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The Role of Domestic and External Shocks in Poland: Results from an Agnostic Estimation Procedure

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The Role of Domestic and External Shocks in Poland: Results from an Agnostic Estimation Procedure [1]

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Abstract

This paper discusses interlinkages between Poland and the euro zone using a simple and agnostic econometric approach. Specifically, we estimate a trend-cycle VAR model using data for real and nominal variables, imposing powerful but uncontroversial assumptions that allow us to identify how external factors affect the evolution of business cycles in Poland in the period 1999-2012. Our results suggest that developments in the euro zone can explain about 50 percent of poland's output and interest rate business cycle variance and about 25 percent of the variance of inflation.

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Keywords: Poland, euro zone, trend-cycle VAR, external shocks

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I. INTRODUCTION

This paper estimates the relative contribution of domestic and external factors in driving Poland's business cycles, using a robust and agnostic econometric approach. For an open economy as closely integrated with the euro zone as Poland, understanding how and by how much external shocks affect the domestic economy is one of the key inputs to economic policy. In this paper, we adopt an agnostic approach and impose uncontroversial assumptions that allow us to identify the role of external shocks on Poland's business-cycle fluctuations. Our results suggest that developments in the euro zone can explain about half of output and interest rate business-cycle variance and about one-fourth of variance of inflation.

We estimate a trend-cycle VAR model using data on output, inflation, policy interest rate, and the exchange rate. The estimation approach addresses the issue of misspecification of reduced-form models, as highlighted by Andrle and Brůha (2013). A trend-cycle VAR is a model in which trend and cyclical dynamics are modeled separately, making it possible to properly account for time-varying trends. The idea is that the cyclical dynamics and low-frequency trend dynamics are driven by different economic mechanisms. While the cyclical dynamics are expected to reflect similar phenomena in the regions considered, the trend dynamics of a post-transition economy are different than the dynamics of advanced economies it converges to. In this paper, we acknowledge the convergence process directly, namely the occurrence of differential rates of steady-state output growth and the correspondence trend appreciation of the real exchange rate, the well known Ballassa-Samuelson effect. More importantly, in our specification we acknowledge the nature of the inflation targeting regime by modeling inflation deviations from its time-varying target, as opposed to inflation or the price level.

The identification of domestic and external shocks is based on the small open economy (SOE) assumption. It is hard to dispute that economic developments in Poland are unlikely to affect the euro zone economic variables in any significant way, due to the size of the economy and the level of financial and trade integration. The small open economy assumption implies restrictions on the dynamic coefficients of the model at all time periods, not just contemporaneously. The short-coming of this simple identification procedure –one that we are willing to accept from the outset– is that the euro zone 'spillovers' to Poland cannot be distinguished from common shocks to both regions. The ability to separate common shocks from spillovers requires adopting much less innocuous assumptions.

Our analysis has several caveats and should be interpreted with care. First, the sample size used for the estimation is relatively short. Extending the sample backwards, however, may not lead to a more robust analysis due to structural changes that affected Poland in the 1990s. Second, while the baseline model allows us to impose minimal assumptions to identify shocks, we are unable to distinguish euro zone shocks from common shocks to both regions. Third, our analysis is not truly structural; hence our ability to perform policy counterfactuals is limited and should be interpreted with care.

The remainder of the paper is structured as follows. In Section II we describe the model and our identification strategy. In Section III we discusse the data and the estimation procedure. We report our results in Section IV, including a counterfactual simulation to illustrate the role of external shocks during 1999-2012 and a conditional forecasting exercise. In Section V we summarize our conclusions.

II. The Model

A. Motivation

For an economy as closely integrated with the euro zone as Poland, it is crucial to know how much of its business-cycle fluctuations is due to external shocks. Over the last fifteen years, bilateral trade with euro zone countries as a share of GDP has doubled, and the process of vertical integration of its manufacturing sector with that of its trading partners has progressed dramatically. The euro zone also holds about 75 percent of total inward FDI stock in Poland. Financial integration of Poland to the euro zone is large and increasing, with exposure to BIS-reporting banks –counting both cross-border lending and locally-funded assets of foreign bank subsidiaries– reaching almost 60 percent of GDP in 2011.

There are a number of potential approaches to analyze the role of domestic and external shocks; in this paper we use the time-series analysis approach. In particular, we employ a vector autoregressive (VAR) time series framework to estimate the share of business-cycle fluctuations that are driven by foreign shocks over the period 1999-2012. This allows us to obtain meaningful results with a small set of identifying assumptions. The setup of the model reflects the economic developments in both regions. First, the small-open-economy assumption allows us to identify Poland-specific shocks that do not affect the euro zone. Second, Poland's convergence process and its transitional dynamics have implications for data transformation and for the structure of the model.

Our modeling choices are guided by acknowledging the fact that the reduced form of the VAR model itself is the key component of the analysis and cannot be separated from shock identification. When the reduced-form model is severely misspecified, no sophisticated identification scheme of structural shocks will fix the problem. Ideally, the reduced-form model should display properties of stability and fit for purpose, for instance accuracy of n-step ahead predictions and convergence to a well-defined steady state. In our case, the model should allow inflation to attain official inflation targets within a well-defined time horizon.

