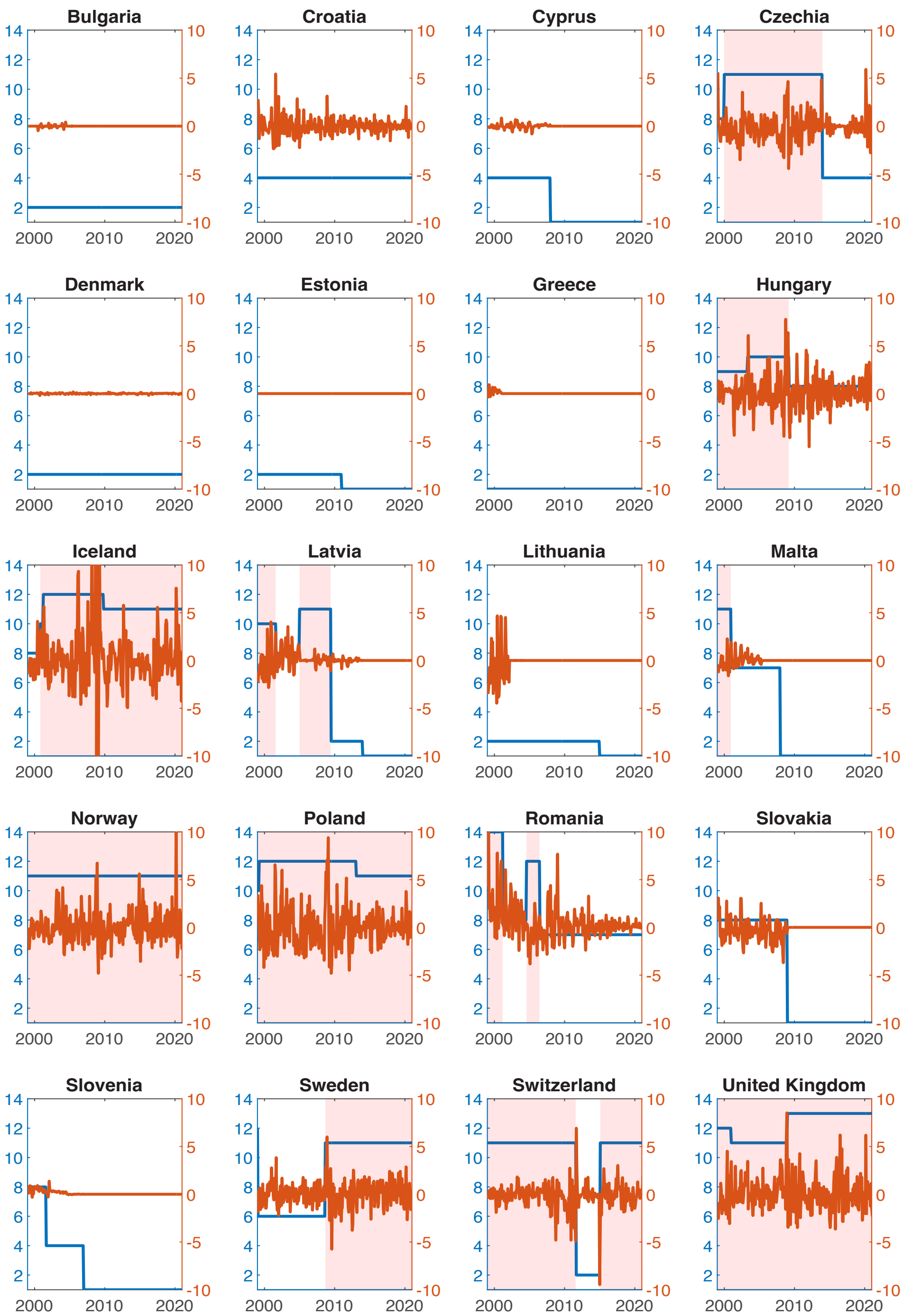
Here we provide a brief overview of the exchange rate policies of the EA neighbor countries from 1999 to 2021. Figure A.1 displays for each country in our sample the time series of the fine exchange-rate regime classification of IRR, measured against the left axis (1-14, since there are no instances of 15 in our sample), and the month-on-month change of the bilateral euro exchange rate, measured against the right axis (in percent). The shaded area indicates country-month observations that qualify as floats in our baseline (IRR category 9 or above). Table 1 in the main text summarizes this information in a compact way. In what follows we look at each country in more detail and provide details on the classification of IRR. When appropriate, we also provide information from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), the convergence reports by the European Commission, or the websites of the central banks.

