The Shock-Absorbing Capacity of the Flexible Exchange Rate in Poland

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In recent years, numerous studies have analyzed the sources of exchange rate fluctuations in the context of the shock-absorbing capacity of flexible exchange rates. This paper analyzes, within a Structural Vector Autoregressive (SVAR) framework, the role of the flexible exchange rate in Poland over the past decade. Our contribution to the existing literature is twofold: First, we expand the prevailing SVAR models to include a financial market shock, defined as a stochastic change in a country's risk premium. This appears to be highly relevant in the face of the ongoing global financial crisis. Second, we analyze to what extent the crisis has affected the stabilizing capacity of the złoty/euro exchange rate. We find that the exchange rate has been a shock-absorbing rather than a shock-propagating instrument. We also demonstrate that – in line with our expectations – the contribution of financial market disturbances to exchange rate volatility has increased during the current global crisis.

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1 Introduction

Since the highly influential paper of Meese and Rogoff (1983), who pointed out that the behavior of nominal exchange rates (NERs) can be described by a simple random walk, a lot of ink has been spilled over the sources of NER fluctuations in the context of the exchange rate regime choice. The empirically observed large NER volatility under floating led many to perceive the flexible NER as a source of shocks (Buiter, 2000; Buiter and Grafe, 2002; Mundell, 2003). In contrast, analyses drawing on the theory of optimum currency areas, which was initiated by the works of Mundell (1961) and McKinnon (1963), are based on the notion that the (irrevocable) fixing of the NER represents a cost to the economy in terms of macroeconomic stability because, due to nominal rigidities, the real exchange rate (RER) reacts to asymmetric shocks more slowly than under floating.

The consensus view seems to be that the flexible NER can act as a shock-absorbing instrument in the case of some shock types and as a shock-propagating instrument in the case of other shock types. Specifically, the NER is thought of as a stabilizing instrument if its fluctuations are mainly driven by real, especially demand, shocks and as a destabilizing one if they are largely driven by nominal disturbances (see section 2). Using this implicit assumption, many authors have studied the sources of NER and RER fluctuations within the Structural Vector Autoregressive (SVAR) model with long-run identifying restrictions à la Blanchard and Quah (1989). The first such paper was by Lastrapes (1992); other authors, most notably Clarida and Galí (1994), have modified his model to include additional variables and shock types. The results of this strain of literature are briefly reviewed in section 2.

This paper contributes to the empirical literature analyzing the sources of NER and RER fluctuations. The focus is on Poland roughly over the recent decade. As a (relatively) new Member State of the European Union (EU), Poland is obliged

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to adopt the euro as soon as it has met the nominal convergence criteria stipulated in the Treaty of Maastricht. At the moment of writing, the exchange rate of the Polish złoty is freely floating, as has been the case since 2000, with no central bank intervention in the foreign exchange market. The question arises, then, to what extent one should expect increased macroeconomic instability in Poland after the future euro adoption. In other words, to what extent can the flexible NER currently be regarded as a stabilizing instrument whose loss should be booked on the cost side when analyzing the costs and benefits of the euro adoption? It is important to note that by "increased macroeconomic instability" we understand increased volatility of real output (or another measure of activity), and not of prices or other nominal variables.

In line with the above-mentioned view, we assume that the floating[2] NER can be regarded as stabilizing if its stochastic changes are largely driven by asymmetric real demand shocks, and as destabilizing if it fluctuates mainly in response to asymmetric nominal disturbances. Theoretical arguments supporting this view will be discussed in section 2 below. The goal of our empirical analysis is to determine, first, to what extent the złoty/euro NER has acted as a shock absorber over the past decade or so and, second, whether the ongoing global financial crisis has affected its stabilizing capacity. We seek to answer these questions based on SVAR analysis, using the long-run identifying scheme originally proposed by Blanchard and Quah (1989).

Our contribution to the existing literature is twofold: First, we expand the prevailing SVAR models to include a financial market shock, defined as a stochastic change in the risk premium of a country. This appears highly relevant in the face of the current global financial crisis, as one of its pronounced effects has been increased risk aversion and the associated rise in risk premiums in the international financial markets, which led to significant depreciation of many currencies. Second, we analyze to what extent the global crisis has affected the shock-absorbing or shock-propagating role of the floating exchange rate in Poland.

The remainder of this paper is organized as follows: The next section briefly reviews the relevant theoretical arguments and empirical studies, focusing on the shock-absorbing capacity of flexible exchange rates. Section 3 presents the empirical methodology, and section 4 describes the data that we use. Section 5 discusses the empirical results, and section 6 concludes.

2 The Shock-Absorbing Capacity of Flexible Exchange Rates: Literature Review

One of the key arguments of early proponents of flexible exchange rates – such as Friedman (1953) – was that under floating, economies can adjust to asymmetric shocks better than when the NER is pegged. As already mentioned, this argument rests on the assumption of nominal rigidities, most notably downward rigidity of prices and nominal wages. Given this assumption, when an adverse shock occurs such that a decline of an economy's terms of trade becomes necessary to restore equilibrium, under a fixed exchange rate regime the adjustment process is more lengthy and costly in terms of welfare (because it is associated with persisting

[2] *Throughout this paper, we will use the terms "flexible" and "floating" interchangeably, and the same applies to the terms "fixed" and "pegged."*

negative output gap and increased unemployment). When the NER is allowed to float, in contrast, the terms of trade may fall via NER depreciation without the need for nominal prices to fall. In other words, the NER flexibility can make up for the lack of downward flexibility of prices and wages (Meade, 1951). This was also the point of departure of the optimum currency area theory: Mundell (1961) argued that any two economies only need separate currencies with a flexible NER when they are prone to asymmetric shocks.

In his seminal paper on optimum currency areas, Mundell only regarded one shock type, namely "a shift of demand from the goods of entity B to the goods of entity A" (Mundell, 1961, p. 658). In fact, the shock-absorbing capacity of the NER crucially depends on the type of shock, an economy's size (especially in the case of shocks emanating from the rest of the world), and possibly some other features of the economy that are included in the economic model at hand. With regard to shock types, obviously the flexible NER can help absorb country-specific shocks, i.e. disturbances affecting entire economies (rather than smaller units such as sectors) only in an asymmetric or idiosyncratic way relative to other economies (because a change in the bilateral NER affects a given pair of economies in an asymmetric way, so that it cannot be regarded as an adjustment tool in the case of symmetric shocks).