Three considerations based on economic theory and institutional arrangements lead us to estimate a trend-cycle VAR model. The transition process and economic convergence of Poland towards the euro zone; the associated relatively higher productivity growth in tradable sectors with respect to nontradable sectors, which contributed to a trend real exchange appreciation; and, the adoption of the inflation targeting regime in 1998. Ignoring these facts would necessarily result in a misspecified reduced-form model and an incoherent estimate of structural shocks. We discuss each issue in greater detail below.

First, since the early 1990s Poland's long-term growth has been affected by the transition process and convergence towards the euro zone. The average output growth in Poland from 1998–2012 was close to 4 percent, in comparison to roughly 1.5 percent growth in the euro zone. For the medium term, it is plausible to assume that Poland's trend output growth will remain around 4 percent, consistent with the process of economic convergence. While long-term growth remains determined by the complexities of the transition process involving technology adoption and institutional changes, the dynamics of business cycles in Poland should be more responsive to the cyclical dynamics of its trading partners.

Second, consistent with the Harrod-Balassa-Samuelson hypothesis the convergence process has involved a gradual real exchange rate appreciation. Cyclical developments in the real exchange rate affect inflation, interest rates, and output in a dramatically different way than trend developments. The trend, or 'equilibrium' real exchange rate appreciation –determined by the evolution in productivity– has little effects on inflation, for instance, since it is fully backed up by productivity developments. The process of transition may also lead to a slowly decline in the country risk premium, as institutions strengthen and markets deepen. Our econometric model thus cannot model a log-level of the real exchange rate; instead, it needs to focus on cyclical deviations from the trend, or 'equilibrium' real exchange rate.

Third, during the process of disinflation, Poland adopted the inflation targeting monetary policy regime in 1998. During the disinflation process, the inflation target was lowered in steps from 7 percent to 2.5 percent and has remained at that level since 2004. Ignoring the implications of the inflation targeting regime and changes in the inflation target may lead to a severe misspecification of the model, the 'price puzzle' for instance.

Crucially, it is wrong to model the log-level of prices in a VAR setting when the inflation targeting regime is adopted. A non-stationary VAR would not ensure that inflation will converge to the inflation target set by the monetary authority. In addition, in many countries –especially in the emerging ones– the explicit, or implicit, inflation targets have been varying over time and it is the deviation of inflation from the target that matters for monetary policy decisions and business cycle dynamics. Moreover, even in the case of a constant inflation target and when the inflation variable is used in the VAR, the steady state of inflation (unconditional mean of the model) will be a nonlinear function of the constant and all coefficients that govern dynamics. Without a priori restriction on the model, there is no guarantee that the inflation would converge to its officially announced target.[1]

B. Econometric Specification

We formulate a trend-cycle VAR model with block-exogeneity restrictions.[2] Our model is a relatively standard VAR model with particular assumptions about (i) causality among economic variables and (ii) the steady state of the economy. First, the small-open-economy assumption implies a Sims-Granger causality restriction on the VAR in the form of a block-triangular representation of the dynamics. It is not sufficient to just restrict the contemporaneous response of the large economy to SOE shocks to zero, as is done in Choleski identification schemes, since SOE shocks would still affect the large economy with a lag. Second, the steady-state considerations of the model are simplified by its trend-cycle nature, since the cyclical components are zero-mean and the model does not feature a constant term.

The steady state of a stationary VAR model is a complex and nonlinear function of the constant and coefficients governing dynamics. The implications of a constant (intercept) in the

[1] In general, ignoring changes in the inflation target in a VAR setting might lead to a phenomenon called price puzzle, i.e., increases in nominal interest rate leads to higher price level, or inflation. Take the case of Poland's disinflation for instance. Both inflation and interest rates have been trending downwards on account of two factors: a consistent decrease of the inflation target and active monetary policy that sought to anchor inflation expectations. If we specify a VAR using inflation and interest rates, the positive correlation of those variables at low frequencies may contribute to results displaying the price puzzle. For instance, Wolden Bache and Leitemo (2008) illustrate using a simulation experiment with a DSGE model that correct identification of monetary policy shocks in a VAR requires that the model distinguishes between transitory and permanent policy shocks (i.e. change in the inflation target).

[2] Alternatively, we could have specified a dynamic factor model (DFM) to capture common and idiosyncratic dynamics in both regions. We choose a VAR model, however, as the data would have a VAR representation even in the case when the factor model would be the true representation of the data.

model are not sufficiently appreciated in empirical VAR analysis. In a model $x_t = c + A(L)x_{t-1} + \varepsilon_t$ the mean is, trivially $\bar{x} = [1 - A(L)L]^{-1}c$. Unless the data are modeled as demeaned, the analyst has no direct control over the mean, or must apply a prior about the mean, as in Villani (2009). Having a well-defined steady state of the model is key to a VAR's proper estimation of the dynamics coefficients and good forecasting performance, as also demonstrated in Villani (2009).

