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Unemployment**

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Exchange Rates, the Competitiveness of Nations and Unemployment¹

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Abstract

The main goal of this paper is to assess the impact of exchange rate fluctuations on economic activity, namely on unemployment. We estimate a Vector Autoregressive (VAR) model for each of the following major economies: Australia, Brazil, China, Germany, Japan, Switzerland, the United Kingdom and the United States of America. The VAR model comprises the following variables: the unemployment rate, the GDP growth rate, the inflation rate, the interest rate, and the real effective exchange rate. We use the Cholesky decomposition to identify the shocks that drive these variables. The results obtained using the Cholesky decomposition depend on the ordering of the variables; therefore we discuss the results obtained when different orderings are employed. Our results suggest that an exchange rate appreciation leads to an increase in unemployment in relatively small countries such as Australia, Switzerland and the UK, but not in Japan or in the USA. The results for Brazil, China and Germany do not appear to be satisfactory, possibly because the sample covers a period of important structural change in those countries.

Keywords: competitiveness, currency wars, exchange rate, monetary policy, unemployment, VAR model.

JEL classification: F16, F31, F41

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1. Introduction

The relationship between exchange rates and employment is the subject of intense debate, straddling economics and politics (see, e.g., Delgado, Ketels, Porter and Stern, 2012). The exchange rate, or, more precisely, the real exchange rate, guides the allocation of resources between sectors, according to the relative strength (competitiveness) of domestic producers vis-à-vis international competitors (Montiel, 2011; Nelson, 2015). This means that changes in the exchange rate can impact the competitiveness of certain domestic sectors and thus labor markets via trade flows. However, it is usually exchange rate appreciations that worry policymakers, in view of their potential detrimental impact on international competitiveness and consequently on domestic economic growth and employment (Bussière, Lopez and Tille, 2014).

Nevertheless, the relevance of the concern about “national competitiveness” is itself controversial. Krugman (1994) has dubbed it “a dangerous obsession” and argues that concerns about competitiveness are “almost completely unfounded”. De Grauwe (2010) also expresses some skepticism, partially due to the policies that are put forward to promote competitiveness, such as currency devaluation or “strategic” industrial policy. On the other hand, Mishkin (2007) clearly expresses worry about the competitiveness mechanism, arguing that an appreciation of the dollar restrains exports and stimulates imports, which implies a reduction in aggregate demand with negative consequences for economic growth and employment in the United States of America. Based on the case of France, Noyer (2007) gives a more balanced view. For this author, while it is clear that the euro's appreciation in recent years penalizes export sectors whose competitors are located in other monetary areas, it is also evident that it benefits those sectors which are large consumers of imported commodities. Therefore, the overall effect on France's growth and external balance is not clear. Amiti, Itskhoki and Konings (2012) highlight the fact that large exporters are simultaneously large importers, a situation which may lead to incomplete pass-through of exchange rate shocks into international prices, thereby calling into question the positive effect of exchange rate fluctuations in terms of competitiveness.

The connection between exchange rates and economic activity has received renewed interest in recent years with the debate around the problematic of currency wars, initiated by Brazil's Finance Minister Guido Mantega in September 2010 (Cline and Williamson, 2010). According to the International Monetary Fund (IMF), this situation happens when currencies are held artificially low to boost exports, a policy action popularly referred to as “currency manipulation”.

Indeed, following the Great Financial Crisis of 2008-9, which has lowered growth rates throughout the world, some countries, especially China, Malaysia, Singapore, Switzerland, Hong Kong, Taiwan and other East Asian countries, are purposely using various policies to weaken the value of their currency to increase exports and create jobs. However, there is the risk of this being a zero-sum game, in which some must end up disappointed. A weaker currency in one country implies a stronger currency in some other country or countries. Therefore, these policies come at the expense of other nations, including the United States, Japan and the Euro area, which, if unable to retaliate through the same channel, will observe a destruction of jobs and consequently an increase in their unemployment rate, albeit temporarily.

To overcome the worrying economic signs that their economies still exhibit, the United States of America, the United Kingdom and, to a lesser extent, the Euro area adopted in recent years expansionary monetary policies. In addition to the cut in short-term interest rates, the monetary authorities have used quantitative easing to provide further monetary stimulus to the economy. Quantitative easing is an unconventional form of monetary policy that expands the money supply through government purchases of assets, usually government bonds (Fawley and Neely, 2013; Nelson, 2015).

However, as the U.S. dollar, the British pound, and the euro are floating currencies, some emerging countries, such as Brazil, argue that these expansionary policies have caused these currencies to depreciate against the currencies of emerging markets, therefore operating as “beggar-thy-neighbor” policies (Bussière, Lopez and Tille, 2014; Nelson, 2015). In response to the concerns of emerging-market economies, the Federal Reserve, the Bank of England, and the European Central Bank argue that the net effect of quantitative easing on trading partners is not necessarily negative. These policies are adopted only for domestic purposes (stimulate domestic consumption and investment), so that any effect on the currencies of emerging countries will be a side-effect or by-product of the policy (Economist, 2013).

The debate about the effects on domestic output and employment resulting from exchange rate manipulation thus remains far from over. The main goal of this paper is to analyze the effects of exchange rate variations on economic activity, namely on the unemployment rate. Our contribution to the literature stems from the fact that we estimate a model which also incorporates an equation for unemployment, to quantify the reaction of this variable to exchange rate shocks.

The remainder of the paper is organized as follows. Section 2 presents a brief review of the literature around the relationship between exchange rate movements, competitiveness and unemployment. This is followed, in Section 3, by a description of the model, data and empirical strategy. Section 4 shows the results of the econometric analysis and discusses their implications. Section 5 discusses some limitations of our approach and concludes.

2. Literature Review

Porter (1990) contradicts the prevailing thinking about competitiveness, which views labor costs, interest rates, exchange rates, and economies of scale as the most potent determinants of competitiveness. To Porter (1990), a nation's competitiveness depends on the capacity of its industry to innovate and upgrade. Countries gain advantage against the world's best competitors because of pressure and challenge. Domestic companies benefit from having strong domestic and foreign rivals, aggressive home-based suppliers, and demanding local customers. Competitive advantage is also created and sustained through a highly localized process. Differences in national values, culture, economic structures, institutions, and history all contribute to competitive success.

In general, Porter (1990) identifies four broad attributes of a nation, that individually and as a system constitute the famous “diamond of national advantage”. These attributes are the following: i) Factor conditions, such as skilled labor or infrastructure necessary to compete in a given industry; ii) the nature of home-market demand for the industry's product or service; iii) the presence or absence in the nation of supplier industries that are internationally competitive and iv) the conditions in the nation governing how companies are created, organized, and managed, as well as the nature of domestic rivalry (Porter, 1990, p. 78).

