

CAN A TWO-SECTOR BUSINESS CYCLE MODEL ACCOUNT FOR THE 2001 RECESSION OF TURKEY?

S. Tolga Tiryaki*

ABSTRACT This paper investigates whether a two-sector small open economy real business cycle model calibrated to match Turkish data is able to account for the simultaneous sharp reversal in the current account, real exchange rate depreciation, and the severe recession observed in the aftermath of the 2001 financial and currency crisis of Turkey. Estimated shocks for the model's eight exogenous variables are used to simulate model dynamics, and the resulting time series are compared to the actual series. The model does a fairly good job in matching the output drop, while it faces difficulty in matching the sharp real exchange rate depreciation.

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Keywords Business cycles, Turkey

ÖZ Bu çalışmada Türkiye verisine uygun olarak ayarlanan iki sektörlü bir küçük açık ekonomi reel iş çevrimi modelinin, Türkiye'nin 2001 yılındaki finansal ve döviz krizinin ardından yaşadığı eşzamanlı cari işlemler düzeltmesi, para birimindeki reel değer kaybı ve şiddetli durgunluğu açıklamakta yeterli olup olmadığı araştırılmaktadır. Modeldeki sekiz dışsal değişken için tahmin edilen şoklar modelin dinamiklerini simüle etmekte kullanılmış ve elde edilen zaman serileri gerçek serilerle karşılaştırılmıştır. Model çıktıdaki düşüşü yakalamada oldukça başarılı olmakla birlikte para birimindeki keskin değer kaybını yakalamada güçlük çekmiştir.

TÜRKİYE'NİN 2001'DEKİ DARALMASINI İKİ-SEKTÖRLÜ BİR İŞ ÇEVİRİMİ MODELİ AÇIKLAYABİLİR Mİ?

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1. Introduction

An important part of business cycle research agenda since the beginning of 2000s has been directed towards accounting for the differences in business cycle characteristics between emerging market economies and more advanced economies. Early research on business cycles in small open developed economies highlights the importance of terms of trade shocks (Mendoza, 1995), interest rate shocks (Mendoza, 1991; Correia et al., 1995), etc. As small open economies are not large enough to have an influence on world prices, exogenous developments in these prices may have considerable impact on domestic macroeconomic fluctuations, still, notwithstanding the dominant role played by productivity shocks.

Early small open economy models laid the foundations towards recent studies on emerging market business cycles. For example, Neumeyer and Perri (2005), Uribe and Yue (2006), and Tiryaki (2010) start from the observation that emerging markets are prone to paying a (risk) premium over the world interest rate in their borrowing contracts. The interaction of this premium (the country spread) with other factors such as the fundamentals of the economy or the world interest rates introduces a strong propagation mechanism. Moreover, a simple financial friction in the form of a working capital requirement also helps to strengthen the effect of interest rate fluctuations on the volatility of other macroeconomic variables.

Using a two-sector small open economy real business cycle model, Tiryaki (2009) examines the sources of macroeconomic fluctuations in Turkey, and provides an extensive analysis of the causes and propagation of business cycles in a setup which highlights the role of sectoral asymmetries and interactions. The primary finding of Tiryaki (2009) is that the prices of imported inputs and imported tradables are the two most important sources of fluctuations in Turkey. Productivity in the nontradable sector comes next as an important factor behind the fluctuations in most of the quantity variables. Tradable sector productivity, on the other hand, plays a more significant role in the determination of relative prices, such as the relative price of the consumption good and the real exchange rate. The model generates significant asymmetry in the impulse responses of sectoral variables. The performance of the model in matching business cycle moments is reasonably good. The model also shows that variable capital utilization acts as a strong amplification mechanism, especially in the

tradable sector, and reduces the reliance on productivity shocks. Another finding with important policy consequences is that the effect of liability dollarization operates mainly through the tradable sector. The effect of imported tradables price shocks is amplified strongly and the tradable sector's output volatility rises significantly with liability dollarization.

The main objective of this study is to account for the 2001 recession of Turkey using the business cycle model of Tiryaki (2009). The financial and currency crisis of Turkey in 2001 provides us with an environment to take the model to an informal test. We will have a closer look at the collapse of Turkey's exchange-rate-based stabilization plan in 2001 in the next section. We aim to see whether the model can account for the observed evolution of main variables after the crisis. Specifically, we address the question that to what extent the observed sharp reversal in current account, real exchange rate depreciation, and output drops are explained by the model.

