A Welfare Evaluation of East Asian Monetary Policy Regimes under Foreign Output Shock
Joseph D. Alba, Wai-Mun Chia, and Donghyun Park assess the welfare impact of external shocks under different monetary policy regimes in East and Southeast Asia. To do so, they numerically solve and calculate the welfare loss function of a dynamic stochastic general equilibrium (DSGE) model with complete exchange rate pass through. Their DSGE model simulation results suggest that consumer price index inflation targeting delivers the least welfare losses for most small open economies in East and Southeast Asia.

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Abstract

Adverse foreign output shocks have a sizable impact on the welfare of small open economies. Therefore, one of the key roles of monetary policy in those economies is to minimize the welfare losses arising from such shocks. To assess the welfare impact of external shocks under different monetary policy regimes, we numerically solve and calculate the welfare loss function of a dynamic stochastic general equilibrium model with complete exchange rate pass through. We find that consumer price index (CPI) inflation targeting minimizes welfare losses for import-to-gross domestic product (GDP) ratios from 0.3 to 0.9. However, welfare under the pegged exchange rate regime is almost equivalent to CPI inflation targeting when the import-to-GDP ratio is 1, while the domestic inflation targeting minimizes welfare when the import-to-GDP ratio is 0.1. We calibrate the model and derive welfare implications for eight East Asian small open economies.
I. Introduction

Adverse foreign output shocks have a sizable impact on the macroeconomic performance of small open economies. For example, the sharp recession of the advanced economies due to the global financial and economic crisis of 2008–2009 had a pronounced effect on the export and growth of East Asia’s highly open, export-dependent economies. Table 1 shows the cumulative contraction in real gross domestic product (GDP) growth, relative to trend, of 11.8% to 13.08% for Singapore; Taipei, China; and Hong Kong, China. For the Republic of Korea, Malaysia, the Philippines, and Thailand, it was 7.3% to 8.26%. Table 1 confirms that the primary channel for the transmission of the global crisis to East Asia was the trade channel. The cumulative contraction of real export growth ranged from 5.96% for Indonesia to 38.78% for Thailand. It is not surprising that exports have a large impact on the real GDP of East Asian economies in light of their heavy export dependence. The ratio of exports to GDP even exceeds 100% in Hong Kong, China; Malaysia; and Singapore.

In light of their large effect on the macroeconomic outcomes of small open economies, we can expect adverse foreign output shocks to have a large effect on their welfare. Therefore, one of the key roles of monetary policy in those economies is to minimize the welfare losses arising from such shocks. Table 1 shows the various monetary and exchange rate policy regimes adopted by East Asian economies. Hong Kong, China and Singapore have fixed and pegged exchange rate regimes respectively while the Republic of Korea, Indonesia, the Philippines, and Thailand have adopted inflation targeting policies. Malaysia and Taipei, China aim to do both, i.e., stabilize prices and intervene in the foreign exchange rate markets. Economies that target exchange rates—Hong Kong, China; Singapore; and Taipei, China—showed lower average changes in exchange rates than countries that target inflation—Indonesia, the Republic of Korea, the Philippines, and Thailand.¹ The exception is Malaysia, which target both variables but experienced an average change in exchange rate closer to inflation targeting countries. In addition, economies that target the exchange rate suffered a visibly larger cumulative decline in real GDP compared to economies that target inflation. Inflation has been generally low for all economies regardless of policy regimes.²

¹ Hong Kong, China; Singapore; and Taipei, China experienced the smallest average percentage change in exchange rates of −0.42%, −3.01%, and 3.98%, respectively. In contrast, Indonesia, the Republic of Korea, the Philippines, and Thailand experienced an average percentage change in exchange rates in the range of 6.92% to 27.16%. Malaysia, which targets both exchange rate and inflation but experienced an average change in exchange rate of 6.90%, which is closer to inflation-targeting countries, is an exception.