However, if historically the term competitiveness has been used mostly to draw attention to the cost position of firms or countries, as it is indicated by Aiginger, Barenthaler-Sieber and Vogel (2013), the concept of competitiveness is still often used today when an economy (or a firm or industry) is challenged by new low-cost competitors, as e.g., from China, India, Indonesia or Vietnam. It is this narrow focus on costs (“cost competition” or “price competition”) that was criticized by Krugman (1994) as “elusive and meaningless” at the conceptual level and “misleading or even dangerous” at the policy level, since this narrow perspective implies that cost reduction is the only effective policy response to ensure the competitiveness of nations.

In a more applied perspective, Delgado et al. (2012) build and estimate a model to explain foundational competitiveness across countries. The authors distinguish between the role of macroeconomic and microeconomic influences on competitiveness. Macroeconomic factors set general conditions that create opportunities for higher productivity but do not directly link to company productivity and labor mobilization. On the other hand, microeconomic determinants of competitiveness are related with specific attributes of the national business environment (e.g. whether business regulation enhances or inhibits investment and growth), the structure of economic activity (e.g. the extent of local rivalry and the extent of agglomeration spillovers from cluster development), and the use of sophisticated business management practices (Delgado et al., 2012, p. 3).

Based on a Schumpeterian perspective about economic growth, Fagerberg, Srholec and Hnell (2005) identify technology, capacity, costs and demand as the main sources of the competitiveness of nations. Working on a sample of 100 countries in the period 1993-2002, the authors argue that these four elements are relevant sources of competitiveness and consequently of economic growth. For example, the authors view technology as one of the main explanations behind the continuing good growth performance of the Asian tigers.

On the contrary, Garelli (2006) assumes that economic value is only created by enterprises. Nations can establish an environment that hinders or supports the activities of enterprises. However, a nation does not directly generate economic added value. The author concludes that competitiveness strategies succeed when they balance the economic imperatives imposed by world markets with the social requirements of a nation formed by history, values systems, and tradition (Garelli, 2006, p. 3).

As is clear from this review of the literature, there is no general consensus on competitiveness. The term encompasses several dimensions. Changes in the exchange rate, especially when carried out intentionally, emerge as an important issue under the general heading of competitiveness because of the effects that they may have on economic activity and unemployment, although effects these may be of a temporary nature.

In what concerns the analysis of the impact of exchange rate movements on economic activity, we can say that most of the existing studies predominantly focus on episodes of weakening currencies, more specifically sharp depreciations, currency wars, or currency crises.

This is understandable given that currency crises generally have powerful adverse effects on economic activity, as documented by Cerra and Saxena (2008), Bussière, Saxena and Tovar (2012) and Bussière, Lopez and Tille (2014), among others. A different perspective is presented by Kappler et al. (2012) who look at the impact of an appreciation on the current account balance and on real output. The authors find that large real exchange rate appreciations lead to a deterioration of the current account through lower savings and lower exports, the impacts being larger in emerging market and developing countries. However, they find little impact on overall GDP as domestic demand and net exports move in opposite directions.

Alexandre, Bação, Cerejeira and Portela (2011) show that both the degree of openness and the technology level mediate the impact of exchange rate movements on labor market developments. According to their estimations, whereas employment in high-technology sectors seems to be relatively immune to changes in real exchange rates, these appear to have a sizable and significant effects on highly open low-technology sectors. The analysis of job flows also suggests that the impact of exchange rate fluctuations on these sectors occurs through employment destruction.

Branson and Love (1988) also found evidence that for the United States of America, during the 1970s and 1980s, real exchange rate movements had a strong impact on manufacturing employment. The authors conclude that the appreciation of the U.S. dollar in the first half of the 80s had a strong effect on employment destruction. Evaluating the effects of

real exchange rate fluctuations on employment at the industry level for a set of seven industrialized countries, Burgess and Knetter (1998) observe that real exchange rates appreciations were associated with declines in employment in most of the countries analyzed. Namely, these authors verify that employment rates in the United States of America, Canada, and Italy are more affected by exchange rate fluctuations than in Japan, Germany and France. More recently, Klein, Schuh and Triest (2003) also confirm that real exchange rate fluctuations have significant effects on job reallocation between the various sectors of activity.

Based on different concepts of exchange rate equilibrium, and consequently identifying various exchange rate misalignments, Cassino and Oxley (2013) examine the relationship between exchange rate movements and the real economy. The authors find that there is no single answer to how exchange rate fluctuations affect the economic activity. Exchange rates respond to many different types of shocks. These shocks may be fundamental shocks which have a persistent impact on the real equilibrium exchange rate, and consequently on economic activity and employment, or non-fundamental disturbances which push the exchange rate away from its equilibrium level. Under these circumstances, exchange rate misalignments may be persistent or extremely transitory. For this reason, policymakers need to have a clear understanding of the type and nature of the exchange rate shocks when deciding on appropriate responses, for example, to maintain or increase country's competitiveness.

Eichengreen (2007) also refers to “other narratives” which give to real exchange rate further prominence. The author mentions the literature on export-led growth as a strategy to keep the prices of tradable goods high enough to make it attractive to shift resources into their production and thereby avoid adverse effects on unemployment rate.

In our paper the focus is on the impact of exchange rate fluctuations on unemployment. We present our approach to this issue in the following sections and our results in Section 4.

3. Model and Data

In order to obtain a quantitative estimate of the impact of exchange rate movements on unemployment, we will employ the VAR methodology introduced by Sims (1980). Specifically, we will estimate, separately for each of the countries included in our sample, a set of five equations, one for each of the following (endogenous) variables: the unemployment rate, the growth rate of the Gross Domestic Product (GDP), the inflation rate, the interest rate and the real effective exchange rate.

These variables were chosen because they are the main focus of attention in economic policy and in macroeconomic research; they are the main aggregate indicators of economic activity. However, conventional contemporary macroeconomic models tend to focus on the output gap rather than on GDP growth, a change of focus that reflects the difference between analysing “growth cycles” – by looking at deviations from trend or potential output – or analysing “classical cycles” – by looking at the growth rate of GDP (Mintz, 1972). Additionally, those models also tend not to explicitly analyse the behaviour of the unemployment rate. In fact, if one wishes to move beyond the sort of mechanical relation exemplified by Okun's Law, 80 years after John Maynard Keynes's General Theory, unemployment (or, more precisely, “involuntary unemployment”) still represents a challenge for macroeconomic modelling – see, e.g., the recent textbook treatments in Shimer (2010) and Galí (2011).