Country-specific shocks, in turn, can further be divided into several subtypes, such as temporary (transitory) versus permanent, nominal versus real, foreign (imported) versus domestic, purely exogenous versus policy-induced disturbances (Buti and Sapir, 1998). In our previous analyses (Stążka, 2008a, 2008b), we showed that for the question of the shock-absorbing capacity of floating exchange rates, the most relevant breakdown is that into nominal or monetary (LM; liquidity preference and money supply equilibrium) and real shocks, with the latter including real supply (AS; aggregate supply) and real demand (IS; investment and saving equilibrium) disturbances. The shock-absorbing capacity of flexible versus fixed exchange rates can be analyzed within basic models of exchange rate determination, such as the overshooting model of Dornbusch (1976). In the following discussion, we will focus on this model and the case of a small open economy, such as Poland. It is worth stressing that similar conclusions – with some caveats addressed below – can be reached based on several other models, including that of Clarida and Galí (1994), who originally proposed one of the SVAR models that we will employ in our empirical analysis.

A country-specific adverse real demand (IS) shock, by lowering the demand for goods in the given economy, in the short term also lowers the level of real output or income. This, in turn, leads to a decline in the demand for real money balances and, consequently, a decrease of the domestic interest rate. Under floating, the incipient capital outflow results in nominal and, in the short term (because of price stickiness), also real exchange rate depreciation. The weaker RER supports domestic demand and reverses – partially or fully – the initial drop in output. In contrast, in a credibly fixed exchange rate regime, such as a monetary union, the interest rate cannot deviate from the world level at any time, so the drop in demand for real money balances caused by the adverse IS shock leads to incipient liquidity outflows to the rest of the world. The failure of the NER to adjust, along with nominal price stickiness, means that equilibrium in the goods market can only be reached after a period of a negative output gap, as discussed above. Thus, a flexible NER reduces output volatility when asymmetric real demand shocks occur, acting as a shock-absorbing instrument.

In turn, an idiosyncratic adverse monetary shock, by reducing the domestic real money balances, pushes up the domestic interest rate, which depresses domestic demand and thus output. The drop in output, via a decline in the demand for real money balances, leads to a certain decrease of the rate of interest, but this effect can hardly dominate the initial interest rate increase (Dornbusch, 1976; Stążka, 2008b). Under floating exchange rates, the increase in the interest rate attracts capital inflows, leading to NER and RER appreciation; the latter effect again depresses domestic demand, driving the system further away from equilibrium. Under pegged NER, in contrast, the initial drop in the domestic real money balances cannot affect the level of the domestic interest rate. Instead, the incipient inflow of liquidity from the rest of the world ensures that the shock is immediately absorbed. In the case of asymmetric LM shocks, a flexible NER thus acts as a shock-propagating mechanism and a pegged NER insulates small open economies from such shocks.

In the case of asymmetric supply shocks, the conclusions are not clear cut – they depend on whether or not agents are characterized by exchange rate illusion[3] (see the discussion in Stążka, 2008a). Finally, our empirical analysis in section 5 will also include a fourth shock type whose identification seems important from the viewpoint of our research question, especially in the face of the current global financial crisis, namely a financial market shock. We define it as a shock that originates in the financial markets and affects the NER by changing the country risk premium. Obviously, when a given bilateral NER is credibly fixed, this type of disturbances cannot affect it; indeed, in a simple model of exchange rate determination, it has no impact on the economy as a whole. Under floating, the incidence of such shocks makes the NER a source of unnecessary volatility.

As already mentioned, there are certain caveats to think about. As stressed by some authors, especially in the strand of new open economy macroeconomics, in several instances the NER can fail to affect the terms of trade and have the expenditure-switching effects attributed to it by most models. This could result from weak passthrough of the NER into import prices, caused by factors originating at the micro- or macroeconomic level, such as monopolistic competition and pricing-to-market or local currency pricing strategies of firms (Bailliu and Bouakez, 2004), or increased credibility of domestic monetary policy (Gagnon and Ihrig, 2004). Further potential reasons for weak responsiveness of the RER to NER fluctuations include (1) significant real wage rigidity (Sachs, 1980), (2) the lack of exchange rate illusion (see the discussion in Mundell, 1961; or McKinnon, 1963), and (3) the flexibility of nominal wages and prices, as assumed by the monetary approach to the exchange rate determination.

[3] *An adverse AS shock results in an increased price level, leading to a decline of real money balances. Under floating, the domestic interest rate rises, attracting capital inflows and resulting in appreciation of both the NER and the RER. The absorption of the shock thus involves a combination of rising prices and NER appreciation. In a monetary union, the NER cannot change, so the RER appreciation necessary to bring about long-term equilibrium has to be reached via a rise in the price level. With no exchange rate illusion, agents should perceive the adjustment process as equally costly under both exchange rate arrangements. However, if in their view changes of the RER which are due to price movements have a stronger impact on welfare than the same changes to NER movements, then agents should view the flexible NER as an instrument which facilitates the absorption of asymmetric AS shocks.*

Because the (de)stabilizing role of the flexible NER largely depends on the type of shocks which hit an economy, whether or not a given NER is a shock-absorbing or shock-propagating instrument thus boils down to an empirical question. As mentioned in section 1, the first empirical analysis of the sources of NER and RER fluctuations using a SVAR analysis is due to Lastrapes (1992). His model used two variables, the NER and the RER, and two shock types, nominal and real, the former being defined as the one which has no long-run impact on the RER. The analysis, which covered six industrial countries, showed that the fluctuations of both variables are mainly driven by real shocks. This led the author to conclude that the NER and the RER react to changes in fundamentals, so the NER is helpful with regard to shock absorption.

Many authors have followed in the footsteps of Lastrapes. Enders and Lee (1997) confirmed his results for the same set of countries and a longer sample period. Several others also found that real shocks are the main driving force of NER and RER fluctuations e.g. in Greece (Apergis and Karfakis, 1996), Japan, Taiwan and South Korea (Chen and Wu, 1997), or a group of emerging economies from Latin America and East Asia (Chowdhury, 2004). Clarida and Galí (1994) expanded the model of Lastrapes to include two real shock types instead of one. Moreover, they used the price level instead of the NER and added real output as the third variable. They found that stochastic RER volatility is mainly the result of LM shocks in Germany and in Japan and of demand (AD; aggregate demand) shocks in Canada and the United Kingdom. The results for Japan were later confirmed by Chadha and Prasad (1997) and those for the U.K. by Astley and Garratt (2000).