One of the central goals of macroeconomics is to understand the sources of aggregate fluctuations. Business cycle models, in general, provide the policymakers with insight into the sources of macroeconomic fluctuations and the transmission channels of various shocks through the economy. The question asked in the paper is whether a two-sector "real" business cycle model can account for the 2001 recession (not "crisis")¹; and the paper identifies some "real" shocks as having non-negligible influence on Turkish business cycles in general and on the 2001 recession in particular. The paper offers the policymaker a set of results which is obtained from a computational experiment carried out using a coherent model structure and parameterization representative of the key characteristics of the Turkish economy.

Nonetheless, there are some macroeconomic policy-related issues that are left out in the analysis and that may have been affected the performance of the model. For example, the restructuring of the banking sector by the government and the consequent fiscal adjustment both have implications also for the recession and the eventual recovery; or adopting the floating exchange rate regime after the collapse of the fixed exchange rate regime implies a very different monetary policy environment.

¹ The model has no intention to explain the making of the 2001 crisis, nor does it have the appropriate structure to deal with such an ambition. The crisis, which was ultimately a financial one, was incorporated in the model through the exogenous shocks. For example, the devaluation of the Turkish lira is reflected on the relative prices of imported tradable goods and imported inputs, while the impact of the banking sector crisis can be found in the country risk premium.

2. A Brief Account of the 2001 Turkish Crisis

In this section, we discuss the evolution of the Turkish economy towards the collapse of the exchange-rate-based stabilization plan which started in January 2000.² The main pillar of the stabilization plan had been a pre-set rate of daily depreciation for 18 months announced in advance. After the initial 18 months, Turkish lira was planned to fluctuate within a gradually widening band, eventually starting to float freely following the latter 18 months of the plan. The pressure on the Turkish lira has become enormous only after 13 months, and the lira had to be set afloat in February 2001. The result was a very severe recession of output. Gross domestic product shrank by 5.7 percent in 2001; current account turned from a deficit of 4.9 percent of GDP in 2000 to a surplus of 2.3 percent of GDP in 2001; trade-weighted CPI-based real exchange rate depreciated by 18 percent in 2001 over the previous year in which the real exchange rate appreciated by 11 percent.

At the outset of the stabilization plan, January 2000, real interest rates came down very rapidly owing to optimistic expectations and sizeable amount of IMF lending. Easing of borrowing conditions led to a consumption and investment boom, also stimulating imports. Coupled with rising crude oil prices, this boom paved the way for an increase in the current account deficit. Growing current account deficit, in turn, added to the fragility of the Turkish economy stemming from the weak banking sector overexposed to both maturity and currency mismatches. Turkish lira was continuously becoming stronger in real terms because of the inertia in domestic inflation under the pre-announced crawling peg regime.

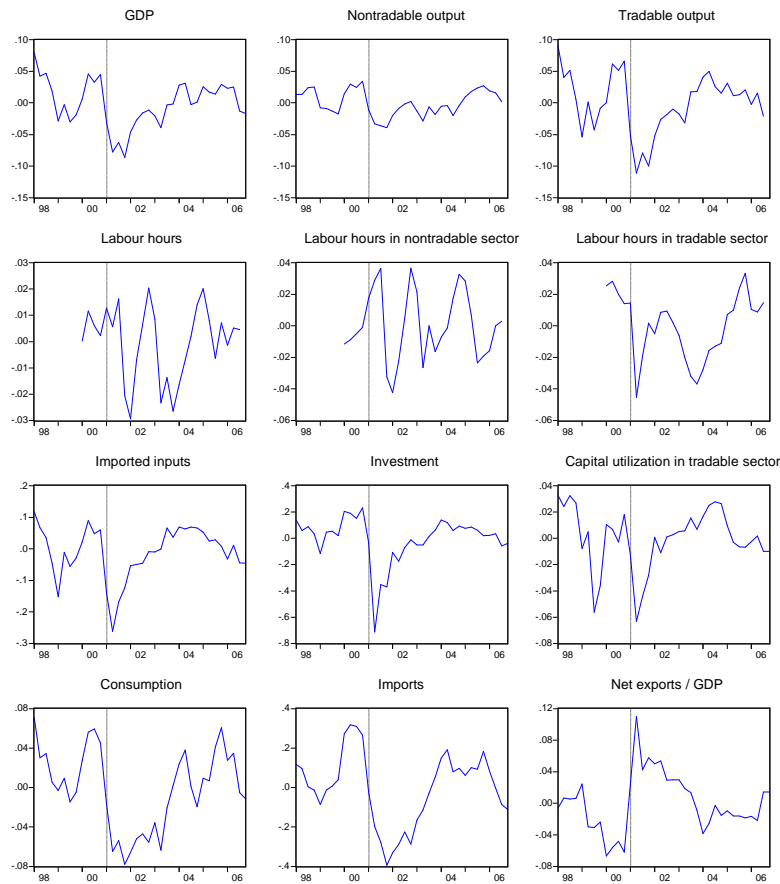
Figures 1 and 2 plot time series of relevant aggregates and prices for the period 1998-2006. All series are in log scale and detrended using the Hodrick-Prescott filter, except, capacity utilization and interest rate components are filtered in levels. Figure 1 illustrates clearly the initial boom in GDP in 2000, and the collapse following the February 2001 crisis (indicated by the vertical dashed line in figures). Notice that tradable sector output falls by almost twice as much as the fall in nontradable output. Both labour hours and capacity utilization in the tradable sector fell sharply during the crisis. Labour hours in the nontradable sector did not initially react, only to catch up by the end of the year.