Bulgaria: Currency board in place since 1997 under which the Bulgarian Lev (BGN) is pegged to Deutsche Mark and to the Euro afterwards. IRR classification: 2 ("Pre announced peg or currency board arrangement").

Croatia: According to the central bank the "monetary policy framework is based on maintaining the stability of the nominal exchange rate of the kuna against the euro." IRR classification: 4 ("De facto peg").

Cyprus: Adoption of the euro on January 1, 2008. IRR classification: 1 ("No separate legal tender or currency union") since then. On May 2, 2005 Cyprus joined the ERM2, but the exchange rate fluctuations were much narrower than the +/- 15% margin permitted under ERM2. IRR classification from 1999-2008: 4 ("De facto peg"); see also Central Bank of Cyprus website.

Figure A.1: Exchange-rate regimes and fluctuations



Notes: blue line measures exchange-rate regime classification of IRR against the left axis, red line is month-on-month change of the bilateral euro exchange rate against the right axis (in percent). The shaded area indicates country-month observations that qualify as a float in our baseline (IRR category 9 or higher).

Czechia: CPI-Inflation targeting since 1998. From November 2013 to April 2017, exchange rate target as an additional monetary policy instrument, to avoid koruna to strengthen below 27 CZK/EUR (see Convergence programme of the Czech Republic, April 2017). IRR classification: 4 ("De facto peg"). IRR classification throughout 1999: 8 ("De facto crawling band that is narrower than or equal to +/-2%"), since 2000:M01: 11 ("Moving band that is narrower than or equal to +/-2%").

Denmark: Denmark is a member of the ERM2 for the whole sample priod, but it pegs the Danish krone (DKK) against the euro allowing for a fluctuation band of only +/- 2.25% (see website of the Danish central bank). IRR classification: 2 ("Pre announced peg or currency board arrangement").

Estonia: In the early part of our sample the Eesti kroon is pegged to the euro via a currency board arrangement. In 2004, Estonia joined the ERM2, in January 2011 the euro. IRR classification: 2 ("Pre announced peg or currency board arrangement") and 1 ("No separate legal tender or currency union"), before and after, respectively.

Greece: Adoption of the euro following a currency peg on January 1, 2002. Greece was member of the ERM2 until the end of 2001. IRR classification: 4 ("De facto peg") and 1 ("No separate legal tender or currency union"), before and after, respectively.

Hungary: Since 2001 inflation target (see website of the Hungarian central bank) and freely floating exchange rate since February 2008 (see website of the Hungarian central bank). Prior to October 2001, the currency followed a crawling peg to a currency basket of composed of the euro (70%) and the USD (30%), allowing for horizontal bands of ± 2.25%. In May 2001, the size of the bands was increased to ± 15%. Furthermore, the reference currency was changed to the euro in 2001. This regime was upheld until 2008. IRR classification: 9 ("Pre announced crawling band that is wider than or equal to ±2%") up to 2003:M04, 10 ("De facto crawling band that is narrower than or equal to ±5%") up to 2009:M03 and 8 ("De facto crawling band that is narrower than or equal to ±2%") since then.

Iceland: In 1999 and 2000 the Icelandic króna (ISK) was pegged to a basket of nine currencies (the Canadian dollar, the Danish krone, the euro, the Japanese yen, the Norwegian krone, the pound sterling, the Swedish krona, the Swiss franc, and the U.S. dollar) allowing for horizontal bands of +/- 9%. IRR classification: 8 ("Pre announced crawling band that is wider than or equal to ±2%"). In March 2001 this peg was dropped in favor of an inflation target. However, a subordinate goal of exchange rate stabilisation was formulated, which gives the central bank a mandate to intervene on the foreign exchange markets (see website of the central bank of Iceland). According to the AREAER, disruptions on the international financial markets from 2008 onward led the central bank to intervene on the foreign exchange markets to stabilise the currency. IRR classification 1999–2008: 8 (“De facto crawling band that is narrower than or equal to ±2%”), up 2011:M09: 12 (“De facto moving band ±5% , Managed floating), 11 (“Moving band that is narrower than or equal to ±2%”) since then.