With regard to the EU Member States that joined from 2004, the results of SVAR models with long-run identifying restrictions have not been clear cut. The earliest such study by Dibooglu and Kutan (2001), covering the time period from 1990 to 1999, used a bivariate model with the RER and the price level and showed that the main source of RER fluctuations in Hungary were real shocks and in Poland nominal shocks. Borghijs and Kuijs (2004) employed a three-dimensional model with real output, the RER and the NER, and samples starting between 1993 and 1998 and ending in 2003. They demonstrated that the RER movements in the Czech Republic and Hungary were mainly due to (nominal) LM shocks, in Slovakia mainly due to (real) IS shocks, and in Slovenia the contribution of both shock types was similar. Interestingly, in the case of Poland the analysis pointed to the dominant role of LM shocks for the full sample (1995 to 2003), but when the first three years were excluded from the sample, the contribution of real (IS and AS) disturbances rose significantly. Further, based on Lastrapes' bivariate specification, Kontolemis and Ross (2005) found that in most of these EU Member States, the RER against the euro was driven by real shocks and the NER by nominal shocks. When using the same three-dimensional specification as Borghijs and Kuijs (2004) but samples starting slightly earlier, they showed that in all countries except Estonia, the RER was mainly driven by IS shocks. Rodríguez and Torres (2007) confirmed the important role of real disturbances for the RER movements in the Czech Republic and Hungary (IS shocks) and Poland (AS shocks) between 1993 and 2004.

At first glance, it appears that earlier studies pointed to a dominant role of nominal shocks in stochastic exchange rate fluctuations, whereas more recent studies seem to suggest that RER movements in the Member States that joined from 2004 are to a large extent driven by real shocks. However, it is worth stressing that results of SVAR analyses are rather specification sensitive – the above-discussed differential results obtained for the Czech Republic and for Hungary by Borghijs and Kuijs (2004) and by Kontolemis and Ross (2005)[4] are just one example. In any case, the high specification sensitivity is a reason for cautious interpretation of any results derived with the help of SVAR models, especially when formulating policy recommendations.

3 A Structural VAR Approach to Study the Sources of Exchange Rate Fluctuations

In the following, we will present the approach which we are using to study the sources of exchange rate fluctuations in Poland. The empirical analysis whose results will be discussed in the next section is based on four differently specified structural VAR models employing the long-run identification scheme originally proposed by Blanchard and Quah (1989).

Let the vector of endogenous variables be specified as

$$X_t = \left[\Delta y_t \quad \Delta q_t \quad \Delta p_t \right]' ,$$

where y_t is the real output or income, p_t the price level, $q_t \equiv s_t + p^* - p_t$ the RER (s_t is the NER in price notation and p^* the price level abroad); Δ denotes the difference operator. All lowercase variables are in logs and are assumed to be integrated of order 1, I (1). Presume that the endogenous variables' vector X_t is driven by the following vector moving average (VMA) process:

$$X_t = \sum_{i=0}^{\infty} A_i L^i \varepsilon_t = A(L)\varepsilon_t , \qquad (1)$$

where A_i are parameter matrices, L is the lag operator, A(L) a lag polynomial, and $\varepsilon_t = \left[\varepsilon_{1\,t} \quad \varepsilon_{2\,t} \quad \varepsilon_{3\,t} \right]$ is a vector of identically normally distributed, mutually orthogonal and serially uncorrelated white noise disturbances (*structural* or *primitive* shocks)[5]:

$$E(\varepsilon_t) = 0, \quad E(\varepsilon_t \varepsilon_t') = \Sigma_\varepsilon = \mathrm{I}, \quad E(\varepsilon_s \varepsilon_t') = [0] \quad \forall s \neq t . \qquad (2)$$

It is thus assumed that the endogenous variables are driven by past and present realizations of the structural shocks. To recover these shocks from the data, one has to estimate and invert the following VAR representation of the process:

$$X_t = \sum_{i=1}^{p} B_i L^i X_t + e_t = B(L)\, X_t + e_t , \qquad (3)$$

[4] *The differential results of Borghijs and Kuijs (2004) and Kontolemis and Ross (2005) may be due to the choice of time series. In both studies, the price and output variables are specified in relative terms against the euro area as a reference economy. The key difference (apart from slightly different time periods covered) is that the former study uses aggregated data for the euro area whereas the latter uses trade-weighted averages of data for the individual Member States.*

[5] *The assumption that each of the disturbances has a unit variance is a convenient normalization. Equation 1 can also include exogenous components, such as a constant, a deterministic time trend, seasonal or other dummies as well as other strictly exogenous variables, but they are suppressed here for brevity.*

$$X_t = \left(\mathrm{I} - B(L)\right)^{-1} e_t = \left(\mathrm{I} + B(L) + B(L)^2 + ...\right) e_t = \sum_{i=0}^{\infty} C_i L^i e_t = C(L)\ e_t\ , \tag{4}$$

where B_i, C_k are parameter matrices, *B(L)*, *C(L)* are invertible lag polynomials, and $e_t = \left[e_{1t}\ \ e_{2t}\ \ e_{3t}\right]'$ is a vector of normally distributed, serially uncorrelated disturbances that can be correlated with each other:

$$E(e_t) = 0, \quad E\left(e_t e_t^{'}\right) = \Sigma_e, \quad E\left(e_s e_t^{'}\right) = [0] \quad \forall s \neq t. \tag{5}$$

Comparing equations 1 and 4 above reveals that

$$e_t = A_0 \varepsilon_t\ , \tag{6}$$

and therefore

$$\Sigma_e = A_0 \Sigma_\varepsilon A_0^{-1} = A_0 A_0^{-1}. \tag{7}$$

In order to recover the past structural shocks, ε_t , based on VAR residuals, $\hat{e}_t$, one needs to impose three identifying restrictions on the estimated VAR system. We presume that the three structural shock types are real aggregate supply (AS), real aggregate demand (IS) and nominal or monetary (LM) disturbances, denoted respectively $\varepsilon_t^{AS} \equiv \varepsilon_{1t}$, $\varepsilon_t^{IS} \equiv \varepsilon_{2t}$ and $\varepsilon_t^{LM} \equiv \varepsilon_{3t}$. We further assume that the shocks can be identified through their long-term impact on the system variables: IS shocks do not affect the real income level in the long run, whereas LM shocks have no long-run impact on either the real income or the RER, i.e.