Imports of both final goods and intermediate goods also fell significantly as the demand for consumption and investment went down. The large decrease in domestic absorption created the strong reversal in the current account.

² Descriptive and analytical studies on the Turkish crisis of 2001 are Alper (2001), Özatay and Sak (2002), Akyüz and Boratav (2003), and Özkan (2005), among others.

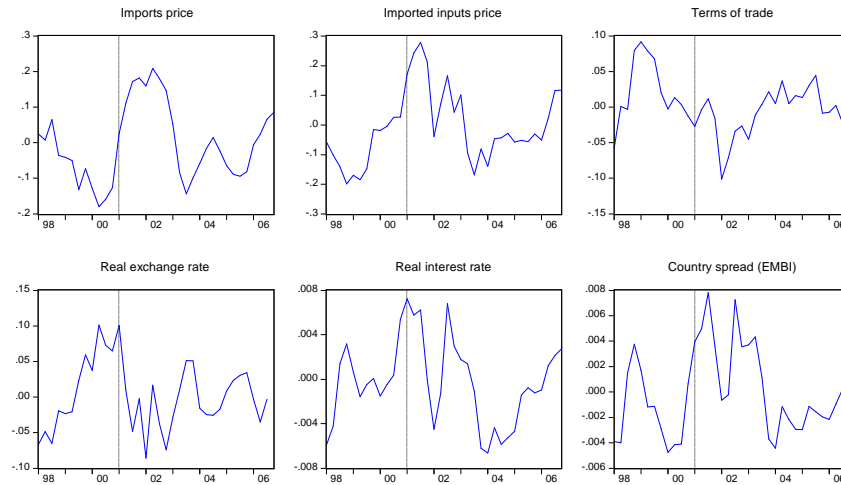
The price of imports relative to the price of nontradable goods rose. Also imported inputs became more expensive, partly due to the coincident rise in crude oil prices. Terms of trade did not change that much because export prices followed a similar pattern to that of import prices. Real exchange rate depreciated sharply. Notice also the symmetry between real exchange rate and import prices.

Figure 1. Evolution of Key Macroeconomic Variables before and after the 2001 Crisis



Note: All series are in log scale and Hodrick-Prescott filtered, except for capital utilization series, which is filtered in levels.

Figure 2. Evolution of Relative Prices and Interest Rates before and after the 2001 Crisis



Note: All series are in log scale and Hodrick-Prescott filtered, except for interest rate and spread series, which are filtered in levels.

3. Model and Methodology

The dynamic stochastic general equilibrium model of Tiryaki (2009) builds on the stylized two-sector neoclassical small open economy business cycle model by enriching the transmission mechanism along several directions. There are two sectors in the economy: nontradable goods producing sector and tradable goods producing sector. Domestically produced tradable goods and imported tradable goods are combined to obtain the final composite tradable good using a constant elasticity of substitution aggregator. Then, this composite tradable good is combined with the nontradable good to obtain the final composite good.