One important recent example of this kind of macroeconomic modelling is given in Dees, Pesaran, Smith and Smith (2014), which presents a framework for the construction of modern macroeconomic models using the global vector autoregression (GVAR) approach – see also di Mauro and Pesaran (2013), Garratt, Lee, Pesaran and Shin (2012) and Smith and Galesi (2013).

The GVAR approach, first proposed by Pesaran, Schuermann and Weiner (2004) and extended, along multiple dimensions, by Dees, di Mauro, Pesaran and Smith (2007), attempts to model in an explicit and consistent way the mechanisms that lead to the international transmission of shocks. Such modelling effort is especially important in the context of forecasting.

Dees, Pesaran, Smith and Smith (2014) present a multi-country New Keynesian (MCNK) model, which builds on a version of the traditional New Keynesian model (see, e.g., Clarida, Galí and Gertler, 1999). Thus, the basic single-country three-equation New Keynesian model (the three equations being the Phillips curve equation, an aggregate demand – IS curve – equation and the Taylor rule equation) is augmented with an equation for the real effective exchange rate. In addition, the set of individual country models is supplemented with a first-order autoregressive equation for the price of oil. As a consequence, this model includes the following variables: inflation, the output gap, the interest rate, the real effective exchange rate and the oil price. In this paper we restrict ourselves to the core macroeconomic variables (substituting GDP growth for the output gap) and thus omit the oil price from our model. On the other hand, we add the unemployment rate to our model, so that we can estimate the response of unemployment to exchange rate shocks. Since the main ingredient of Okun's Law (GDP growth, in the original formulation of the Law) is present in our model, we have reasons to believe that our model should be able to provide at least a reasonable account of unemployment fluctuations. Finally, we included a dummy variable to account for the possible effect of the international financial crisis in 2009, the year in which the spread of the crisis to other countries (besides the USA) was most visible.

According to the VAR methodology, in each equation of the model the explanatory variables (besides the constant and possibly other deterministic terms) will be lags of all the endogenous variables. The GVAR approach augments the VAR model for each country (or region) with “foreign” variables, these being either global variables (such as oil prices and “global unobserved factors”) or weighted averages (with country specific weights) of the domestic variables of the other countries included in the GVAR model. Therefore, the GVAR approach provides a much finer model of the macroeconomic linkages that exist between countries.

In this paper, we do not aim at providing such a detailed view of the international macroeconomic linkages. Rather, as mentioned above, we intend to evaluate the importance for unemployment of shocks to the exchange rate – the variable that is often viewed as the international transmitter (or signaller) of shocks par excellence, as discussed in the previous sections of this paper. Thus, we will estimate national VAR models separately for each country and focus on the impulse-response function of unemployment to shocks associated with the real effective exchange rate.

Our dataset comprises annual data for the period 1981-2014 for the five variables, across the eight countries, in our VAR model. The main descriptive statistics of our dataset are presented in Table 1. The data sources are the following:

- Unemployment: the unemployment rate is the series with WEO subject code LUR from the World Economic Outlook database of the International Monetary Fund (April 2015 edition).
- GDP growth: the growth rate of real GDP is the series with WEO subject code NGDP_RPCH from the World Economic Outlook database of the International Monetary Fund (April 2015 edition).
- Inflation: the inflation rate for all countries except Brazil was computed as the growth rate of the GDP deflator, series with WEO subject code NGDP_D taken from the World Economic Outlook database of the International Monetary Fund (April 2015 edition). For Brazil, the growth rate of the GDP deflator is the series with code NY.GDP.DEFL.KD.ZG from the World Development Indicators of the World Bank (accessed on September 9, 2015).
- Real effective exchange rate: the original data for the real effective exchange rate for all countries except Brazil is the series with code PX.REX.REER from the World Development Indicators of the World Bank (accessed on September 9, 2015). For Brazil the series comes

from OECD, “Main Economic Indicators - complete database”, Main Economic Indicators (database), <http://dx.doi.org/10.1787/data-00052-en> (accessed on September 10, 2015, via the Federal Reserve Economic Data of the St. Louis Federal Reserve Bank, series ID CCRETT01BRM661N). In the estimations we used the logarithm of the original data for all countries.

- Interest rate: the interest rate series comes from the International Monetary Fund's International Financial Statistics. From 1981 until 2012, it is the yearly average of the quarterly series with code Rshort included in the GVAR dataset (2013 Vintage). This dataset was prepared by Rodrigo Mariscal, Ambrogio Cesa Bianchi and Alessandro Rebucci at the Inter-American Development Bank, Washington DC, US, and is available for download at <https://sites.google.com/site/gvarmodelling/data> (accessed on September 9, 2015). For 2013 and 2014, the annual interest rate data was collected from Datastream.

When the identification of the shocks in a VAR model is carried out by means of the Cholesky decomposition, the ordering of the variables (more precisely, the positioning of the variances and covariances of the estimated VAR residuals in the residual variance-covariance matrix that will be decomposed) matter for the results. Different orderings will give different impulse-response functions because the identification obtained by the Cholesky decomposition imposes a recursive structure on the model: the first variable will react contemporaneously to the first shock only; the second variable will only react contemporaneously to the first and the second shocks; the last variable will react contemporaneously to all shocks. The ordering of the variables must therefore make sense from the point of view of economic theory.

Following the discussion in the literature (e.g., Christiano, Eichenbaum and Evans, 1999, 2005), we divide our variables in two groups. The first group (of “slow-moving” variables – see Bernanke, Boivin and Elias, 2005) includes unemployment, GDP growth and inflation. These are the variables that, as discussed in the literature, are expected to react with a lag to all or most other shocks. The second group (of “fast-moving” variables) includes the interest rate and the exchange rate. These variables are consistently placed last in VAR models, given that they should react very quickly to shocks, independently of their source. Nevertheless, it is not clear whether the interest rate or the exchange rate should come first in the ordering. In view of this, we applied the Cholesky decomposition to both cases. We will thus discuss the results obtained under the two orderings of these variables.

There is still the issue of the ordering of the slow-moving variables. However, our focus here is merely on the response of unemployment to exchange rate shocks. Proposition 4.1 in Christiano, Eichenbaum and Evans (1998) implies that the impulse-response function of a slow-moving variable with respect to a shock to a fast-moving variable is invariant to the ordering of the slow-moving variables. This means that, in this paper, we do not need to worry about how we order unemployment, GDP growth and inflation; it is only the ordering of the interest rate and of the exchange rate that matters, and we will experiment with the two possible orderings.