² In fact, Indonesia and Thailand experienced deflation.
Table 1: Selected Economic Indicators of Small Open Economies in East Asia

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<th>Economy</th>
<th>Cumulative Change in Real GDP Growth (%)</th>
<th>Average Change in CPI Inflation (%)</th>
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<th>Cumulative Change in Real Export Growth (%)</th>
<th>Percentage of Export over GDP</th>
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<tr>
<td>Hong Kong, China</td>
<td>–13.08</td>
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<tr>
<td>Singapore</td>
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</tr>
<tr>
<td>Taipei, China</td>
<td>–12.04</td>
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<td>40</td>
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<td><strong>ASEAN 4</strong></td>
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</tr>
<tr>
<td>Indonesia</td>
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<td>–2.55</td>
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<td>31.54</td>
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</tr>
<tr>
<td>Malaysia</td>
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<td>0.21</td>
<td>6.92</td>
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<td>102.24</td>
<td>90</td>
<td>Aims for stable prices and stable effective exchange rate</td>
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<tr>
<td>Philippines</td>
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</tr>
<tr>
<td>Thailand</td>
<td>–8.26</td>
<td>–1.11</td>
<td>7.61</td>
<td>–38.78</td>
<td>57.61</td>
<td>64</td>
<td>Inflation targeting</td>
</tr>
<tr>
<td>Benchmark: US</td>
<td>–6.72</td>
<td>–1.29</td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td>Taylor rule</td>
</tr>
</tbody>
</table>

ASEAN 4 = Indonesia, Malaysia, the Philippines, and Thailand; CPI = consumer price index; GDP = gross domestic product; US = United States.

Note: We consider the first quarter of 2008 as the benchmark date of the 2008 financial crisis. We follow Blanchard and Gali (2007) in calculating the cumulative change in real GDP gain or loss over eight quarters following benchmark date relative to the trend given by the cumulative real GDP growth rate over the preceding eight quarters. The change in CPI inflation (national currency to US dollar) is the average rate of inflation (depreciation or appreciation) in eight quarters following each of the benchmark date minus the average inflation (depreciation or appreciation) rate over the eight quarters immediately following the benchmark date. A positive (negative) sign in the fourth column indicates the depreciation (appreciation) of the national currency against the US dollar. Murray, Nikolisko-Rzhevskyy, and Papell (2008) argue that the US Federal Reserve followed the Taylor principle from 1985–2009. Exchange rate is defined as national currency per US dollar.

Sources: All quarterly data are from CEIC Data on Emerging Markets except for export and import as a percentage of GDP, which are from the World Development Indicators online (August 2011). When available, seasonally adjusted real GDP are used. Information on countries that target inflation are from Truman (2003) except for Indonesia, which is from the Bank of Indonesia website. Information on the monetary policy of Singapore is from the Monetary Authority of Singapore website. Information on the monetary policies of Malaysia and Taipei, China are from the Economic Intelligent Unit’s 2008 Country Reports.
The central objective of this paper is to evaluate and compare the welfare impact of external shocks under different monetary and policy regimes. More specifically, we look at the welfare effects of foreign output shocks under seven different types of monetary and exchange rate policy regimes—a fixed or pegged exchange rate rule, a consumer price index (CPI) inflation targeting rule, inflation and exchange rate targeting rule, domestic inflation targeting, Taylor-type rule, nominal output targeting, and real output targeting. We do so for eight small open economies in East Asia—Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei, China, and Thailand—to assess and compare the extent to which each monetary and exchange rate policy regime protects each of the eight economies from external shocks. Our welfare evaluation is based on numerically solving and calculating the welfare loss function of a dynamic stochastic general equilibrium (DSGE) model. We calibrate the model to derive welfare implications for the eight countries.