$$\sum_{i=0}^{\infty} \frac{\partial(\Delta y_t)}{\partial\left(L^i \varepsilon_t^{IS}\right)} = 0 \quad \text{and} \quad \sum_{i=0}^{\infty} \frac{\partial(\Delta y_t)}{\partial\left(L^i \varepsilon_t^{LM}\right)} = 0 \quad \text{and} \quad \sum_{i=0}^{\infty} \frac{\partial(\Delta q_t)}{\partial\left(L^i \varepsilon_t^{LM}\right)} = 0\ . \tag{8}$$

These restrictions are general enough to incorporate a number of economic models of exchange rate determination, including the model of Dornbusch (1976) (see the analysis in Stążka, 2008a, 2008 b).

The above-described SVAR specification is the one proposed by Clarida and Galí (1994). Apart from that, in the empirical analysis we will also estimate three other specifications. A first modification of the baseline model involves replacing one endogenous variable, the price level, with another one, the NER. This has the obvious advantage of making possible the analysis of the stochastic behavior of the NER, in particular of the sources of its variability. A second modification consists in expanding the three-dimensional models to include a financial market shock (see section 2) and, consequently, an additional endogenous variable – one which is affected by financial market (FM) shocks (as well as the other shock types) in the long run, e.g. a financial market index. With four endogenous variables, one needs a set of six identifying restrictions, three of which are the same as in the three-variable case. The remaining three are given by our assumption that FM shocks have no permanent impact on any of the variables y_t, q_t, p_t or s_t:

$$\sum_{i=0}^{\infty} \frac{\partial(\Delta y_t)}{\partial\left(L^i \varepsilon_t^{FM}\right)} = 0 \quad \text{and} \quad \sum_{i=0}^{\infty} \frac{\partial(\Delta q_t)}{\partial\left(L^i \varepsilon_t^{FM}\right)} = 0 \quad \text{and} \quad \left(\sum_{i=0}^{\infty} \frac{\partial(\Delta p_t)}{\partial\left(L^i \varepsilon_t^{FM}\right)} = 0 \quad \text{or} \quad \sum_{i=0}^{\infty} \frac{\partial(\Delta s_t)}{\partial\left(L^i \varepsilon_t^{FM}\right)} = 0\right) \tag{9}$$

where the two restrictions in brackets are used depending on which variable, the price level or the NER, is used in a given SVAR model. All in all, we will use the following vectors of variables and shocks (f_t is a financial market index):

1. specification A, with $X_t = \left[\Delta y_t \;\; \Delta q_t \;\; \Delta p_t \right]'$ and $\varepsilon_t = \left[\varepsilon_t^{AS} \;\; \varepsilon_t^{IS} \;\; \varepsilon_t^{LM} \right]'$,
2. specification B, with $X_t = \left[\Delta y_t \;\; \Delta q_t \;\; \Delta s_t \right]'$ and $\varepsilon_t = \left[\varepsilon_t^{AS} \;\; \varepsilon_t^{IS} \;\; \varepsilon_t^{LM} \right]'$,
3. specification C, with $X_t = \left[\Delta y_t \;\; \Delta q_t \;\; \Delta p_t \;\; \Delta f_t \right]'$ and $\varepsilon_t = \left[\varepsilon_t^{AS} \;\; \varepsilon_t^{IS} \;\; \varepsilon_t^{LM} \;\; \varepsilon_t^{FM} \right]'$,
4. specification D, with $X_t = \left[\Delta y_t \;\; \Delta q_t \;\; \Delta s_t \;\; \Delta f_t \right]'$ and $\varepsilon_t = \left[\varepsilon_t^{AS} \;\; \varepsilon_t^{IS} \;\; \varepsilon_t^{LM} \;\; \varepsilon_t^{FM} \right]'$.

In the empirical part of the paper, we will estimate the four differently specified VAR models for both Poland and the euro area, identify the structural shock series, determine which types of shocks were the main driving force behind the stochastic fluctuations of the NER and the RER in Poland vis-à-vis the euro area, and analyze the demand shock correlation between the two economies.

4 Data Description

Ideally, the time series to be used as proxies for the variables y_t, p_t and q_t should capture the entire output of the given economy as well as the nominal and real (relative to the rest of the world) price level of that output, i.e. the gross domestic product, the GDP deflator and the RER based on GDP deflators at home and abroad. When deciding upon the specific time series to be used in the empirical analysis, however, we are restricted by the availability of data, the assumption that all time series should be I (1) and – for the purpose of shock correlation analysis – the requirement of their comparability between Poland and the euro area.

The major difficulty with empirical analyses of former centrally planned economies, such as Poland, is the fact that usable time series are rather short, beginning around the mid-1990s at the earliest. GDP series for Poland are not long enough to be employed in a VAR model. Thus, we must resort to monthly data: industrial production and retail sales as possible output proxies, and the producer price index (PPI) as well as the Harmonised Index of Consumer Prices (HICP), and for Poland also the consumer price index (CPI) as candidates for the price variable.

Regarding the NER and the RER, as our focus is on asymmetric shocks in Poland relative to the euro area, the relevant exchange rate is that of the Polish złoty against the euro, not the effective exchange rate. A potential problem is the fact that the złoty NER has only been freely floating since April 2000 or de facto since July 1998, when Narodowy Bank Polski ceased to intervene in the foreign exchange market. On the other hand, however, prior to floating, the złoty was allowed to fluctuate within a relatively wide band and its central rate was set against a basket of currencies, so its exchange rate *against the euro* was determined to a large extent by market forces since roughly 1995.[6] The NER is calculated as monthly averages of the daily reference rates of the European Central Bank (ECB), and the RER is computed as the NER deflated with the relevant price indexes for Poland and the euro area. Finally, we choose WIG20 for Poland and DAX30 for the euro area as financial market indicators, again as monthly averages of the daily observations.