Table 1: Descriptive statistics

Australia	U AUS	g AUS	i AUS	R AUS	E AUS
mean	7.0439	3.1993	4.0908	7.6927	4.4391
st.deviation	1.8370	1.6184	3.0665	4.1195	0.14083
maximum	10.858	6.3460	12.081	16.750	4.6994
minimum	4.2420	-1.1130	-0.29984	2.5000	4.2021
Brazil	U BRA	g BRA	i BRA	R BRA	E BRA
mean	6.8054	2.5748	342.42	1051.7	4.3637
st.deviation	2.4875	3.0947	692.45	2971.8	0.19971
maximum	12.317	7.9010	2700.4	15779.	4.6520
minimum	3.3500	-4.4000	4.9153	8.1800	3.9829
China	U CHN	g CHN	i CHN	R CHN	E CHN
mean	3.2276	9.8576	5.3602	5.3643	4.6783
st.deviation	0.85082	2.7482	5.0295	3.0348	0.31808
maximum	4.3000	15.200	20.203	11.340	5.4782
minimum	1.8000	3.8000	-2.1296	1.9800	4.2432
Germany	U DEU	g DEU	i DEU	R DEU	E DEU
mean	7.7244	1.6974	2.2261	4.1727	4.6425
st.deviation	1.5648	2.0761	2.5986	2.8320	0.049378
maximum	11.000	5.7230	14.626	11.262	4.7744
minimum	4.8310	-5.5800	-0.68694	0.050000	4.5608
Japan	U JPN	g JPN	i JPN	R JPN	E JPN
mean	3.5689	2.0187	0.049734	2.3577	4.5917
st.deviation	1.0712	2.5074	1.4662	2.8282	0.16356
maximum	5.3580	7.1470	3.1969	7.5253	4.8866
minimum	2.0920	-5.5270	-2.1646	0.00085083	4.2535
Switzerland	U CHE	g CHE	i CHE	R CHE	E CHE
mean	2.5264	1.7646	1.7863	2.3250	4.5399
st.deviation	1.4697	1.6623	1.8848	2.3927	0.065745
maximum	5.1990	4.3760	7.4712	8.3275	4.6988
minimum	0.19000	-2.1140	-0.32736	-2.0000	4.4200
UK	U UK	g UK	i UK	R UK	E UK
mean	7.8360	2.2664	3.7398	6.3563	4.6727
st.deviation	2.2109	1.9523	2.4297	4.0251	0.088606
maximum	11.750	5.9340	11.636	14.093	4.8341
minimum	4.7500	-4.3110	1.0913	0.30000	4.5079
USA	U USA	g USA	i USA	R USA	E USA
mean	6.4331	2.7419	2.6701	4.5116	4.7086
st.deviation	1.6403	1.9356	1.5840	3.3924	0.11165
maximum	9.7080	7.2590	9.3359	14.078	5.0038
minimum	3.9670	-2.7760	0.75973	0.040000	4.5550

Notes: U: unemployment rate; g: GDP growth rate; i: GDP-deflator inflation rate; R: interest rate; E: real effective exchange rate.

4. Results and Discussion

One of the first things to decide when building a VAR model is the order of the model, that is to say, the number of lags to include in the model. Given the length of our sample (34 years), the number of variables (five) and the fact that the data are annual and therefore long lags are not expected to be necessary, we set two as the maximum number of lags to be tried. To select the number of lags we used the Schwartz (1978) Bayesian information criterion, as implemented in the econometrics software Gretl, version 1.9.90, which we employed to perform all the computations reported here. For all countries, the criterion selected one lag. The results of the estimations are in Tables 2-9.

In general, the results show a good fit of the model: high R-squared (usually above 80%), significant F-statistic and Durbin-Watson statistic close to 2. There are, nevertheless, some deviations. In fact, the model seems to perform noticeably worse for Brazil than for the other countries, in terms of the coefficient of determination and of the significance of the explanatory variables. Nevertheless, even in the case of Brazil, the errors do not appear to be autocorrelated. It also appears to be the case that the equation for GDP growth appears to fit less well than the other equations: either annual GDP growth is harder to forecast with a VAR model than the other variables, or our model misses something of relevance for the modelling of GDP growth. We do not pursue the issue here, but research building upon this paper should look into that question.

The performance of the model for Brazil should be related to the fact that the sample covers a very heterogeneous period in the economic history of Brazil. Namely until 1994 inflation and interest rates were above 100%, while in recent years these indicators have presented one-digit values. Figure 1 illustrates the difference between the behavior before and since 1995: the second period simply appears to be absent from the plot.

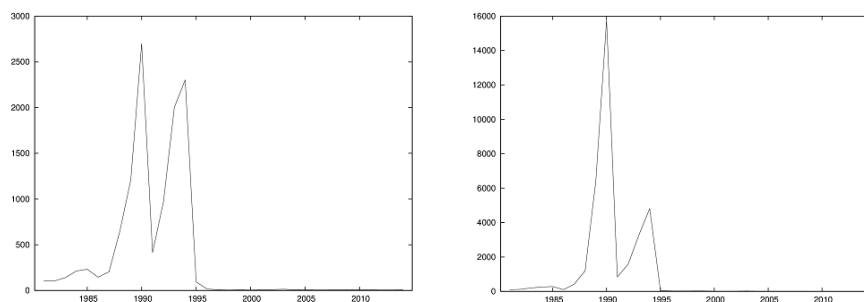


Figure 1: GDP-deflator inflation (left) and the short-term interest rate (right) in Brazil.

Let us now turn to the main topic of our paper: the response of unemployment to exchange rate shocks. Figures 2-9 show, for each of the eight countries included in our sample, the impulse-response functions of unemployment when there is a one standard-deviation impulse in the exchange rate equation, together with the 90% confidence intervals computed by bootstrap. The first thing to notice is that, except for Brazil, the shape of the impulse-response function is similar regardless of whether the ordering is (slow-moving variables, exchange rate, interest rate), or (slow-moving variables, interest rate, exchange rate). Nevertheless, in the case of Brazil, the impulse-response function under either of the orderings is never significantly different from zero.

Notice also that, when analyzing the impulse-response functions, one must bear in mind that an increase in the value of the real effective exchange rate series that we are using means that exports become more expensive relative to imports, that is, that domestic producers become less competitive.

Therefore, one would expect to see an increase in domestic unemployment following an adverse shock to the exchange rate. That is indeed the pattern we find for Australia, Switzerland and the United Kingdom. The maximum impact arrives earlier in the UK (two periods after the shock) than in Australia and in Switzerland (three or four periods after the shock). Interestingly, the largest magnitude of the impact appears to be similar across the three countries: the unemployment rate increases by at most 0.10 to 0.15 percentage points. Nevertheless, it must be noted that, given that the standard deviation of the Australian exchange rate is roughly twice the standard deviation of the Swiss and of the UK exchange rates (see Table 1), it appears that Australian unemployment is less responsive to a 1% change in the exchange rate than the Swiss and the UK unemployment rates.