Our paper is broadly similar with Alba, Su, and Chia (2011) in its methodology. More precisely, the two papers both use a model that is broadly based on Monacelli’s (2004) DSGE model of a small open economy. However, Alba, Su, and Chia (2011) examine the impact of a negative foreign output shock on the volatility of macroeconomic variables under alternative monetary and exchange rate policy regimes while we examine the more fundamental, policy-relevant issue of the impact of such a shock on welfare. While macroeconomic volatility is important, it is a much less complete yardstick for evaluating policy regimes than welfare. Furthermore, the analysis of Alba, Su, and Chia (2011) is limited to three policy regimes and four countries. Their main finding is that small open economies that follow either fixed exchange rate or inflation targeting tend to stabilize real exchange rate and inflation but at the expense of substantial volatility in the real economy.

Our paper evaluates and compares the welfare losses of foreign output shocks under alternative monetary and exchange rate policy regimes, and is thus able to inform us about the relative desirability of different policy regimes. Such a welfare comparison is useful for determining the optimal monetary and exchange rate policy regime in East Asia’s small open economies that are highly dependent on trade and hence vulnerable to foreign output shocks. The pronounced impact of the 2008–2009 recession in the advanced economies is a vivid reminder of this vulnerability. The central question we seek to answer is the following: which monetary and exchange rate policy regime leaves East Asian small open economies best off under external shocks? The rest of this paper is organized as follows. Section II explores the relationship between monetary and exchange rate policy regimes and macroeconomic performance. Section III specifies our model. Section IV reports and discusses the main results, and Section V concludes the paper.
II. Role of Monetary and Exchange Rate Policies in Cushioning External Shocks

The current crisis calls for a re-examination of macroeconomic policies in general and monetary and exchange rate policies in particular. Stiglitz (2008) argues that inflation targeting is inappropriate, especially for emerging economies where energy and commodities make up a larger share of the household budget compared to industrialized countries. Other economists have suggested alternative monetary policy targets such as nominal GDP.\(^3\) In addition, Blanchard, Dell’Ariccia, and Mauro (2010) argue that there may be a case for the emerging market central bankers’ practice of targeting inflation while also intervening in the foreign exchange markets. Despite the criticism of inflation targeting, de Calvalho Filho (2010) finds that inflation-targeting countries outperformed noninflation-targeting countries in the post-2008 period. He argues that during the crisis, inflation targeting countries lowered nominal interest rates by more, resulting in even larger real interest rate differentials and thus an even stronger monetary stimulus.

The theoretical and empirical literature also suggest a number of rationales for why different monetary and exchange rate policy regimes may differ in their capacity to protect countries from external shocks. For example, it is often argued that countries with flexible exchange rate regimes can better insulate their economies from negative real shocks.\(^4\) In a study that is highly relevant to the transmission of foreign output shocks to East Asia during the 2008–2009 crisis, Hoffmann (2007) uses data from a sample of 42 developing countries to test the hypothesis that flexible exchange rates serve as a shock absorber in small open economies, and mitigate the impact of external shocks more effectively than fixed exchange rate regimes. Hoffman finds that countries with more flexible nominal exchange rates suffer smaller decline of real GDP. This is due to real exchange rate depreciation, which improves external competitiveness and thus partly offsets the negative impact of foreign output shocks.

In this paper, we evaluate and compare the welfare loss due to foreign output shocks in East Asia’s small open economies under alternative monetary and exchange rate policy regimes. To do so, we develop a simple DSGE model that contains a goods market characterized by imperfect competition and nominal rigidities.\(^5\) We numerically solve and calculate the welfare loss function of the DSGE model under seven types of monetary and exchange rate policy regimes—a fixed or pegged exchange rate rule, a CPI inflation targeting rule, inflation and exchange rate targeting rule, domestic inflation targeting,

\(^3\) A debate on nominal GDP targeting among economists could be accessed online at http://economistsview.typepad.com/economistsview/2010/12/bernanke-and-mishkin-on-nominal-gdp-growth-targeting.html


\(^5\) There is a large and growing literature on open economy DSGE models that incorporate imperfect competition and nominal rigidities. Obstfeld and Rogoff (1995 and 1996) initiated open-economy macroeconomics research based on a synthesis of dynamic intertemporal approaches and sticky-price models of macroeconomic fluctuations. This synthesis is known as the new open economy macroeconomics. Many economists have relied on this new class of models to address many classical problems with new tools, and to generate new research ideas and questions.
Taylor-type rule, nominal output targeting, and real output targeting. The open economy framework makes it possible to examine the exchange rate channel in the transmission of foreign output shocks to the domestic economy. We assume foreign output shocks to be exogenous.