Due to detrending of the data, all variables in our model have a zero mean, the model is stable and converges to its well-defined steady state. Denoting the vector of domestic variables as y_t and a vector of foreign variables as y_t^* we specify the model as

$$\begin{bmatrix} y_t \\ y_t^* \end{bmatrix} = \begin{bmatrix} \bar{y}_t \\ \bar{y}_t^* \end{bmatrix} + \begin{bmatrix} \hat{y}_t \\ \hat{y}_t^* \end{bmatrix}, \tag{1}$$

where the actual variables are decomposed into trend components, $\bar{y}_t$, and cyclical components, $\hat{y}_t$. The cyclical dynamics are driven by a block-triangular VAR model of order p:

$$\begin{bmatrix} \hat{y}_t \\ \hat{y}_t^* \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ 0 & A_{22}(L) \end{bmatrix} \begin{bmatrix} \hat{y}_{t-1} \\ \hat{y}_{t-1}^* \end{bmatrix} + \begin{bmatrix} R_1 & R_2 \\ 0 & R_3 \end{bmatrix} \begin{bmatrix} \varepsilon_t \\ \varepsilon_t^* \end{bmatrix}. \tag{2}$$

The steady state of $\{y_t, y_t^*\}$, or a steady rate of growth, is fully determined by assumptions about the trend process $\{\bar{y}_t, \bar{y}_t^*\}$. In our case, output growth would revert to its steady state, as would inflation and the level of interest rates. [3]

In the model, the shocks ε_t and ε_t^* are identified only as two groups, no shocks are identified within these groups. The dynamics of the model are driven by $A(L)$ with the block-zero restriction imposed a priori. We compute the matrix R using Cholesky factorization of the estimated covariance matrix of reduced form VAR residuals, ξ_t, that is $RR' = \Sigma_\xi = \mathbb{E}\xi\xi'$, assuming $\Sigma_\varepsilon = I$. Let us emphasize that the block-triangular form of R by itself is not a sufficient condition for the model to mimic the small-open-economy model assumption and to identify two orthogonal groups of shocks. That assumption would hold only in the first period of the shock, then Poland would start affecting the dynamics of the euro zone, which is inconsistent with macroeconomic reality.

[3] Our solution is to separate cyclical dynamics from the trend ones. An alternative would be to specify Vector Error-Correction Model (VECM). The strategy would, however, imply that long-run and cyclical dynamics are driven by the same shocks. Using VECM would not also free us from being careful about the steady state of the model and modeling inflation deviation from a time-varying target. Further, an economy along its convergence path need not display a co-integrated relationship with the economy it converges towards.

The trend components of the model are not specified using a parametric model. As opposed to Brůha (2011) or Canova and Ferroni (2011), for instance, we do not specify a proper model for the trend components, which would ensure full consistency among various trends for forecasting purposes. Instead, we focus only on a specific data bandwidth, processing data variables in a mutually consistent way, which alludes to a concept of the band spectrum regression, see e.g. Engle (1974) or Engle (1981). Our setup, however, remains in the time domain and the need for differentiating between factors driving low frequencies and cyclical frequencies of the data is explained using economic arguments.

Some 'trend' components are directly observable – the inflation target in our case. For countries with an explicit time-varying inflation target, failing to condition for its changes leads to a serious misspecification. Yet, including the target variable directly into the VAR model is not trivial, since it consists usually of a sequence of discrete jumps, it is exogenous to cyclical developments, and does not conform to the asymptotic distributional assumptions of the model.

C. Relationship to the Existing Literature

Our empirical analysis is rests on two important principles. The first principle is our explicit focus on modeling the cyclical dynamics using a VAR model where the changes in the inflation target are considered. The second principle is the identification of external shocks using the block-exogeneity restrictions. We outline how this paper fits within these principles below.

On the first principle, the consequences of failing to address the economic fundamentals implied by the convergence process, the disinflation process, and the openness of the economy are particularly dire in the case of emerging countries. In our view, ignoring these issues in a VAR leads to severely misspecified reduced-form models and, subsequently, to an inconsistent identification of structural shocks and possibly to price or other related 'puzzles'. For instance, Mackowiak (2006) investigates how much of the macroeconomic variance in Poland, Hungary and the Czech Republic is due to external shocks in the period 1992–2004. The author imposes a block-exogeneity restriction, yet does not model the exchange rate dynamics and specifies the model in log levels. Failure to acknowledge the modeling challenges implied by the inflation targeting regimes adopted in central European countries, along with the disinflation process in Poland since 1998 and in the Czech Republic since 1997, casts doubts on his results. Similarly, Rusnak and Horvath (2008) analyze the role of foreign shocks for the Slovak economy before it joined the euro zone in 2009. The authors work with the log-level of prices and do not account for the disinflation process in Slovakia or changes in the inflation target.

On the second principle, the small-open-economy assumption can be found in the VAR literature. A representative work on this strand of literature is the paper by Cushman and Zha (1997), which employs block-exogeneity but fails to account for the cyclical consistency of the model. Their sample is 1974–1993, which covers the Canadian disinflation which started in 1991 and continued through 1993 and beyond. The disinflation was accompanied by a dramatic decline in inflation, nominal interest rate, and real loss in output. Their sample also features a dramatic increase of inflation during the 1980s, with corresponding large increases in long-term inflation expectations. Further, they estimate the model using the price level, not using the inflation rate.