The impulse-response functions for Japan also show an increase in unemployment following an increase in the exchange rate. However, in this case the effect on unemployment is very small and not statistically significant.

In the other three countries (China, Germany and the USA), the impulse-response function does not display the expected positive sign. In the case of the USA, the impulse-response function is close to the horizontal axis and is never significantly different from zero. In the case of Germany, the impulse-response function is never significant, but the estimated magnitude is close to that reported above for Australia, Switzerland and the UK, although with the opposite sign. In the case of China, the impulse-response function also attains that same order of magnitude, with the “wrong” sign, and it is significantly different from zero. One possible explanation is that our model is inadequate for China and Germany. Perhaps even more than Brazil, China has seen many important changes happen during the period covered by our sample. That our simple model may fail to capture the complexity of the structural change that has taken place in China – see, e.g., Zhu (2012) – is therefore not surprising. Germany has also been through the process of reunification, which may help explain the estimates reported here.

Our results suggest that exchange rate fluctuations appear to be a matter of concern for workers in some countries but not for all. Depending on the trade-offs involved in welfare maximization in each country, benign neglect of shocks to the exchange rate may not be the optimal policy. Therefore, it will be interesting for policymakers concerned with the detrimental effect of exchange rate movements on domestic unemployment to know how other countries manage to insulate unemployment from exchange rate shocks. It is possible that the different responses derive from different degrees of openness, in which case nothing of practical relevance will be learned. But it is also possible, for instance, that it is the reaction of policy instruments that is giving rise to the observed differences. In this case, a detailed analysis of the behavior of the more successful policymakers may be helpful for other countries. Nevertheless, we venture to suggest that relatively small countries with their own currencies, such as Australia, Switzerland and the UK, are more susceptible to the destabilizing effects of exchange rate fluctuations.

Table 2: Estimates of the VAR model for Australia

	U_AUS	g_AUS	i_AUS	R_AUS	E_AUS
constant	-3.47631 (4.69373)	4.88372 (9.56888)	11.3492 (12.7522)	-12.9198 (10.1177)	1.34001*** (0.401782)
U_AUS_1	0.798366*** (0.0810494)	0.513933*** (0.165232)	-0.204604 (0.220199)	0.338562* (0.174708)	-0.0123879* (0.0069378)
g_AUS_1	-0.27221*** (0.0767866)	0.219469 (0.156541)	0.297048 (0.208618)	0.773867*** (0.165519)	-0.00984364 (0.0065729)
i_AUS_1	-0.0967327 (0.0633838)	0.182374 (0.129218)	0.750782*** (0.172204)	0.432288*** (0.136628)	0.0123218** (0.0054256)
R_AUS_1	0.167897*** (0.0468907)	-0.250402** (0.0955939)	0.0222883 (0.127395)	0.609832*** (0.101076)	-0.008782** (0.0040138)
E_AUS_1	1.09273 (1.00337)	-1.09015 (2.04552)	-2.27976 (2.72601)	2.05121 (2.16283)	0.729186*** (0.0858882)
d09	0.968664 (0.727768)	-0.663604 (1.48367)	-5.58796*** (1.97724)	-3.33183** (1.56875)	-0.0902687 (0.0622968)
R-squared	0.889867	0.412924	0.673237	0.896073	0.858531
F	35.01297***	3.047880**	8.928070***	37.36258***	26.29772***
D-W	1.652987	1.651031	1.811955	2.428896	1.453495

Notes: The VAR model is estimated by applying ordinary least squares to each equation. The dataset is annual and covers the period 1981-2014. *U* is the unemployment rate; *g* is the GDP growth rate; *i* is the inflation rate (computed from the GDP deflator); *R* is the interest rate; *E* is the real effective exchange rate; *d09* is a dummy variable which equals 1 in the year 2009 and is zero otherwise. *R-squared* is the usual coefficient of determination. *F* is the F-statistic for the test of the null hypothesis that all the lags and the dummy variable in the corresponding equation have null coefficients. *D-W* is the Durbin-Watson statistic. The values in parentheses are the standard deviations associated to the estimate of each coefficient. *: the coefficient (or the F statistic) is significant at the 10% significance level. **: the coefficient (or the F statistic) is significant at the 5% significance level. ***: the coefficient (or the F statistic) is significant at the 1% significance level.

Table 3: Estimates of the VAR model for Brazil

	U_BRA	g_BRA	i_BRA	R_BRA	E_BRA
constant	2.58574 (6.02246)	10.9125 (13.2738)	4349.90 (2891.63)	19510.1 (14029.9)	1.02893 (0.674697)
U_BRA_1	0.864297*** (0.108958)	0.320713 (0.240149)	-99.6130* (52.3154)	-465.146* (253.828)	-0.00278437 (0.0122066)
g_BRA_1	-0.0156321 (0.0783720)	0.120279 (0.172735)	-32.3553 (37.6296)	-32.1881 (182.575)	0.00506785 (0.0087800)
i_BRA_1	-0.00065387 (0.0006622)	0.00224983 (0.0014596)	0.721484** (0.317965)	0.454099 (1.54273)	5.48154e-05 (7.4190e-05)
R_BRA_1	0.000143199 (0.0001546)	-0.00047419 (0.0003407)	-0.0851936 (0.0742204)	0.186061 (0.360109)	-8.1121e-06 (1.7318e-05)
E_BRA_1	-0.378323 (1.27892)	-2.48388 (2.81881)	-778.783 (614.064)	-3559.64 (2979.37)	0.762249*** (0.143278)
d09	0.444137 (1.29059)	-3.17919 (2.84452)	86.5872 (619.666)	259.587 (3006.55)	0.0309381 (0.144585)
R-squared	0.805592	0.280971	0.424456	0.264621	0.614484
F	17.95658***	1.693311	3.195781**	1.559318	6.906999***
D-W	1.609714	1.899984	2.068555	2.066080	1.646964

Notes: See Table 2.