Stochastic shocks are transmitted and propagated through various channels including variable capital utilization, imported intermediate goods, working capital requirement, capital adjustment cost, bond adjustment cost, asymmetries in factor shares of production in the two sectors, asymmetries in the composition of final expenditure groups, and lastly, liability dollarization. There are eight exogenous variables driving the model dynamics: demand for imports in the rest of the world, productivity in tradable and nontradable sectors, government expenditure, relative prices of both intermediate and final goods imports, world interest rate, and country spreads. They are subject to stochastic shocks and assumed to follow AR(1) processes. Detailed description and calibration of the model, and the

solution of the log-linearized system of equations are described in Tiryaki (2009) and available from the author upon request.

Given that the 2001 crisis was a banking and currency crisis, the country spread rate and the real exchange in the model capture different aspects of the linkage between the financial and real sectors. Exogenous fluctuations in the country spread account for most of the variation in real interest rates; and they are transmitted to firms' production decision through the cost of capital channel and the working capital channel, and also transmitted to the household's decisions through the standard consumption smoothing channel. As for the real exchange rate, exogenous fluctuations in the nominal exchange rate are reflected in the real exchange rate to the extent that they change import prices relative to the prices of domestically produced goods and services.

In this study, we take the model's eight exogenous variables and estimate their law of motion equations and the resulting shock terms. We then feed these shocks to the model's equations in order to obtain model's predictions of the behaviour of output, current account, and real exchange rate during the 2001 recession. These three variables constitute the basic stylized facts studied in the literature on sudden stop episodes in emerging market economies. Evidence on sudden stop episodes indicates simultaneous real exchange rate depreciation, significant output drops, and reversal of the current account. It is also possible to view these three variables as a summary of the overall economy. Output represents domestic balance, current account represents external balance (or, equivalently, the domestic savings investment balance), and the real exchange rate represents the adjustment between internal and external balance to maintain general equilibrium.

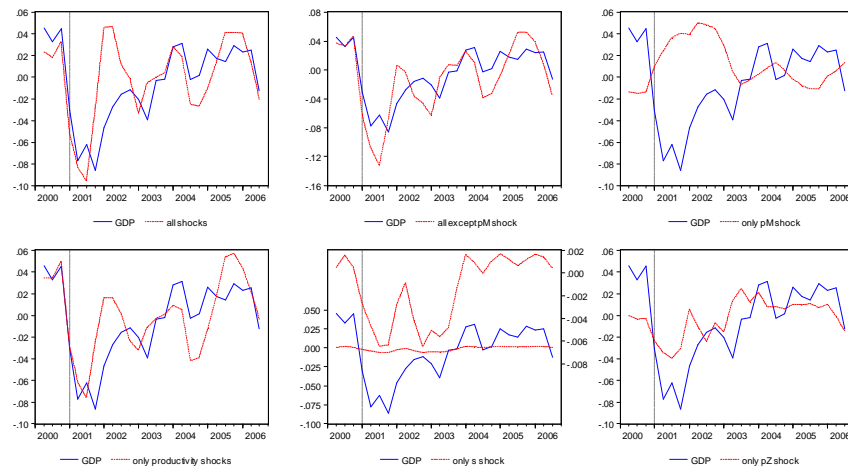
4. Evaluation of Model-Based Time Series after the Crisis

In this section, we discuss the model's ability to replicate key observations during the Turkish crisis in 2001. The focus of the analysis will be whether the model is able to predict simultaneously a prolonged contraction in GDP, real exchange rate depreciation, and sharp current account reversal following the crisis period.

In the first quarter of 2001, when the exchange-rate-based stabilization programme collapsed in February, we observed coincident positive shocks to the prices of imported tradables and imported inputs in the order of approximately 2 standard deviations, and negative shocks to productivity in both sectors in the order of approximately 2 standard deviations, and a positive shock to the country spread component of real interest rate in the order of approximately 1.5 standard deviations.

In Figures 3, 4, and 5, we plot, respectively, the evolution of GDP, net exports to GDP ratio, and real exchange rate before and after the collapse of the exchange-rate-based stabilization programme, as well as the predictions of the baseline model, given the values of estimated shocks. The first plot in each figure presents the combined effect of all shocks; the second plot in the first row plots the combined effect of all shocks except shock to the price of imported tradables; while the third plot shows the isolated effect of imported tradables price shock. The plot on the left hand side of the second row in figures shows the prediction of the baseline model when there are only sectoral productivity shocks in the model. The middle plot in the second row shows the prediction when there is only country spread shock;³ and the plot on the right hand side of the bottom row shows the prediction when there is only imported inputs price shock.