Many DSGE models consider only two factor inputs. In contrast, we follow Kim and Loungani (1992) and assume oil to be an input in a constant elasticity of substitution (CES) production function where oil and capital are substitutes. Hence, our model captures an important stylized fact of global energy use, i.e., more developed economies use less energy per unit of capital than less developed economies. In addition, it is possible that exchange rate depreciation affects the price of imported oil which, in turn, affects domestic output. We follow Monacelli (2004) and assume that capital is subject to adjustment costs. Each monetary and exchange rate policy regime implicitly assigns different weights on overall inflation, domestic inflation, the output gap, and exchange rate in the interest rate rule. By explicitly evaluating and comparing the welfare loss due to foreign output shocks under different types of monetary policy regimes, we address the extent to which different policy regimes mitigate the loss of welfare.

III. The Model

In this section, we lay out our model, which is broadly based on Monacelli’s (2004) DSGE model of a small open economy. Identical and infinitely lived households earn income from working for and renting physical capital to domestic firms. They consume baskets of differentiated domestic and foreign tradable goods.

A. Households

The domestic economy is populated by a continuum of infinitely lived identical households. They consume baskets of differentiated domestic and foreign goods that are both tradable and indexed by $j$. The baskets of domestic and foreign varieties of goods are associated with utility-based price indices $P_{H,t} \equiv \left( \int_0^1 P_{H,t}(j)^{1-\theta} \, dj \right)^{1/\theta}$ and $P_{F,t} \equiv \left( \int_0^1 P_{F,t}(j)^{1-\theta} \, dj \right)^{1/\theta}$, respectively, where the $H$ is the index for home and $F$ for foreign. The price indices are expressed in units of domestic currency. $P_{H,t}(j)$ and $P_{F,t}(j)$ are prices of the individual domestic and foreign good $j$, respectively, where $\theta > 1$ is the elasticity of substitution between varieties within each category. The utility-based consumer price index is given by $P_t = \left( \gamma P_{H,t}^{1-\rho} + (1-\gamma) P_{F,t}^{1-\rho} \right)^{1/(1-\rho)}$. 

In each period, the households optimally allocate their expenditure on differentiated goods within each category. The demand functions are:

\[
C_{H,t}(j) = \left( \frac{P_{H,t}(j)}{P_{H,t}} \right)^{-\vartheta} C_{H,t}; \quad C_{F,t}(j) = \left( \frac{P_{F,t}(j)}{P_{F,t}} \right)^{-\vartheta} C_{F,t}
\]

(1)

for all \( j \) goods within the interval of 0 and 1, where the goods are produced by a continuum of firms and the firms are owned by domestic households.

\[
C_{H,t} = \left( \int_0^1 C_{H,t}(j)^{\vartheta - 1/2} dj \right)^{2/3 - 1} \quad \text{and} \quad C_{F,t} = \left( \int_0^1 C_{F,t}(j)^{\vartheta - 1/2} dj \right)^{2/3 - 1}
\]

are composite indices of domestic and foreign goods, respectively. The households consume a CES composite of both home products \((C_H)\) and foreign products \((C_F)\):

\[
C_t = \left( \gamma^{\psi \rho} C_{H,t}^{\vartheta - 1/\rho} + (1 - \gamma)^{\psi \rho} C_{F,t}^{\vartheta - 1/\rho} \right)^{\psi/\rho - 1}
\]