Table 4: Estimates of the VAR model for China

	U_CHN	g_CHN	i_CHN	R_CHN	E_CHN
constant	4.20091*** (0.759809)	2.32782 (9.80703)	6.45226 (13.7298)	-1.92137 (3.45170)	0.328856 (0.417279)
U_CHN_1	0.700642*** (0.0723560)	0.139858 (0.933916)	-1.23775 (1.30748)	-0.790064** (0.328702)	0.0565706 (0.0397371)
g_CHN_1	-0.0142159 (0.0161142)	0.631358*** (0.207990)	0.582347* (0.291185)	0.0855433 (0.0732045)	0.0126799 (0.0088498)
i_CHN_1	0.0281199** (0.0122949)	-0.149353 (0.158693)	0.537032** (0.222169)	0.187039*** (0.0558539)	-0.00846083 (0.0067522)
R_CHN_1	-0.08669*** (0.0256081)	0.133093 (0.330529)	-0.119223 (0.462739)	0.549592*** (0.116334)	0.0118839 (0.0140637)
E_CHN_1	-0.59419*** (0.118402)	0.224424 (1.52825)	-1.06324 (2.13954)	1.06945* (0.537885)	0.855334*** (0.0650253)
d09	0.102342 (0.199984)	-0.0889181 (2.58123)	-4.84662 (3.61371)	-1.75981* (0.908495)	0.0317719 (0.109829)
R-squared	0.960883	0.323553	0.635409	0.937444	0.896304
F	106.4456***	2.072692*	7.552132***	64.93740***	37.45539***
D-W	1.704632	1.411358	1.432340	1.371868	1.883561

Notes: See Table 2.

Table 5: Estimates of the VAR model for Germany

	U_DEU	g_DEU	i_DEU	R_DEU	E_DEU
constant	4.00142 (11.6936)	-24.0737 (31.8136)	14.9817 (38.2947)	1.40698 (17.0927)	1.48400** (0.551670)
U_DEU_1	0.973030*** (0.0911446)	0.0459165 (0.247967)	-0.528302* (0.298483)	0.148770 (0.133227)	0.00426926 (0.0042999)
g_DEU_1	-0.17943*** (0.0542554)	0.220323 (0.147607)	0.320894* (0.177677)	0.312160*** (0.0793056)	-2.4910e-05 (0.0025596)
i_DEU_1	0.0665327 (0.0587778)	-0.0580804 (0.159910)	0.00773908 (0.192487)	0.0678610 (0.0859161)	0.00390730 (0.002773)
R_DEU_1	0.151052** (0.0544682)	-0.0861885 (0.148186)	0.410866** (0.178374)	0.763856*** (0.0796166)	0.00414490 (0.0025696)
E_DEU_1	-0.923137 (2.58892)	5.55825 (7.04340)	-2.37218 (8.47829)	-0.537668 (3.78425)	0.667154*** (0.122137)
d09	0.250438 (0.639673)	-7.45508*** (1.74029)	-0.164320 (2.09482)	-2.61633*** (0.935015)	0.0183564 (0.0301778)
R-squared	0.860463	0.466209	0.505777	0.898918	0.721197
F	26.72169***	3.784707***	4.434639***	38.53604***	11.20931***
D-W	1.179567	1.337826	2.106617	1.484428	1.639763

Notes: See Table 2.

Table 6: Estimates of the VAR model for Japan

	U_JPN	g_JPN	i_JPN	R_JPN	E_JPN
constant	-0.567088 (1.85056)	-12.2254 (13.9450)	7.66537 (4.69928)	2.36226 (5.73211)	0.422217 (0.622109)
U_JPN_1	0.877709*** (0.109852)	0.427116 (0.827795)	-0.642838** (0.278956)	0.178914 (0.340266)	-0.0244295 (0.0369292)
g_JPN_1	-0.057821** (0.0258517)	0.00861968 (0.194807)	0.200284*** (0.0656474)	0.207058** (0.0800757)	-0.019051** (0.0086907)
i_JPN_1	0.111885 (0.0964151)	-0.622648 (0.726542)	0.267560 (0.244835)	0.351545 (0.298646)	-0.0563217* (0.0324122)
R_JPN_1	-0.0370430 (0.0503837)	0.856602** (0.379670)	-0.0782469 (0.127943)	0.686609*** (0.156063)	0.0387240** (0.0169376)
E_JPN_1	0.266130 (0.349383)	2.33898 (2.63280)	-1.23020 (0.887217)	-0.630530 (1.08221)	0.914705*** (0.117453)
d09	1.03689*** (0.292327)	-6.64271*** (2.20285)	0.483523 (0.742331)	0.195554 (0.905484)	0.0669874 (0.0982726)
R-squared	0.951073	0.507326	0.813311	0.928938	0.758620
F	84.23346***	4.462201***	18.87821***	56.64633***	13.61897***
D-W	1.199783	1.618049	1.665323	1.521698	1.544231

Notes: See Table 2.

Table 7: Estimates of the VAR model for Switzerland

	U_CHE	g_CHE	i_CHE	R_CHE	E_CHE
constant	-9.11616 (7.86873)	31.5313 (23.8438)	24.7275 (18.1247)	2.60836 (21.8153)	1.15491 (0.731661)
U_CHE_1	0.779070*** (0.0839483)	0.0595139 (0.254380)	-0.383234* (0.193365)	-0.169237 (0.232738)	0.00260674 (0.0078058)
g_CHE_1	-0.22648*** (0.0538023)	0.264633 (0.163031)	0.195121 (0.123927)	0.191435 (0.149162)	-0.00125601 (0.0050027)
i_CHE_1	-0.0958641 (0.0799734)	-0.123811 (0.242335)	0.321598* (0.184210)	0.111524 (0.221718)	-0.00198634 (0.0074362)
R_CHE_1	0.164948*** (0.0431306)	-0.290592** (0.130694)	0.0867916 (0.0993466)	0.779352*** (0.119575)	0.00226725 (0.0040104)
E_CHE_1	2.17915 (1.71519)	-6.45806 (5.19738)	-5.11438 (3.95076)	-0.502756 (4.75521)	0.745412*** (0.159484)
d09	1.40271*** (0.466304)	-4.58121*** (1.41299)	-1.27440 (1.07408)	-1.68043 (1.29278)	0.0272788 (0.0433585)
R-squared	0.918099	0.458253	0.720473	0.780782	0.636316
F	48.57584***	3.665480***	11.16905***	15.43387***	7.581768***
D-W	1.202881	1.510987	2.131735	1.594610	1.561689

Notes: See Table 2.