Figure 3. Comparison of Actual and Model-Based GDP Series



According to model's predictions, all shocks, except for the positive imported tradables price shock, that occurred in the first quarter of 2001 worked in contractionary direction (Figure 3). The positive 2-standard-deviation shock to imported tradable price, on the other hand, predicts a counterfactually strong, export-driven output boom. This is due to the excess sensitivity of the impulse response of tradables output to imports price shocks, which is significantly at odds with the expected response that could

³ Notice that the model-based series in this plot are shown in two scales (left and right). In the left scale, the model-based series are drawn at the same scale as the actual series. Yet, the variation caused by only country spread shocks is so small that we draw the model-based series also in the right scale in order to show the correlation between model-based and actual series.

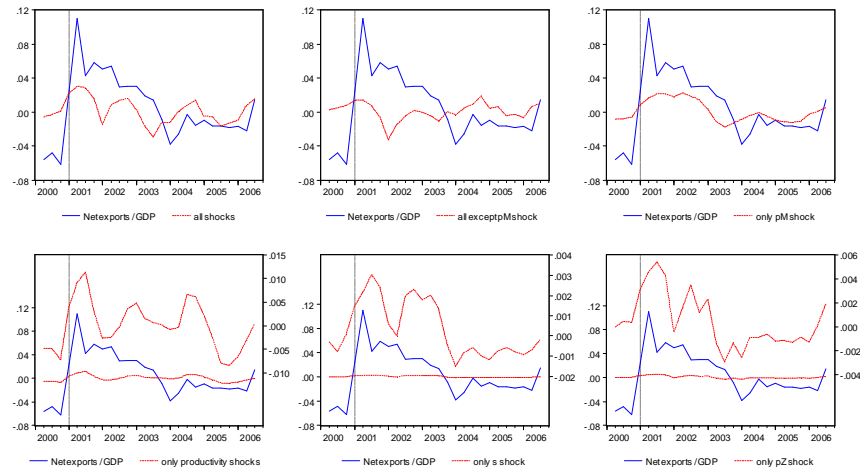
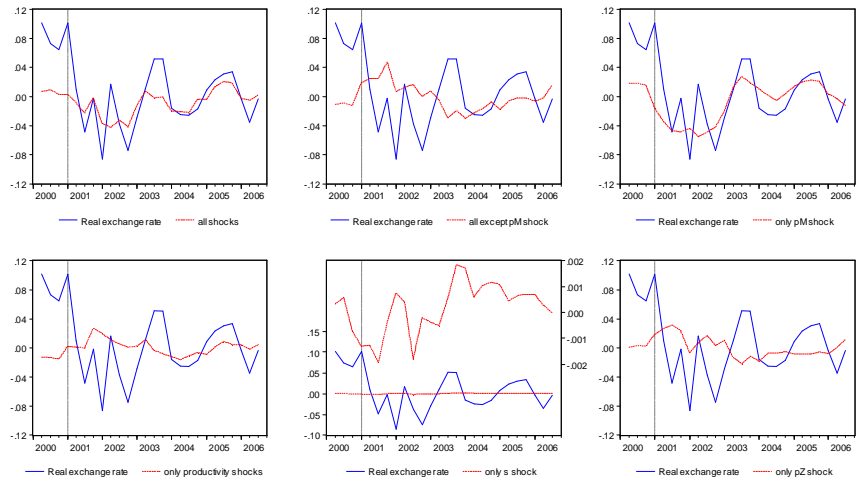
be reconciled with the data. Excluding this effect but keeping all other shocks, the model predicts a sharper collapse in output in the first quarter of 2001, followed by a relatively sluggish recovery. Even productivity shocks alone predict a dramatic collapse of output in the wake of the crisis.

The impact of the anomaly regarding the economy's response to imported tradables price shock can also be seen in Table 1, which shows the correlation coefficients between actual and model-based series under different shock combinations. For example, the model with all shocks produces a correlation coefficient of 0.63 between actual and model-based output series, whereas the model with all shocks except imported tradables price shock produces a correlation coefficient of 0.81. The country spread shock and the imported inputs price shock also lead to a fall in output when considered in isolation, yet these shocks cannot generate sufficiently strong responses in order to account for almost 8 percent fall in output. However, as shown in Table 1, the correlation between model-based and actual series is quite high even when we consider each shock in isolation.