[6] *Another problem would arise if our sample covered the time period prior to the launch of the euro in 1999. In that case we would have to construct proxies for the złoty/euro exchange rate.*

With regard to the I (1) assumption, we ran augmented Dickey-Fuller and Phillips-Perron tests on all time series.[7] The results of both test types were qualitatively the same; they are not reported here to save space, but are available on request from the author, along with all other results. We could not decisively reject the hypothesis of the HICP for the euro area being integrated of order 2;[8] all other time series seemed to have the right order of integration. For comparability reasons, we could not use the HICP or the CPI for Poland, which left us with only one proxy for the price level, the PPI, and two proxies for output. Because the PPI and retail sales can hardly be regarded as corresponding measures of output and the price level, we finally decided to use the industrial production but not retail sales.[9]

Finally, the fact that the PPI series starts in January 2000 determined the beginning of our sample. The above-mentioned issues of computing the euro exchange rate prior to 1999 and of the exchange rate regime change in Poland in July 1998 thus became irrelevant, and the sample covers a period without very significant regime shifts (perhaps apart from Poland's accession to the EU in May 2004). The sample ends in May 2009, which leaves us with 113 observations. All time series were recalculated as indexes with a base in January 2000, and they enter the VAR models as first differences of logarithms of the respective indexes. The details of the time series employed are given in table A1 in the annex.

5 Empirical Results

5.1 VAR Model Selection and Identification of Shocks

In specifying the VAR models, in several cases different lag length criteria pointed to different maximum lags. We therefore determined the lag length so that the VAR residuals are normal (or at least not skewed, which is a crucial assumption; see Juselius, 2006), not serially correlated and homoskedastic.[10] Taking lags 1 and 2 turned out to be sufficient in most cases. In each VAR model we used a constant, a linear time trend (if it was significant in any equation), and dummy variables capturing regime shifts visible in the VAR residuals. All VAR models are stable, i.e. their roots lie within the unit circle. Thus, all the conditions necessary for the use of the Blanchard and Quah identification scheme are satisfied.

The eight VAR models – i.e. specifications A to D for Poland and for the euro area – were then estimated and the long-run identification applied to identify the structural shock series. Before proceeding, we checked whether the identified shock series are specification sensitive, i.e. whether the AS, IS, LM and FM shocks for a given economy identified with the help of specifications A, B, C and D are

[7] *Specification of the test equations in terms of exogenous components (constant, trend, or neither) was in each case dependent upon whether or not the differenced time series (e.g.) had a zero or nonzero mean, or followed a linear time trend. This was checked through eyeballing and through regression of each differenced series on a constant and trend.*

[8] *More specifically, the tests pointed to a unit root in levels or in first differences depending on the specification of the test equation; we believe that this finding is mainly due to the increase in the volatility of the series after the launch of the euro in 1999.*

[9] *In our previous analyses (see Stążka, 2008a and 2008b), we tried using different sets of times series, also specifications employing retail sales. According to most criteria, such as the stochastic properties of VAR residuals or the economic interpretability of impulse responses, the specification that we chose here turned out to be the best.*

[10] *The residuals were tested for normality with the help of the Jarque-Bera test, for serial correlation with the help of the Lagrange multiplier test and for heteroscedasticity with the help of the White test.*

similar. Simple correlation analysis (whose results are not reported to save space) has shown that both AS, IS and FM shocks are highly comparable across the different specifications in both Poland and the euro area, with correlation coefficients ranging above 0.8 in the majority of all cases. LM shocks, in contrast, are only comparable across models with the same nominal variable (price level or NER), i.e. shocks identified based on specifications A and C are highly correlated, and the same holds for shocks from specifications B and D. We can interpret the LM shocks identified with the help of models A and C as "price level-specific" nominal shocks, and those identified with the help of models B and D as "exchange rate-specific" nominal shocks. We will take this result into consideration when analyzing the shock correlation between Poland and the euro area in the next subsection.

5.2 The Shock-Absorbing Capacity of the Flexible Exchange Rate

As underlined before, we assume that the NER can be regarded as a shock-absorbing (shock-propagating) instrument if its fluctuations are mainly driven by real demand (monetary) disturbances. Moreover, if the NER fluctuates mainly in response to financial market shocks, then its flexibility constitutes a source of instability.[11] Incidentally, under floating the NER and the RER are very closely aligned, with a correlation coefficient near unity (MacDonald, 1998), so we are interested in analyzing both NER and RER movements. The sources of stochastic changes of a variable can be scrutinized by means of forecast error variance decomposition (FEVD; Lütkepohl and Krätzig, 2004). Table 1 below shows the results for Poland – the percentage of the forecast error variance (FEV) of the NER and RER at different forecast horizons that is attributable to each of the four structural shock types. For each model, the dominant shock is in bold type.

As can easily be seen, both the NER and the RER fluctuated mainly in response to real demand (IS) shocks, which points to the conclusion that the NER has been a shock absorber over the sample period. A closer look at table 1 reveals some other interesting results. First, the contribution of financial market shocks to the fluctuations of both exchange rates is below 5% across all specifications and forecast horizons and so we conclude that NER flexibility has not been a source of shocks.[12] Second, in models that use the price level (A and C), the contribution of LM shocks to stochastic RER volatility is generally larger than in models using the NER (B and D). In other words, "price level-specific" monetary disturbances are of greater importance for RER fluctuations than "exchange rate-specific" disturbances. This is in sharp contrast to our previous analysis, covering a shorter sample; we will return to this result later on. Finally, AS shocks also play a nonnegligible role for exchange rate movements – in any case they are more significant than FM shocks.