Table 8: Estimates of the VAR model for the United Kingdom

	U_UK	g_UK	i_UK	R_UK	E_UK
constant	-17.8709** (6.62778)	-14.3500 (18.3984)	27.5398* (15.5310)	25.9974 (16.2637)	2.74209*** (0.592565)
U_UK_1	0.986913*** (0.0626054)	0.386749** (0.173790)	-0.140820 (0.146704)	-0.120282 (0.153626)	-0.02051*** (0.0055973)
g_UK_1	-0.238*** (0.0489790)	0.273669* (0.135963)	0.185336 (0.114773)	0.450557*** (0.120188)	0.00679424 (0.0043790)
i_UK_1	0.0110205 (0.0690143)	-0.240195 (0.191580)	0.646838*** (0.161722)	0.351543** (0.169352)	0.0138514** (0.0061703)
R_UK_1	0.0707192 (0.0424516)	0.00731675 (0.117844)	0.0795558 (0.0994775)	0.722407*** (0.104171)	-0.006719* (0.0037954)
E_UK_1	3.82342*** (1.35791)	3.01388 (3.76950)	-5.63342* (3.18201)	-5.54232 (3.33214)	0.443088*** (0.121406)
d09	1.45343*** (0.507171)	-5.59293*** (1.40788)	-0.403852 (1.18846)	-2.69834** (1.24453)	-0.14677*** (0.0453442)
R-squared	0.962621	0.607177	0.751782	0.927364	0.809648
F	111.5957***	6.697934***	13.12440***	55.32468***	18.43150***
D-W	1.635690	1.613292	1.989232	2.488248	2.027909

Notes: See Table 2.

Table 9: Estimates of the VAR model for the United States of America

	U_USA	g_USA	i_USA	R_USA	E_USA
constant	2.21956 (4.90400)	-16.6832 (13.1411)	0.822677 (4.55068)	5.74802 (10.6733)	1.09693** (0.469002)
U_USA_1	0.695905*** (0.0649938)	0.386816** (0.174161)	0.00416664 (0.0603111)	0.117805 (0.141455)	0.00338670 (0.0062158)
g_USA_1	-0.23279*** (0.0597937)	0.148987 (0.160227)	0.115374** (0.0554857)	0.322432** (0.130137)	0.00654820 (0.0057185)
i_USA_1	0.205662* (0.117368)	-0.88701*** (0.314506)	0.648224*** (0.108912)	-0.0125731 (0.255444)	0.0101368 (0.0112247)
R_USA_1	0.0373572 (0.0621946)	0.246820 (0.166660)	-0.0405713 (0.0577135)	0.790736*** (0.135363)	0.00427095 (0.0059481)
E_USA_1	-0.102899 (1.07268)	3.80252 (2.87441)	-0.0495938 (0.995392)	-1.44179 (2.33461)	0.747399*** (0.102587)
d09	2.97472*** (0.579736)	-4.40749*** (1.55350)	-1.03734* (0.537967)	-0.673830 (1.26176)	0.0655217 (0.0554440)
R-squared	0.914203	0.564651	0.825700	0.875660	0.832602
F	46.17368***	5.620361***	20.52805***	30.51729***	21.55314***
D-W	1.654749	1.702055	1.097997	1.640789	1.054236

Notes: See Table 2.

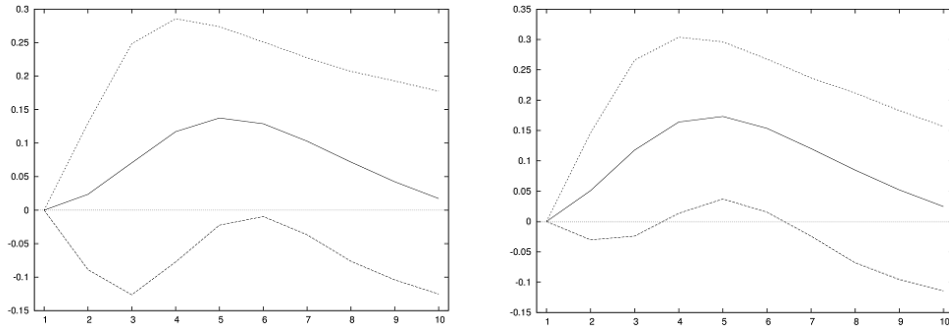


Figure 2: Impulse-response function of unemployment to the exchange-rate shock in Australia when the interest rate is ordered last (left) and when the exchange rate is ordered last (right).

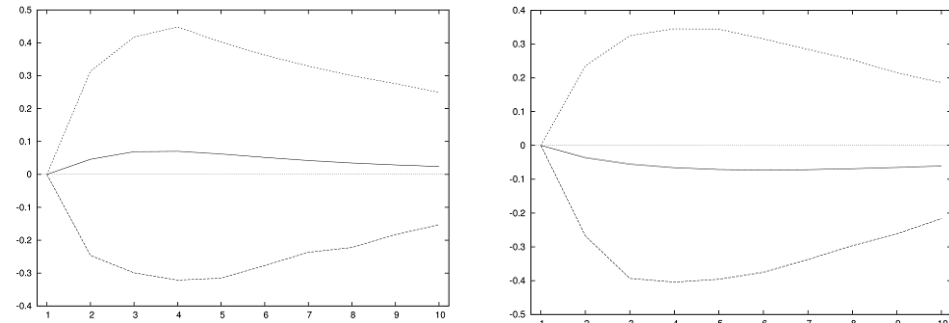


Figure 3: Impulse-response function of unemployment to the exchange-rate shock in Brazil when the interest rate is ordered last (left) and when the exchange rate is ordered last (right).

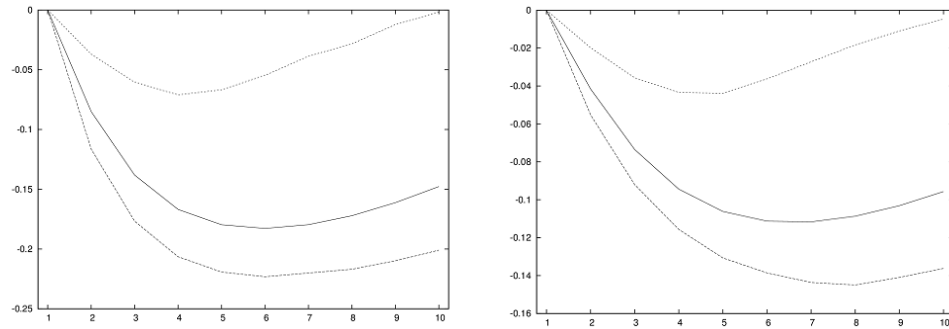


Figure 4: Impulse-response function of unemployment to the exchange-rate shock in China when the interest rate is ordered last (left) and when the exchange rate is ordered last (right).