(2)

where \( \gamma \in [0,1] \) is the share of home-produced goods in total consumption so \((1 - \gamma)\) represents the share of foreign-produced goods. \( \rho > 1 \) is the elasticity of substitution between domestic and foreign goods. Investment composite index \( I_n, \) \( (I_{H,t}, I_{F,t}) \) has an identical expression as consumption for simplicity. The optimal allocation of any given expenditure between domestic and foreign goods yields the consumption demand

\[
C_{H,t} = \gamma \left( \frac{P_{H,t}}{P_t} \right)^{-\rho} C_t; \quad C_{F,t} = (1 - \gamma) \left( \frac{P_{F,t}}{P_t} \right)^{-\rho} C_t
\]

The representative domestic household maximizes the utility function over time:

\[
E_t \sum_{t=0}^{\infty} \beta^t \left[ \frac{C_{t,1}^{-\sigma}}{1 - \sigma} - \frac{N_{t,1}^{\psi \rho}}{1 + \varphi} \right]
\]

(3)

where \( \sigma > 0 \) and \( \varphi > 0 \), \( \beta \) is the discount factor and \( \beta \in (0,1) \). \( 1/\sigma \) is the intertemporal elasticity of substitution and \( \varphi \) is the elasticity of labor substitution. \( E_t \) is the expectation operator. \( C_t \) is the consumption and \( N_t \) is the labor supply of the representative household at time \( t \).

The representative household holds securities denominated in domestic currency, rents out its capital to the home-based monopolistic competitive firm, and derives income from working for each time \( t \). Hence, the household’s budget constraint is written as:

\[
P_t (C_t + ln_t) + \sum_{h, t} \nu_{t, t+1} (B_{t+1}) = W_t N_t + Z_t K_t + B_t + \tau_t
\]

(4)

where \( B_{t+1} \) is the portfolio of state contingent securities household holds at the end of \( t \), \( \nu_{t, t+1} \) is defined by Monacelli (2004) as the pricing kernel of state contingent portfolio equal to \( \nu = (h_t^{t+1})' h_t^{t+1} \) where Monacelli lets \( h_t \) be the history of events up to period \( t \) and the date 0 probability of observing \( h_t \) is defined as \( d_t \) where at the initial
state \( d(h^0) = 1 \). Monacelli defines the expectation operator \( E_t \{ \cdot \} = \sum_{h_t} d(h_t^{t+1} | h^t) \). \( W_t \) is the nominal wage, \( Z_t \) is the nominal rental cost, and \( \tau_t \) represents the lump-sum transfer payment.

Following Monacelli, capital accumulation is described as:

\[
K_{t+1} = (1 - \delta) K_t + \Phi \left( \frac{\ln_t}{K_t} \right) K_t
\]

where \( \delta \) is the physical depreciation rate of capital. \( \Phi(.) \) is an increasing and concave function that assumes the adjustment cost in capital accumulation. Hence, \( \ln_t \) units of investment translate into \( \Phi(\ln_t/K_t)K_t \) units of additional capital.

With the arbitrage condition holding, it implies that

\[
\frac{1}{R_t} = \sum_{h_t} v_{t,t+1} \quad \text{and} \quad \frac{1}{R_t^*} = \sum_{h_t} \frac{\epsilon_{t+1}}{\epsilon_t}
\]

given that \( R_t \) and \( R_t^* \) are expected returns in terms of domestic and foreign currency on the bond portfolio. Monacelli equalizes these returns to get

\[
\sum_{h_t} v_{t,t+1} [R_t - R_t^* \frac{\epsilon_{t+1}}{\epsilon_t}] = 0
\]

The rest of the world is assumed to have foreign households with similar preferences as the home country so that foreign demand for home produced good \( j \) is

\[
C_{H,t}^*(j) = \left( \frac{P_{H,t}^* (j)}{P_t^*} \right)^{-\rho} \quad \text{where} \quad C_{H,t}^* = (1 - \gamma^*) \left( \frac{P_{H,t}^*}{P_t^*} \right)^{-\rho} \quad C_t^*.
\]