There have been empirical VAR investigations of the Polish economy in the literature, as well as investigations using structural models. VAR results by Mackowiak (2006) suggest that foreign shocks account for up to 30–50 percent of output dynamics, increasing with the horizon. A companion paper, Andrle and others (2013), uses a structural model to investigate the role of external shocks for Poland and reaches similar conclusions to our VAR analysis – foreign shocks explain roughly 50 percent of the cyclical volatility in output. Recently, an estimated DSGE model for Poland by Grabek, Klos, and Koloch (2009) attributes to foreign shocks only up to 15 percent of the output volatility and 15–57 percent to interest rate volatility. Further, Demchuk and others (2012) analyze monetary policy transmission in Poland using a structural VAR, but ignores completely the effect of foreign variables.

III. Data and Estimation

A. Data and Data Transformation

The set of model variables covers those variables that are key for constructing the simplest structural model of two economies.[4] We use data of quarterly frequency for headline CPI inflation, 3-month nominal interbank interest rates, and real GDP for the period 1999Q1–2012Q4. The bilateral nominal exchange rate PLN/EUR used is defined such that an increase

[4] That might seem obvious, but it is not often respected in the literature, resulting in an omitted variable bias. For instance, in their analysis of monetary policy transmission, Demchuk and others (2012) or Jarocinski (2010) do not acknowledge the monetary policy regime or changes in the inflation target but also do not include foreign variables into the model. That is in stark contrast to the reality of a small open economy with open financial markets.

represents depreciation. The choice between the headline measure of inflation, or a measure of core inflation –excluding food and energy, or trimmed means– is not trivial. We decided to work directly with headline inflation and include the Brent oil price to account for its effects on energy prices which could render an approximate estimate of the effects of commodity prices on inflation.

We do not use any fiscal variables and do not focus on fiscal policy. The reason is not that fiscal policy would not be relevant but that is would have little consequences for identification of domestic from international shocks. In our simple setup, fiscal policy expansion would look in the short run like a demand shock, boosting output, prices, and interest rates.

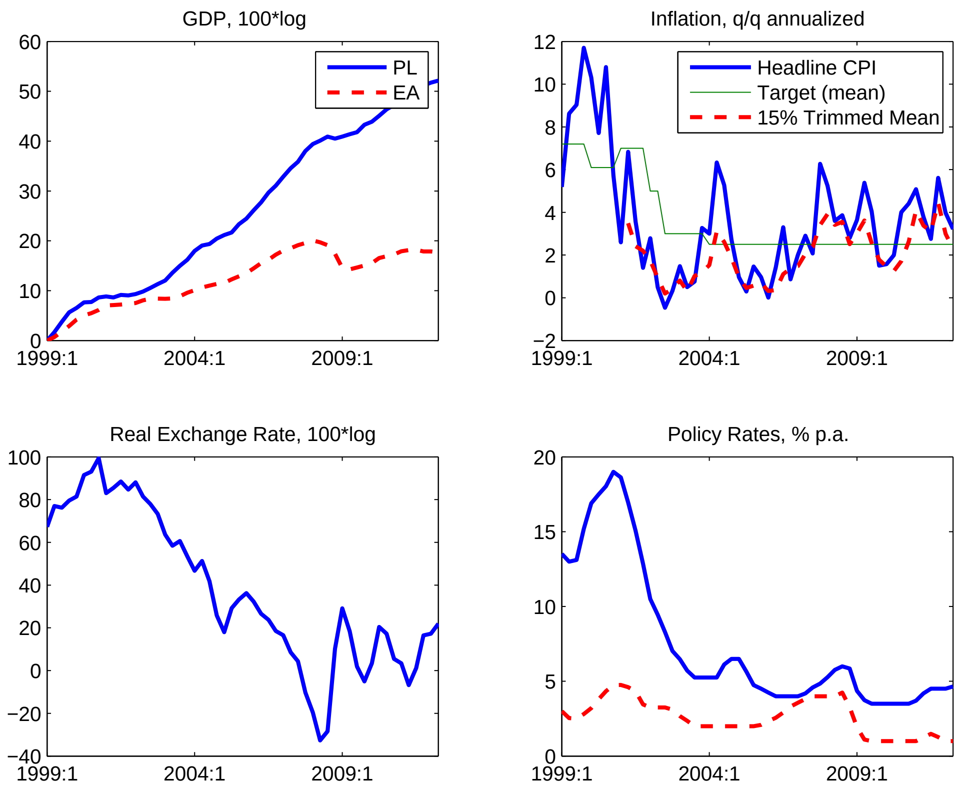
As discussed above, we model only the cyclical dynamics of the data. By cyclical dynamics we refer to frequencies higher than 32 quarters. Inflation is modeled as quarter-on-quarter, annualized rate of change in the CPI. We subtract the announced inflation target from inflation, thereby forming an implicit inflation gap. For the euro zone, the inflation target is assumed to be 1.9 percent and constant during the estimation sample. [5] The inflation target in Poland is time-varying, as can be seen in Fig. 1 where the trending and level behavior of main variables is depicted. Detrending inflation by the official inflation targets effectively eliminates the trend component of inflation but may not result in a zero mean series. In the case of the euro zone, the mean deviation is 0.42, in Poland it is roughly 0.09. The presence of this bias does not affect our results quantitatively.