Now, the question arises as to whether shock-absorbing instruments were necessary during the sample period. It might be the case that the NER and RER in

[11] *In turn, if supply disturbances are the main source of exchange rate variability, the conclusion is not clear cut (see the discussion in Stążka, 2008a). However, most empirical analyses show that this type of shock does not dominate RER movements; this result, confirmed by our analysis (see below), is "something of a stylised fact in the literature on the economics of real exchange rates" (MacDonald, 1998, p. 38).*

[12] *To a certain extent, and in any case for long forecast horizons, this result might be implied by the identification scheme – it is assumed that financial market shocks have no long-run effect on any variable except the financial market index.*

Table 1

Sources of Real and Nominal Exchange Rate Fluctuations in Poland

a) FEVD of the NER (contribution of different shock types to FEV in %)

Horizon (in months)	Model B			Model D			
	AS	**IS**	LM	AS	**IS**	LM	FM
1	6.16	**57.69**	36.15	7.84	**57.89**	31.00	3.27
2	8.90	**58.54**	32.57	11.22	**57.55**	27.85	3.38
3	9.09	**58.41**	32.49	11.41	**57.21**	27.45	3.93
6	9.03	**57.49**	33.48	11.32	**56.60**	28.18	3.89
36	9.03	**57.45**	33.51	11.33	**56.55**	28.23	3.89

b) FEVD of the RER (contribution of different shock types to FEV in %)

Horizon (in months)	Model A			Model C			
	AS	**IS**	LM	AS	**IS**	LM	FM
1	8.76	**60.97**	30.27	7.28	**74.02**	15.80	2.90
2	8.24	**61.25**	30.52	7.56	**72.28**	16.52	3.64
3	8.54	**60.08**	31.38	7.43	**68.51**	19.81	4.25
6	8.44	**58.12**	33.44	7.74	**64.25**	23.98	4.03
36	8.33	**57.23**	34.44	7.75	**64.24**	23.98	4.03
	Model B			Model D			
	AS	**IS**	LM	AS	**IS**	LM	FM
1	7.74	**74.45**	17.81	9.44	**73.34**	13.78	3.43
2	9.84	**73.93**	16.23	11.97	**71.76**	12.67	3.60
3	9.73	**72.65**	17.63	11.82	**70.33**	13.46	4.39
6	9.63	**70.43**	19.94	11.63	**68.64**	15.45	4.28
36	9.64	**70.35**	20.02	11.63	**68.53**	15.56	4.27

Source: Author's calculations.

Note: FEVD: forecast error variance decomposition; NER: nominal exchange rate; FEV: forecast error variance; AS: aggregate supply; IS: investment and saving equilibrium; LM: liquidity preference and money supply equilibrium; FM: financial market, RER: real exchange rate.

Poland moved mainly in response to IS shocks, but these shocks were largely symmetric relative to the euro area. To see how synchronous real demand shocks in Poland were relative to the euro area, we again resort to simple correlation analysis. The relevant correlation coefficients are given in table 2.

The results suggest that Poland was hit by demand disturbances that were largely asymmetric relative to the euro area: all the relevant correlation coefficients are negative and high in absolute value. We considered the possibility that

Table 2

Symmetry of Real Demand Shocks in Poland Relative to the Euro Area

Correlation of the IS shocks identified by different models between Poland and the euro area

Specification	A for the euro area	B for the euro area	C for the euro area	D for the euro area
A for Poland	−0.64	−0.68	−0.66	−0.67
B for Poland	−0.70	−0.90	−0.62	−0.86
C for Poland	−0.69	−0.75	−0.74	−0.76
D for Poland	−0.70	−0.88	−0.62	−0.85

Source: Author's calculations.

Note: IS: investment and saving equilibrium.

this pattern is largely due to the time series used: the models for the euro area use the euro/złoty NER and RER, even though one can hardly argue that this bilateral exchange rate is highly relevant for that area's economic activity and prices. As a sensitivity check, we estimated the models for the euro area using the euro/US dollar exchange rate, but the same pattern of high negative IS shock correlation emerged again (see Stążka, 2008a). We thus conclude that over the sample period, stabilizing instruments such as the floating NER were called for.

5.3 Effects of the Global Financial Crisis

The ongoing global financial crisis, especially its intensification in September 2008, has been associated with increased risk aversion, resulting in capital flight from emerging market economies. This led to strong depreciation of the currencies of many small open economies, including the Polish złoty and the currencies of several other EU Member States that joined from 2004. It was about then that policymakers in the affected countries spoke out about the disadvantages of being a small open economy staying out of the common currency area. The changing attitudes toward euro adoption in these countries seem to corroborate the opinion of those who view the NER as a source of shocks springing from the financial markets. Thus, checking how the results have changed during the most recent period of the global financial meltdown may provide insights.

In terms of our SVAR analysis, the recent developments constituted an exceptionally strong and persistent adverse financial market shock, followed by an adverse (foreign) demand shock. We would thus expect that the financial crisis has increased the contribution of FM and IS shocks to the stochastic volatility of both the NER and the RER. We tested these hypotheses, again using forecast error variance decomposition. Specifically, we compared the results described in subsection 5.2 above and those we obtained in our previous study (Stążka, 2008b), based on exactly the same time series and a sample ending in February 2008, i.e. not covering the last 15 observations in our present sample. Table 3 below presents the results – the change in the contribution of different shock types to the stochastic NER, and RER volatility resulting from expanding the sample.

As can be seen from the table, the results confirm the first of our hypotheses: The contribution of FM shocks to the stochastic volatility of both the NER and the RER has increased. On the one hand, this increase is rather insignificant in absolute terms (i.e. measured in percentage points). On the other hand, it is quite large in relative terms, given the very low contribution of financial market shock to exchange rate fluctuations – the increase e.g. from 2% to 3% can be regarded as rather large.[13] To a certain degree, the flexible NER has become slightly more of a source of shocks during the present global crisis, though it has, as demonstrated in section 5.2, mainly been driven by real demand disturbances.

Moreover, in those models which use the NER as the nominal variable (specifications B and D) an increase in the contribution of IS disturbances can also be observed, which would confirm the second of our hypotheses. In the face of the dominant role of real demand shocks as the driving force of NER and RER fluctuations, this increase is relatively small. At the same time, a rise in the contribution of LM shocks was also recorded. This could not, however, offset the

[13] *See table 1 in subsection 5.2 and the top panel of table 5 in Stążka (2008b).*

Table 3

Impact of the Global Financial Crisis on NER and RER fluctuations

a) Change in the contribution of different shock types to FEV of the NER resulting from the sample expansion (percentage points)

Horizon (in months)	Model B			Model D			
	AS	IS	LM	AS	IS	LM	FM
1	−12.34	6.09	6.25	−18.06	14.19	2.40	1.47
2	−13.30	6.54	6.77	−18.48	13.45	3.15	1.88
3	−14.11	7.11	6.99	−18.29	13.91	3.45	0.83
6	−14.57	7.09	7.38	−18.48	14.00	3.68	0.79
36	−14.57	7.05	7.41	−18.47	13.95	3.73	0.79

b) Change in the contribution of different shock types to FEV of the RER resulting from the sample expansion (percentage points)