### B. Domestic Firms

Labor, capital, and oil are inputs to production described by the constant elasticity of substitution CES production function. Oil is included in the CES function following Alba, Su, and Chia (2011). There is a continuum of monopolistically competitive firms which are indexed by \( j \in [0, 1] \). The CES production function with constant return to scale has the following specification:

\[
Y_t(j) = A_t [i K_{t}^{\alpha} (j) + (1-i) O_{t}^{\nu} (j)]^{(1-\alpha)/(1-\nu)} N_t^\alpha (j)
\]

where \( 0 < \alpha < 1, \ i > 0 \) and \( \nu > 0 \). The elasticity of substitution between capital and oil is equal to \( 1/\nu \) while labor share in production is given by \( \alpha \).

---

\[ R_t = 1 + i_t \] where \( i_t \) is the nominal interest rate.

For details, please refer to Alba, Su, and Chia (2011). Similarly, Backus and Crucini (2000) and Kim and Loungani (1992) nest capital and oil as a CES function within a Cobb-Douglas production function while Rotemberg and Woodford (1996) and Blanchard and Gali (2007) consider oil and labor as inputs to production. Alternatively, Finn (2000) assumes oil and capital as complimentary. The complementarity or substitutability of oil and capital are unresolved in empirical literature. For a survey of the literature, please refer to Apostolakis (1990). In addition, Bodenstein, Erceg, and Guerrieri (2008) consider oil as part of household consumption while Aoki (2001) examines the relationship between sector-specific supply shocks such as oil price shocks and inflation fluctuations.
Monacelli (2004) follows Calvo’s (1983) pricing. A fraction $1 - \phi_p$ of all firms adjusts their prices randomly while the rest of the firms, $\phi_p$, do not adjust their prices. The parameter $\phi_p$ represents the degree of nominal rigidity whereby a larger $\phi_p$ implies fewer firms adjusting their prices, causing a longer expected time between price adjustments. Firms’ future profits at $t+k$ are affected by the choice of price at time $t$ only if the firm does not get another opportunity to adjust its price between $t$ and $t+k$. The domestic firm $j$ will set price $P_{H,t}^{\text{new}}$ to maximize the profit function:

$$E_t \left\{ \sum_{k=0}^{\infty} \beta^k \phi_p^k \Lambda_{t+k} \left[ P_{H,t}^{\text{new}}(j) - MC_{t+k}(j) \right] Y_{t+k}(j) \right\},$$

subject to the domestic and foreign demand given by $Y_{t+k}(j) \leq \left( \frac{P_{H,t}^{\text{new}}(j)}{P_{H,t+k}} \right)^{\epsilon} \left[ C_{H,t+k} + C_{H,t+k}^* \right]$

where $\Lambda_{t+k}$ is the time-varying portion of the firm’s discount factor. Hence, the optimal pricing condition is:

$$P_{H,t}^{\text{new}}(j) = \left( \frac{\epsilon}{\epsilon - 1} \right) \frac{E_t \left\{ \sum_{k=0}^{\infty} \beta^k \phi_p^k \Lambda_{t+k} \left[ P_{H,t}^{\text{new}}(j) - MC_{t+k}(j) \right] Y_{t+k}(j) \right\}}{E_t \left\{ \sum_{k=0}^{\infty} \beta^k \phi_p^k \Lambda_{t+k} Y_{t+k}(j) \right\}}.$$  \hfill (8)

The above equation describes the dynamic markup for price setting. When the price signal $\phi_p$ equals zero, equation (8) becomes $P_{H,t}^{\text{new}}(j) = \frac{\epsilon}{\epsilon - 1} MC_t$. With symmetric equilibrium, the domestic aggregate price index is:

$$P_{H,t} = \left[ \phi_p P_{H,t-1} + \left( 1 - \phi_p \right) \left( P_{H,t}^{\text{new}} \right) \left( \frac{\epsilon}{\epsilon - 1} \right) \right].$$  \hfill (9)