The remaining data were transformed as follows: Cyclical components of output are obtained by applying the high-pass filter to 100 times the log of GDP, thus eliminating frequencies lower than 32 quarters.[6] The cyclical component of output is in percents. The nominal interest rate's cyclical component is obtained by first forming an ex-post deflated measure of the real interest rate, which is also detrended by the high-pass filter. Trend nominal interest rate is obtained as the sum of the trend real rate and the inflation target. The cyclical component of the interest rate is in percents per annum. The real exchange rate was also processed by the high-pass filter and changes in the nominal cyclical component of the exchange rate were constructed using the cyclical components of inflation described in the previous paragraph. The growth rate of the exchange rate is expressed in percents, annualized. The trend in the real price of oil (in EUR) was obtained in an analogous way.

[5] The value of the target for the euro area reflect the goal of inflation to be close but below 2%.

[6] Using high-pass version of Christiano and Fitzgerald (2003) or Hodrick-Prescott high-pass filter makes little difference.

Figure 1. Stylized Facts – Poland and the Euro Zone



Making the data stationary simply by differencing would be inconsistent with economic fundamentals and would amplify their high-frequency dynamics. The second difference of the price level, or acceleration, has little economic meaning and ignores changes in the goals of the central bank. Further –despite the invertibility of the first-difference filter– the model would be dominated by erratic high-frequency dynamics, suppressing business cycle comovement. The growth rates would also not be zero-mean and the need for careful definition of the model's steady-state would arise.

B. Estimation Procedure

We estimate the model using the least squares method with shrinkage. The shrinkage formulation is essentially in the form of the Litterman prior, see Litterman (1986), adjusted to the case of a mean-reverting process. Parameters are thus shrunk towards zero. The mechanistic nature of the procedure motivates us to stay in a non-Bayesian mode and consider the prior only as a shrinkage device to trade variance of the estimator with bias, see e.g. Hastie, Tibshirani, and Friedman (2009). We shrink the autoregressive parameters towards zero with the weight λ_1, which exponentially increases with the lag length, as determined by the parameter λ_2. When $\lambda_2 = 0$, all lags are treated identically and the shrinkage procedure collapses into a ridge regression.[7]

The choice of lag-length (p) and tightness of the shrinkage is determined by the out-of-sample forecast performance of the model. A priori, setting both parameters is difficult. Bayesian VAR practitioners developed several ways to elicit the prior, either by pre-sample or in-sample forecast performance, or by formulating a system of hierarchical priors, see e.g. Giannone, Lenza, and Primiceri (2012). We choose models that perform well in terms of multi-step projection errors, which should shield us from major errors. Our estimation method is not a direct multistep ahead estimation method, however. Due to the small size of the sample, the lag-length needs to be small and we set $p = 1$.

IV. Results

A. The Role of Domestic and External Shocks

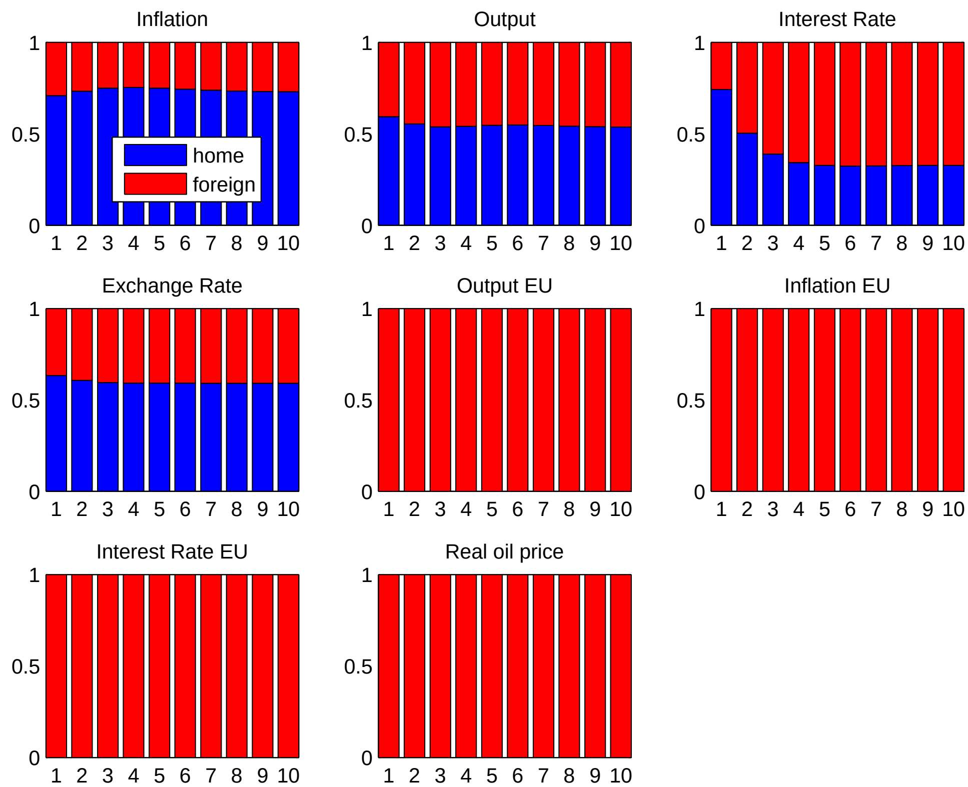
Our results suggest that about half of Poland's business-cycle fluctuations come from external shocks. The share of variance attributed to external shocks in the case of the nominal interest rate is about 60 percent. The variance of inflation, however, is primarily driven by shocks associated with the domestic economy – external shocks total only 25 percent. The exchange rate dynamics at business-cycle frequency reach roughly 40 percent of the variance. Note that a large part of 'unexplained' exchange rate dynamics are attributed to domestic shocks, which also affects the results on inflation. See Figure 2 that depicts the relative forecast error variance decomposition (FEVD) for up to ten quarters.