Horizon (in months)	Model A			Model C			
	AS	IS	LM	AS	IS	LM	FM
1	−10.74	−14.83	25.47	−6.22	−7.98	12.60	1.60
2	−14.76	−11.75	26.52	−9.34	−7.12	13.82	2.54
3	−15.96	−10.62	26.48	−10.57	−8.39	16.91	2.15
6	−16.36	−11.48	27.84	−10.56	−11.65	20.38	1.93
36	−16.47	−12.37	28.84	−10.55	−11.66	20.38	1.93
	Model B			Model D			
	AS	IS	LM	AS	IS	LM	FM
1	−7.66	5.75	1.91	−12.86	12.74	−1.52	1.73
2	−7.96	4.93	3.03	−12.83	10.76	−0.13	2.20
3	−10.17	6.05	4.13	−13.88	11.73	0.76	1.39
6	−10.97	6.83	4.14	−14.57	12.74	0.55	1.28
36	−10.96	6.75	4.22	−14.57	12.63	0.66	1.27

Source: Author's calculations.

Note: a) Increase (+) or decrease (−) resulting from expanding the sample by 15 observations (from a sample covering 2000:M1–2008:M2 to one covering 2000:M1–2009:M5).

FEV: forecast error variance; NER: nominal exchange rate; AS: aggregate supply; IS: investment and saving equilibrium; LM: liquidity preference and money supply equilibrium; FM: financial market, RER: real exchange rate.

increase in the contribution of IS shocks in both specifications and most forecast horizons, so based on this piece of evidence, we can conclude that the floating NER has become even more of a shock-absorbing instrument.

Importantly, though, in models which use the price level instead of the NER (specifications A and C), the contribution of IS shocks actually decreased at the cost of LM shocks. Recalling our interpretation of LM shocks in different models from subsections 5.1 and 5.2, we see that the contribution of "price level-specific" nominal shocks has risen notably in the longer sample, so that these shocks have become more important in driving RER fluctuations than "exchange rate-specific" shocks. This somehow counterintuitive result could perhaps be explained by specific factors driving the price level in Poland since the beginning of 2008, namely large increases of administered prices (especially the prices of energy products and of some services, mainly those related to home maintenance).

In any case, it is difficult to draw unambiguous conclusions regarding the stabilizing versus destabilizing role of the flexible NER during the recent turbulent times. While the importance of financial market shocks for NER and RER fluctuations has risen, so has the importance of IS shocks in half of the specifications. Given that the Polish economy has been hit by the global crisis to a significantly lesser extent than most other EU countries in terms of economic activity[14] and that this was preceded by significant NER depreciation, we are more inclined to accept the view of the złoty/euro exchange rate as a stabilizing rather than a destabilizing force.

6 Summary and Conclusions

This paper examines the role of the flexible złoty/euro exchange rate in terms of output stabilization in the face of asymmetric (country-specific) shocks, which is an important question given the Polish authorities' plans to adopt the euro in the near future. We have contributed to the existing literature by expanding the SVAR models used by other authors to include a financial market shock, defined as a stochastic change in a country's risk premium. Relevant as the impact of financial shocks is in the face of the ongoing global financial crisis, our previous studies (Stążka, 2008a, 2008b) have been – to the best of our knowledge – the only ones so far to identify financial market shocks of this kind. The contribution of the present paper is also to scrutinize the effects of the financial crisis on the shock-absorbing capacity of the złoty/euro NER.

Our analysis, covering a sample period from January 2000 to May 2009, used four differently specified SVAR models with long-run identifying restrictions à la Blanchard and Quah (1989). We have demonstrated, first, that the flexible złoty/euro NER was mainly driven by real demand disturbances, thus acting as a shock-absorbing rather than shock-propagating instrument. Second, we have shown that real demand shocks in Poland and the euro area were largely asynchronous, so that stabilizing instruments were called for.

With regard to the effects of the global crisis on the role of the flexible NER in Poland, the comparison of our current results with those obtained based on a shorter sample points to a certain increase in the contribution of financial market shocks to stochastic NER and RER volatility. Nevertheless, this shock type played a minor role in driving exchange rate fluctuations over the entire sample period, with a contribution to the forecast error variance of the NER and the RER of below 5% in all model specifications. This means that the floating exchange rate can hardly be regarded as a source of shocks.

Importantly, there are some caveats to consider. First, we need to stress that this paper is based on just one model type, namely the structural VAR approach with long-run identifying restrictions. It might be that other models lead to different conclusions about the shock-absorbing capacity of the NER. Second, we have looked at stability costs exclusively in terms of real output; for economic agents, other variables – e.g. the rate of unemployment or the level of consumer prices – are of interest too, but we leave them out. Third, empirical results for any former centrally planned economy should be interpreted with caution because usable time series are relatively short. This can lead to results which are rather specification sensitive, as demonstrated in our previous study (Stążka, 2008b). Last but not

[14] *Since mid 2008, Poland has been among the EU countries with the highest GDP growth rate. In the first two quarters of 2009 it was the fastest growing EU economy and in the second quarter of 2009 the only one which recorded positive GDP growth in annual terms (source: Eurostat).*

least, the result that financial market shocks have played hardly any role in driving stochastic RER and NER fluctuations might be related – at least to some extent – to our identifying restrictions, which assume no long-run effect of FM shocks on either the NER or the RER. While admitting these limitations, we conclude that the floating exchange rate has generally served Poland well and its irrevocable fixing on the day of euro adoption will, at least in the short term, constitute a certain cost in terms of output stability.

References

Apergis, N. and C. Karfakis. 1996. Sources of Fluctuations in Exchange Rates: A Structural VAR Analysis. In: Applied Economics Letters 3. 251–254.

Astley, M. S. and A. Garratt. 2000. Exchange Rates and Prices: Sources of Sterling Real Exchange Rate Fluctuations 1973–94. In: Oxford Bulletin of Economics & Statistics 62. 491–509.

Bailliu, J. and H. Bouakez. 2004. Exchange Rate Pass-Through in Industrialized Countries. In: Bank of Canada Review. Spring. 19–28.