Table 1. Correlations between Actual and Model-Implied Series

	$\rho(y, y^*)$	$\rho(nxy, nxy^*)$	$\rho(rer, rer^*)$
All shocks	0.630	0.490	0.677
All except imported tradables price shock	0.807	-0.195	-0.191
Only imported tradables price shock	-0.728	0.743	0.569
Only productivity shocks	0.695	0.608	-0.309
Only country spread shock	0.801	0.727	0.056
Only imported inputs price shock	0.652	0.636	-0.095

Movements in the net exports/GDP ratio are best tracked by shocks to imports price and country spread. Nonetheless, neither shock is perfectly able to lead to a reversal in the current account balance as sharp as observed in the data (Figure 4). The model predicts too small variability even when exposed to the full suite of shocks.

Figure 4. Comparison of Actual and Model-Implied Net Exports/GDP Series**Figure 5. Comparison of Actual and Model-Based Real Exchange Rate Series**

The structure of the model as a small open economy leads us to take foreign prices as determined exogenously (for tradables) or as given constants (for nontradables). Therefore, real exchange rate movements are caused, to a large extent, by movements in exogenous variables. As it is, the model fails to produce as sharp real exchange rate depreciation as in data;

and, a large part of depreciation came from the shock to the price of imported tradables (Figure 5).

The financial and currency crisis brought about a wide set of policy responses to transform the economy; and these policy responses, which are excluded in the model, may have been affected the performance of the model. Main policy responses to the crisis were (i) the banking sector restructuring and the resulting surge in public debt, (ii) almost a decade-long fiscal adjustment (primary surpluses), (iii) adoption of floating exchange rate and inflation targeting regimes, (iv) microeconomic policy reforms and privatizations. Some of these policy changes can be traced in exogenous shocks, while others may not be captured at all. For example, some economists argue that the effect of the fiscal consolidation during most of the 2000s has been expansionary rather than being contractionary.⁴ Fiscal consolidation, the argument goes, decreases the risk of default by the government, thereby reducing the risk premium. This mechanism is captured in the model by exogenous country spread shocks. As for microeconomic policy reforms and privatizations, one may argue that they increase productivity, which is also captured in the model. Floating exchange rate regime made it possible for the nominal exchange rate to adjust in order to reach equilibrium, whereas, previously other variables, such as the wage rate, among others, had to adjust to reach equilibrium. Moreover, there is evidence that exchange rate pass-through to consumer prices has weakened considerably with the inflation targeting regime (Kara and Ögünç, 2008). The model abstracts from elements such as monopolistic competition, local currency pricing, or pricing to market, therefore the model is lacking an endogenous pricing behaviour, which may have significantly influenced the ability of the model to replicate the time series of the real exchange rate.

5. Conclusion

We carried out an exercise in order to assess whether a two-sector small open economy real business cycle model can replicate the 2001 recession of Turkey. We used the model of Tiryaki (2009) in which propagation of shocks is through various channels including variable capital utilization, imported intermediate goods, working capital requirement, capital adjustment cost, bond adjustment cost, and liability dollarization. The model is calibrated such that it represents the main features of the Turkish economy.

The financial and currency crisis of 2001 was characterized by sizeable shocks in the order of approximately 1.5 to 2 standard deviations to the

⁴ See, for example, Özatay (2008).

imported tradables price, imported inputs price, productivity in tradable and nontradable sectors, and country spread component of the real interest rate. These exogenous variables also account for a great majority of business cycle volatility.

When all of the shocks are used in simulation, the model predicts the fall in output by a close margin, but it is followed by an export-driven rebound in output after two quarters. This is due to the model's excess sensitivity in the response of the economy to imported tradables price shocks. When the imported tradables price shock is excluded, the model yields more realistic time series for output. We also found that movements in the net exports/GDP ratio are best tracked by shocks to import prices and the country spread. However, the model faces difficulty in matching the sharp real exchange rate depreciation.

One implication for policymakers is that the relative prices of imported tradable goods and imported inputs have nontrivial consequences on business cycles in Turkey. However, as the model generates counterfactually strong response of the tradable output to imported tradables price shock, it is likely that the importance of the imported tradables price shock is somewhat exaggerated. Therefore, future models should aim to explain the anomaly that the standard export demand equation generates much stronger expenditure switching effect than what could be reconciled with actual data.

Country spread shocks alone generate model-based series for output and current account that have quite high correlation with actual time series. However, in the current form of the model, country spreads are hardly the major cause of business cycles in terms of magnitudes. Model's lack of amplification power of the country spread shocks, in spite of its ability to generate high correlation between the model-based and actual time series, seems to suggest that the model needs to be augmented with additional amplification mechanisms that specifically address the role of country spreads.

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