These results are robust to changes in the estimation sample. The least robust result, however, concerns the exchange rate, where for the period 1999Q1–2008Q1 the contribution of external factors shrinks towards 15 percent. The reason is that during the Great Recession and beyond, the nominal exchange rate movements are correlated with the changes in the price of oil, an external factor by itself.

[7] The formula for the Litterman prior is as follows. The prior mean is zero, $E(A_k)_{ij} = 0$, where k is the lag, and the variance of the prior is $\mathbf{V}[(A_k)_{ij}] = \lambda_1^2/k^{\lambda_2}$ for $i = j$ and $\mathbf{V}[(A_k)_{ij}] = \lambda_3 \times (\lambda_1^2\sigma_i^2)/(k^{\lambda_2}\sigma_i^2)$ otherwise. We set λ_3, which makes lags of other variables of less importance than own lags, to unity.

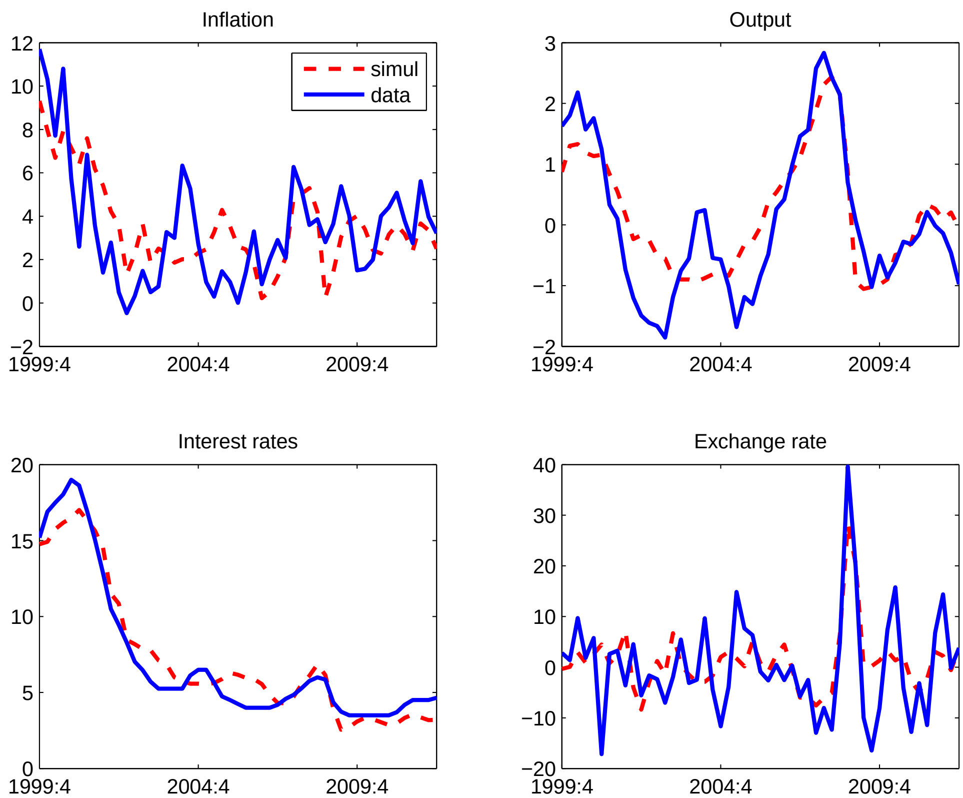
In spite of minimalistic assumptions for structural-shock identification, carrying out a counterfactual exercise is feasible. We do not identify structural shocks individually. However, the two groups of shocks –domestic and external– are identified exactly, and they are orthogonal. We thus simulate the external shocks, given the observed initial conditions, to assess the portion of the dynamics of Poland's economy that is driven by external factors, period-by-period. Note that all shocks in our model are considered unanticipated, as is standard in the case of VAR models. Fig. 3 depicts the actual realization, together with the counterfactual simulation.

Figure 2. FEVD – Home and External Shocks (relative contribution), $T = 2012Q2$



The counterfactual simulation confirms the importance of external shocks. Unlike the forecast error variance decomposition, the simulation allows us to pinpoint periods when external shocks are the most important. There are two somewhat unexpected results, though. First is the close match of the sharp depreciation of the Polish zloty in 2008. This is due to the aforementioned relationship of the exchange rate and external oil prices during and beyond the Great Recession. Second, one would expect that the drop in output due to external developments would be deeper. After all, unlike the euro zone, Poland did not suffer from a deep and prolonged recession. However, again, the almost correct prediction of the exchange rate may ameliorate the effects of a drop in demand. Further, in terms of the peak-to-trough change in the output gap, Poland's slowdown has been also dramatic and on par with the euro zone. The trend, or potential, growth of output in Poland is much higher, however.