Blanchard, O. J. and D. Quah. 1989. The Dynamic Effects of Aggregate Demand and Supply Disturbances. In: American Economic Review 79. 655–673.

Borghijs, A. and L. Kuijs. 2004. Exchange Rates in Central Europe: A Blessing or a Curse?. Working Paper 04/2. Washington, D. C.: International Monetary Fund.

Buiter, W. H. 2000. Monetary Misconceptions. Discussion Paper 469. London: Centre for Economic Performance.

Buiter, W. H. and C. Grafe. 2002. Anchor, Float or Abandon Ship: Exchange Rate Regimes for the Accession Countries. In: European Investment Bank Papers 7. 51–71.

Buti, M. and A. Sapir (eds.). 1998. Economic Policy in EMU: A Study by the European Commission Services. Oxford: Clarendon Press.

Chadha, B. and E. Prasad. 1997. Real Exchange Rate Fluctuations and the Business Cycle: Evidence from Japan. In: IMF Staff Papers 44. 328–355.

Chen, S.-L. and J.-L. Wu. 1997. Sources of Real Exchange-Rate Fluctuations: Empirical Evidence from Four Pacific Basin Countries. In: Southern Economic Journal 63. 776–787.

Chowdhury, I. S. 2004. Sources of Exchange Rate Fluctuations: Empirical Evidence from Six Emerging Market Countries. In: Applied Financial Economics 14. 697–705.

Clarida, R. and J. Galí. 1994. Sources of Real Exchange Rate Fluctuations: How Important Are Nominal Shocks? Working Paper 4658. Cambridge, Mass.: National Bureau of Economic Research.

Dibooglu, S. and A. M. Kutan. 2001. Sources of Real Exchange Rate Fluctuations in Transition Economies: The Case of Poland and Hungary. In: Journal of Comparative Economics 29. 257–275.

Dornbusch, R. 1976. Expectations and Exchange Rate Dynamics. In: Journal of Political Economy 84. 1161–1176.

Enders, W. and B.-S. Lee. 1997. Accounting for Real and Nominal Exchange Rate Movements in the post-Bretton Woods Period. In: Journal of International Money and Finance 16. 233–254.

Friedman, M. 1953. The Case for Flexible Exchange Rates. In: M. Friedman. Essays in Positive Economics. Chicago: The University of Chicago Press. 157–203.

Gagnon, J. E. and J. Ihrig. 2004. Monetary Policy and Exchange Rate Pass-Through. In: International Journal of Finance & Economics 9. 315–338.

Juselius, K. 2006. The Cointegrated VAR Model: Methodology and Applications. Advanced Texts in Econometrics. Oxford: Oxford University Press.

Kontolemis, Z. G. and K. Ross. 2005. Exchange Rate Fluctuations in the New Member States of the European Union. Economics Working Paper Archive 0504015.

Lastrapes, W. D. 1992. Sources of Fluctuations in Real and Nominal Exchange Rates. In: Review of Economics and Statistics 74. 530–539.

Lütkepohl, H. and M. Krätzig (eds.). 2004. Applied Time Series Econometrics, Themes in Modern Econometrics. Cambridge: Cambridge University Press.

MacDonald, R. 1998. What Do We Really Know About Real Exchange Rates? Working Paper 28. Vienna: Oesterreichische Nationalbank.

McKinnon, R. I. 1963. Optimum Currency Areas. In: American Economic Review 53. 717–725.

Meade, J. E. 1951. The Theory of International Economic Policy. Oxford: Oxford University Press.

Meese, R. A. and K. Rogoff. 1983. Empirical Exchange Rate Models of the Seventies: Do They Fit Out-of-sample? In: Journal of International Economics 14. 3–24.

Mundell, R. A. 1961. A Theory of Optimum Currency Areas. In: American Economic Review 51. 657–665.

Mundell, R. A. 2003. Without title. In: HM Treasury. Submissions on EMU from Leading Academics. EMU Study. London: HM Treasury. 197–202.

Rodríguez López, J. and J. L. Torres Chacón. 2007. Following the Yellow Brick Road to the Euro? The Czech Republic, Hungary and Poland. In: Eastern European Economics 45. 47–80.

Sachs, J. D. 1980. Wages, Flexible Exchange Rates, and Macroeconomic Policy. Quarterly Journal of Economics 94. 731–747.

Stążka, A. 2008a. Polen auf dem Weg zur Wirtschafts- und Währungsunion. Der flexible Wechselkurs als ein Instrument zur Absorption asymmetrischer Schocks. Schriften zu Internationalen Wirtschaftsfragen 34. Berlin: Duncker & Humblot.

Stążka, A. 2008b. The Flexible Exchange Rate as a Stabilising Instrument: The Case of Poland. Mimeo. Narodowy Bank Polski. Retrieved from http://www.nbp.pl/bise/seminaria/StazkaO.pdf on May 26, 2009.

Annex

Table A1

Data Description

Time series	Series name; code in Datastream	Start date	Unit	Adjustment	Source
Data for Poland					
Industrial production	Industrial production: mining, manufacturing & quarrying & energy; POESCDE1G	1995:M1	Index (2005=100)	Volume index, seasonally adjusted	Eurostat
PPI	PPI: industry (excluding construction), POESPPIIF	2000:M1	Index (2005=100)	Price index, not seasonally adjusted	Eurostat
Nominal exchange rate	Euro reference exchange rates	Jan. 1, 1999	EUR/PLN	Monthly averages	European Central Bank
WIG20	Warsaw General Index 20; POLWG20	April 18, 1994	Index	Monthly averages	Warsaw Stock Exchange
Data for the euro area (euro-15 countries – aggregate)					
Industrial production	Industrial production: mining, manufacturing & quarrying & energy; Z4ESIMQMG	1990:M1	Index (2005=100)	Volume index, seasonally adjusted	Eurostat
PPI	PPI: industry (excluding construction), Z4ESPPIIF	1980:M1	Index (2005=100)	Price index, not seasonally adjusted	Eurostat
Nominal exchange rate		Jan. 1, 1999	PLN/EUR	Monthly averages	European Central Bank
DAX30	DAX 30 Performance; DAXINDX	Dec. 31, 1964	Index	Monthly averages	Deutsche Börse

Source: Author's compilation.
Note: PPI: Producer Price Index.