Latvia: Up to 2004:M12 peg to IMF special drawing rights. Switch from peg to euro peg on January 1, 2005 with ±1% bands. Joined ERM2 in May 2005 (see website of the central bank of Latvia). Since June 2009 de facto peg to euro, joined euro in January 2014. IRR classification from 1999:M01–2001:M07: 10 (“De facto crawling band that is narrower than or equal to ±5%”), up to 2004:M12: 8 (“De facto crawling band that is narrower than or equal to ±2%”), up to 2009:M06: 11 (“Moving band that is narrower than or equal to +/-2%”), up to 2013:M12: 2 (“Pre announced peg or currency board arrangement”), and 1 (“No separate legal tender or currency union”) since then.

Lithuania: Up to 2002 the Lithuanian litas (LTL) was pegged to the US dollar by means of a currency board arrangement. On February 2, 2002 this peg was transformed into a euro-peg. In 2004 Lithuania joined the ERM2 without changing its effective exchange-rate regime (AREAER). Adoption of the euro on January 1, 2015. IRR classification up to 2014:M12: 2 (“Pre announced peg or currency board arrangement”) and 1 (“No separate legal tender or currency union”) since then.

Malta: In the early part of the sample the Maltese lira was pegged to a currency basket, with weight of euro increased in August 2002. Peg to euro only started in January 2005, and adoption of the euro on January 1, 2008 (AREAER). IRR classification: 11 (“Moving band that is narrower than or equal to ±2%”) up to 2000:M12, 7 (“De facto crawling peg”) up to 2007:M12; 1 (“No separate legal tender or currency union”) afterwards.

Norway: Floating exchange rate. Since March 2001 CPI inflation target. IRR classification: 11 (“Moving band that is narrower than or equal to ±2%”).

Poland: Up to March 2001 Polish zloty (PLN) was pegged to a currency basket consisting of the euro (55%) and the US dollar (45%). The peg followed a crawling and pre-announced central exchange rate to its reference basket. On March 24, 1999 the fluctuation band of the exchange rate around this central rate was increased from +/- 12.5% to +/- 15%. Floating exchange rate since April 2000 (AREAER). IRR classification up to 1999:M03: 10 ("De facto crawling band that is narrower than or equal to ±5%") and 12 ("De facto moving band ±5%, Managed floating") afterwards.

Romania: Central bank maintains "managed float, in line with using inflation targets as a nominal anchor for monetary policy and allowing for a flexible policy response to unpredicted shocks likely to affect the economy" (see central bank website). With the exception of the period from 2002 to 2004, the IMF has also classified the exchange-rate regime of Romania as a managed float (AREAER). In August 2005, the central bank adopted an inflation target (see central bank website). Romania has set 2024 as its target year to adopt the euro, but has not joined the ERM2 yet (see European Commission website). IRR classification up to 2001:M01: 14 ("Freely falling"), up to 2004:M07: 8 ("De facto crawling band that is narrower than or equal to ±2%"), up to 2006:M06: 12 ("De facto moving band ±5%, Managed floating"), up to 2011:M11: 7 ("De facto crawling peg"), and 4 ("De facto peg") since then.

Slovakia: Adoption of the euro following a managed float on January 1, 2009 (AREAER). Joined ERM2 in 2005. IRR classification up to 2008:M12: 8 ("De facto crawling band that is narrower than or equal to ±2%"), and 1 afterwards ("No separate legal tender or currency union") .

Slovenia: Adoption of the euro following a managed float on January 1, 2007. Joined ERM II in June 2004. IRR classification up to 2001:M08: 8 ("De facto crawling band that is narrower than or equal to ±2%"), up to 2006:M12: 4 ("de facto peg") and 1 afterwards ("No separate legal tender or currency union") .

Sweden: Inflation targeting since 1993; floating exchange rate. IRR classification up to 1999:M01: 12 (De facto moving band ±5%, Managed floating), up to 2008:M08: 6 ("De facto crawling peg") and 11 ("Moving band that is narrower than or equal to ±2%") since then.

Switzerland: Free float before September 6, 2011 and after January 15, 2015. Exchange rate floor equivalent to a de facto peg in the period in between. IRR classification up 2011:M8: 11 ("Moving band that is narrower than or equal to ±2%") , up to 2014:M12: 2 ("Pre announced peg or currency board arrangement"), and 11 since then.

United Kingdom: CPI inflation target since 1992. Flexible exchange rate. IRR: classification up to 2000:M12: 12, up to 2008:M12: 11, and 13 since then.

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