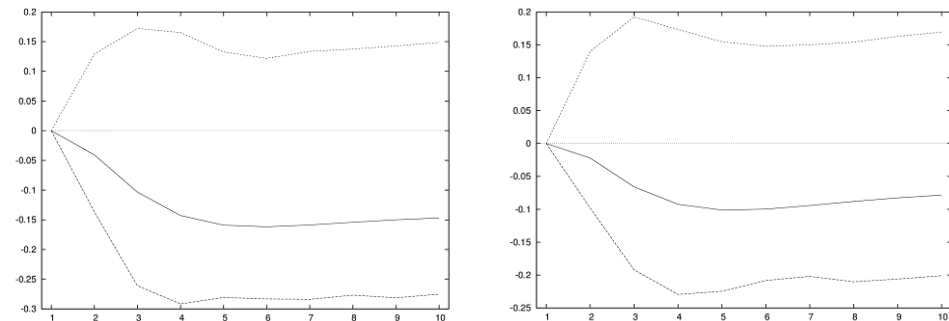


Figure 5: Impulse-response function of unemployment to the exchange-rate shock in Germany when the interest rate is ordered last (left) and when the exchange rate is ordered last (right).

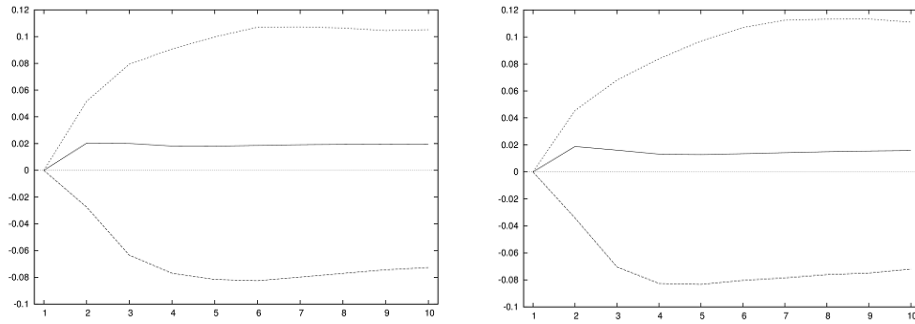


Figure 6: Impulse-response function of unemployment to the exchange-rate shock in Japan when the interest rate is ordered last (left) and when the exchange rate is ordered last (right).

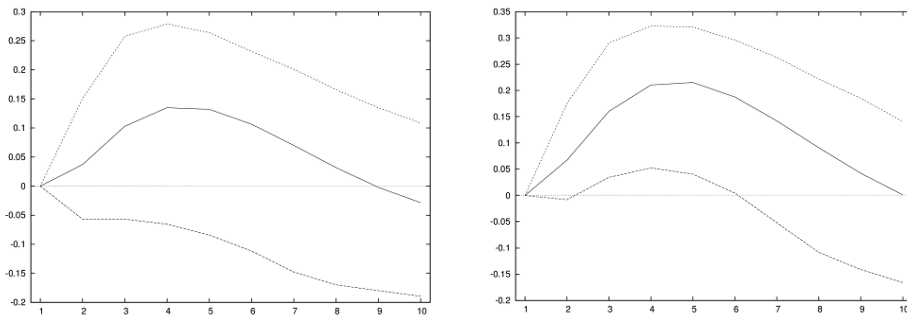


Figure 7: Impulse-response function of unemployment to the exchange-rate shock in Switzerland when the interest rate is ordered last (left) and when the exchange rate is ordered last (right).

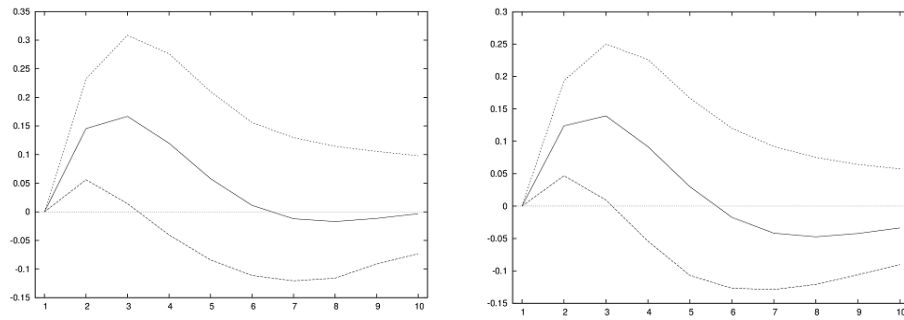


Figure 8: Impulse-response function of unemployment to the exchange-rate shock in the United Kingdom when the interest rate is ordered last (left) and when the exchange rate is ordered last (right).

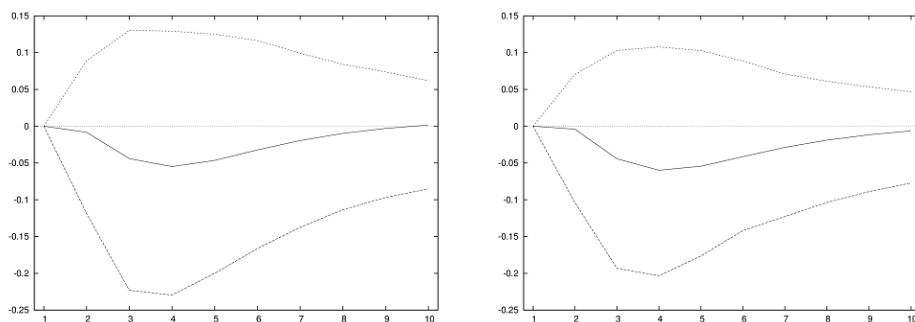


Figure 9: Impulse-response function of unemployment to the exchange-rate shock in the United States of America when the interest rate is ordered last (left) and when the exchange rate is ordered last (right).

5. Conclusion

The estimates presented in this paper show considerable differences across countries in the response of unemployment to exchange rate shocks. Relatively small countries, such as Australia, Switzerland and the UK, appear to experience an increase of about 0.10-0.15 percentage points when the exchange rate appreciates by 0.06-0.14 percentage points, that is to say that the elasticity is not very far from unity. Other countries, most clearly Japan and the USA, do not appear significantly affected, in terms of unemployment, by exchange rate movements. Our results suggest that further research into the possible explanations of these differences may be useful for policymakers.

Our results also suggest other lines of research. First, our VAR model does not appear to fit the Brazilian data well, while the results for China and Germany appear counter-intuitive. Since these countries experienced major structural changes in the period covered by our sample, it is possible that our model needs to be supplemented with elements related to those structural changes in order to produce better results. One first step in this direction would be to test for structural breaks in the model, but the reduced size of our sample relatively to the number of variables limits the usefulness of those tests. A dataset with quarterly data, if available could be helpful. Unfortunately, the GVAR database is not complete for the countries used in our study. Second, we opted to use GDP growth rather than the output gap. The robustness of the results to this option should be investigated. Finally, some plots suggested that the impulses may have permanent effects in some countries, or, in other words, that there are unit roots in some variables. A more detailed study of this issue could lead to the imposition of restrictions suggested by the results of unit root tests.

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