Figure 3. Counterfactual Simulation: Only External Shocks

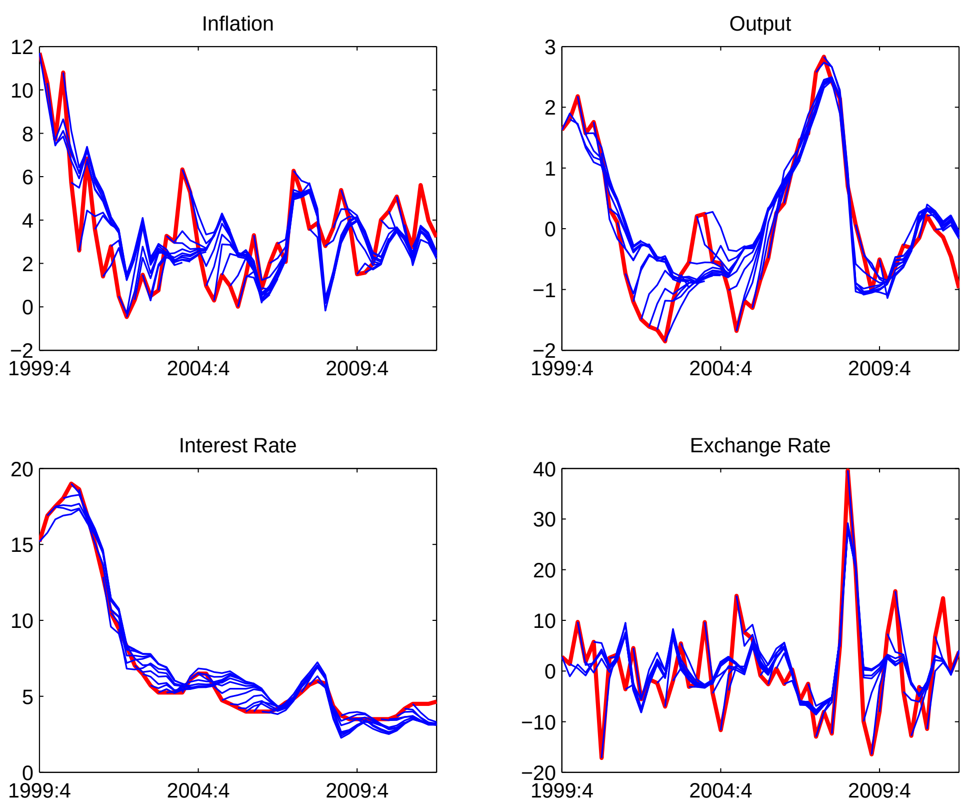


B. Forecasting with trend-cycle VARs

Our tend-cyclical VAR model is not explicitly designed for forecasting, however, it has a vast potential to complement other more structural approaches. Our model does not have a jointly estimated and clear parameterization of the trend process, $\bar{y}_t$. The process for trend output, trend real exchange rate, and real rate of interest can be successfully parameterized, following the lead of structural models, e.g. Carabenciov and others (2008), or an example of a trend-cycle VAR model in Brůha (2011). The multi-period forecasting performance of the model is one of the criteria that help us to assess the plausibility of the model's dynamics.

We judge the n-step ahead forecasting performance of our model as satisfactory. The recursive 8 quarters ahead forecasts, with a given trend component, are depicted in Fig.4. The forecast is conditioned on actual realization of the euro zone variables. The unconditional recursive forecasts are depicted in Fig. 6 in the Appendix. In a true real-time exercise the total forecast error would feature also forecast errors of the trend component, which is, however, of low frequency nature. As we have already pointed out, the crucial benefit of a trend-cycle VAR model is the treatment of the time-varying steady-state of the model. Here, inflation converges eventually to the inflation target and output growth to assumed potential output growth. Note, however, that this is true only after the external, or other conditioning variables are allowed to settle to their respective steady-states.

Figure 4. Conditional In-Sample Forecasts (8 quarters ahead)



For any conditional forecast, the identification of structural shocks is not necessary, unlike in the case of FEVD or counterfactual scenarios. Obviously, due to the parameter constraints imposed by our block-exogeneity assumptions, one cannot condition the developments in the euro zone on evolution of Polish macroeconomic variables. Doing the opposite is, however, straightforward and the block-exogeneity is not the key ingredient here. One can easily condition on the path of the domestic exchange rate, or interest rate – as long as the conditioning with unanticipated shocks makes economic sense. That is the case, usually, for one or two quarters in now-casting and near-term forecasting exercises. The easiest way to carry out the conditioning is to rewrite the trend-cycle VAR in a state-space form and use the Kalman smoother that supports missing observations.

C. A Look into Structural Identification Issues

This paper is not focused on the identification of individual structural shocks, as it tries to be agnostic as much as possible. The minimalistic and realistic modeling assumptions we use allow us to carry out meaningful variance decompositions, counterfactual simulations, and a great deal of forecasting exercises, however.