### C. Price Level, Terms of Trade, and Real Exchange Rate

The nominal exchange rate $\epsilon_t$ is the price of one unit of foreign currency in terms of domestic currency. Assuming the law of one price holds, $P_{H,t} = \epsilon_t P_{F,t}^{*}$ and $P_{F,t} = \epsilon_t P_{F,t}^{*}$. The terms of trade, $S_{t}$, is defined as the price of the imported good relative to the price of the domestic good ($S_{t} = P_{F,t}^{*} P_{H,t} = \epsilon_t P_{F,t}^{*} P_{H,t}$). The real exchange rate is then defined as $\epsilon_t' = \frac{\epsilon_t P_{F,t}^{*}}{P_t}$.

For a small open economy, domestic price changes do not affect the foreign price level. So without loss of generality, we assume that $P_{F,t} = P_t^{*}$, where the foreign price level is determined by the prices of non-oil goods and oil. Hence, it can be expressed as
\(P_t^* = (P_{NO,t}^*)^{\gamma_{NO}} (P_{O,t}^*)^{1-\gamma_{NO}}\). For simplicity, we normalize \(P_{NO,t}^*\) to one so the foreign non-oil inflation, \(\pi_{NO,t}^*\), is zero. The total CPI inflation is defined as \(\pi_t = \log(P_t/P_{t-1})\) and the domestic inflation is defined as \(\pi_{H,t} = \log(P_{H,t}/P_{H,t-1})\).

**D. Monetary Policy and Exchange Rate Regimes**

Following Monacelli (2004), deviations of inflation, output, and nominal exchange rate from their long-run target have feedback effects on short-run movements of the nominal interest rate target given by:

\[
1 + \tilde{i}_t = \left(\frac{P_t}{P_{t-1}}\right)^{\omega_\pi} Y_t^{\omega_y} e_t^{\omega_\epsilon}
\]

where \(\tilde{i}_t\) is the inflation target and \(\omega_\pi\), \(\omega_y\), and \(\omega_\epsilon\) are weights assigned to the movements of CPI inflation, output, and nominal exchange rate, respectively. Rather than CPI inflation, equation (10) could be modified to consider domestic inflation, where inflation could be written as \(\left(\frac{P_{H,t}}{P_{H,t-1}}\right)^{\omega_{\pi,H}}\), where \(\omega_{\pi,H}\) is the weight on domestic inflation. The actual short-run interest rate is determined based on the monetary authority’s desire to smooth changes in the nominal interest rate:

\[
1 + i_t = (1 + \tilde{i}_t)^{1-X} (1 + i_{t-1})^{X}
\]

The exogenous stochastic processes for the foreign output, foreign interest rate, domestic technology, and nominal oil price can be summarized as:

\[
Y_t^* = Y_{t-1}^* \exp(\xi_t^Y), (1 + i_t^*) = (1 + i_{t-1}^*)^{\omega_{iH}} \exp(\xi_t^{iH}), A_t = A_{t-1}^{\omega_A} \exp(\xi_t^{\omega_A})\]

and

\[
P_{O,t}^* = (P_{O,t-1}^*)^{\omega_O} \exp(\xi_t^{\omega_O}),
\]

respectively.8

**E. Welfare**

We analyze the impact of various monetary policy regimes based on social welfare loss function minimized by the central banks. The function is based on the second-order Taylor expansion of the household’s utility around the steady state as in Rotemberg and Woodford (1998 and 1999) and Woodford (2003), and extended to small open economies by Chung, Jung, and Yang (2007) and Divino (2009). The social welfare loss function is derived as in Walsh (2010) and could be expressed as:

\[
W = -\Omega E_0 \sum_{t=0}^{\infty} \beta_t \left\{ \delta_t^2 + \lambda (\hat{y}_t - y_t^{\text{flexible}})^2 \right\}
\]