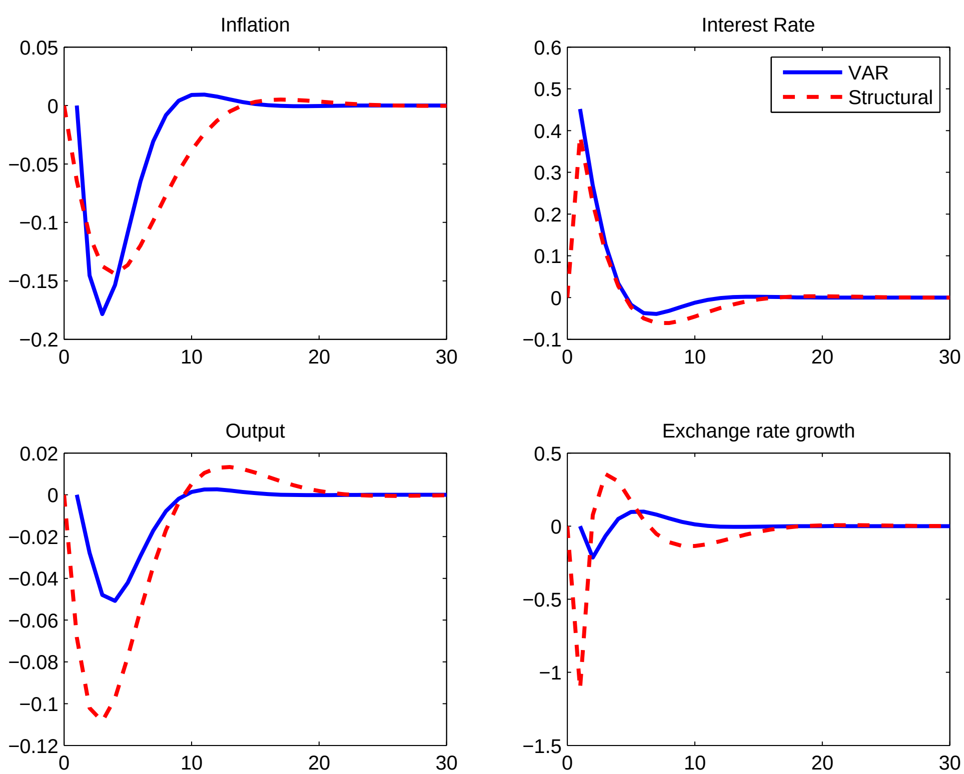
For comparison with the literature, we choose the simplest identification scheme possible and investigate the "monetary policy shock" in Poland. We look at the dynamics of all variables and check the existence of the prize puzzle due to our assertion that the trend-cycle nature of the reduced-form model should the lower chances of running into a price puzzle. We identify a monetary policy innovation by factoring the covariance matrix of residuals using Cholesky decomposition. The ordering implies that the fastest reaction variable is the policy rate, then the exchange rate, inflation and output.

In the case of our specification, the price puzzle is not a feature of our model. Fig. 5 compares the response of domestic variables to a one standard deviation of the policy rate innovation and contrasts it with the response of the forward-looking dynamic New-Keynesian model developed in Andrle and others (2013). The responses to policy rate innovation display important differences, but the sign of the dynamic responses are identical. Again, the biggest disparity arises in the case of the exchange rate response, where response in the VAR is much smaller than in the structural model. The smaller appreciation could, potentially, lower the response of output to the monetary tightening.

Our results are, however, in stark contrast with some previous VAR investigations of monetary policy shocks in Poland. For instance, Demchuk and others (2012) suggest that 30 basis points increase in the policy rate results in a drop in output by 0.2 percent with the peak effect 9–13 quarters after the shock. The depth, duration and signs of their analysis are at odds with ours, or structural models of the Polish economy, see e.g. Demchuk and others (2012). The problem is that the authors do not include foreign variables in their models, use the price level and real variables level, and ignore the changes in the inflation target and the inflation regime altogether. The model thus seems to be seriously misspecified.

It is important to realize, however, that a response of the economy to policy rate innovations does not reveal much about the monetary policy transmission mechanism as such. The 'policy shock' is a non-systematic portion of monetary policy, a disciplined residual. Central bankers' job is to react to all other shocks hitting the economy, in order to maintain price stability and stabilize the economic cycle. It is the systematic response of monetary policy to shocks that should be of utmost importance to students of monetary policy, see e.g. McCallum (1999) for compelling arguments. We illustrate the policy shock only for comparison with the literature and to highlight possible misspecification problems.

Figure 5. Monetary Policy Shock



V. Conclusions

This paper discusses the role of external and domestic shocks for business cycle dynamics in Poland. A carefully designed trend-cycle vector autoregressive model was estimated and domestic together with external shocks identified. To identify the two groups of shocks, it was sufficient to assume that Poland does not affect the developments of the euro zone economy, a plausible assumption for small open economies.

Our results suggest that up to 50 percent of the output variance in Poland is due to external shocks. An analogous result also holds for the nominal interest rate, not a surprising fact in a small open economy. However, only about 25 percent of variance of the headline inflation in Poland is due to external shocks. Headline consumer price inflation features a high share of idiosyncratic variance, also due to changes in regulated prices. The exchange rate is mostly driven by shocks not directly attributable to the euro zone economy or oil prices.

The estimated trend-cycle VAR model focuses exclusively on the business-cycle dynamics of both economies. The design of the model enables us to address misspecification issues arising from the real convergence process of the Polish economy towards the euro zone, trend real exchange rate appreciation due to Harrod-Ballassa-Samuelson hypothesis, or due to the effects of inflation target changes during the period of disinflation.

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Appendix A. Additional Graphs and Results

Figure 6. Unconditional In-Sample Forecasts (8 quarters ahead)