8 The first order conditions, the steady state and market equilibrium, and the log-linearized equations are available from the authors upon request.
where
\[ \Omega = \frac{1}{2} U \hat{C} \begin{bmatrix} \varphi_p & \varphi_p \\ \frac{1 - \varphi_p}{1 - \varphi_p \beta} & \frac{1 - \varphi_p}{1 - \varphi_p \beta} \end{bmatrix} \left( \sigma - 1 \right) \left( \sigma - 1 \right) \lambda, \]
and
\[ \hat{y}_f^{\text{flexible}} \]
is obtained by setting the probability of nonadjustment in price, \( \varphi_p \), close to zero.
We set the inverse of elasticity of intertemporal substitution, \( \sigma \), and the elasticity of substitution between home and foreign produced goods, \( \rho \), equal to 1 following Gali and Monacelli (2005). They show that using this specification together with the assumptions of purchasing power parity and uncovered interest parity, the combined effects of market power and terms of trade distortions could be offset so that under flexible price equilibrium, domestic inflation targeting is the optimal monetary policy. Equation (12) measures welfare loss as a second order approximation to the utility loss of the domestic consumer resulting from deviations from optimal monetary policy. Following Lucas (1987), alternative monetary policies are specified in the context of a simple DSGE model and the welfare losses are compared to draw policy implications.

F. Model Parameterization

The model is solved numerically and parameterized following Monacelli (2004). The marginal disutility of work effort \( \varphi \) is set to 3. As common in the Calvo (1983) pricing models, the probability of price nonadjustment, \( \phi \), is set at 0.75. The steady-state markup, \( \beta / (\beta - 1) \), equals to 1.2. The labor share of output equals 0.70. The elasticity of investment rate to the price of capital \( \eta \) equals 3.

The monetary policy regime parameters are set as follows: The interest rate smoothing parameter, \( \chi \), is 0.5. \( \omega_e = 0.99 \) for fixed or pegged exchange rate, while \( \omega_e = 0.1 \) for flexible exchange rate. Under the flexible exchange rate regime, the central bank could choose to target only CPI inflation so \( \omega_\pi = 1.5 \) and \( \omega_y = 0 \) or only domestic inflation such that \( \omega_\pi y = 1.5 \) and \( \omega_y = 0 \); or choose to follow the Taylor rule so \( \omega_\pi = 1.5 \) and \( \omega_y = 0.5 \); or target nominal output and set \( \omega_\pi = 1.5 \) and \( \omega_y = 1.5 \) or real output and set \( \omega_\pi = 0 \) and \( \omega_y = 1.5 \); The central bank could also target CPI inflation and exchange rate and set \( \omega_\pi = 1.5 \), \( \omega_y = 0 \) and \( \omega_e = 0.8 \).

As in Alba, Su, and Chia (2011), the parameters of the serial correlation of the oil price shocks (\( \rho^v \)), foreign interest rate (\( \rho^i \)), foreign output (\( \rho^y \)), and technology (\( \rho^a \)) are set to 0.90. The degrees of the impact of oil price on the foreign price level (\( \gamma^{NO} \)) equals 0.01 for a positive oil price shock and 0.001 for a negative oil price shock. These reflect the asymmetric effect of oil price shocks. These asymmetric effects also imply that a positive oil price shock has significant effect on marginal cost while a negative oil price shock has negligible effect on marginal cost. The share of capital relative to oil in production (\( \iota \)) is 0.90. The standard deviations from the steady state of oil price (\( \sigma^{\hat{p}_o} \)) of

---

9 The numerical solution of the model is described in Uhlig (1997).
10 For example, Chen, Finney, and Lai (2005) find empirical evidence that gasoline prices in the US respond quickly to a crude oil price increase but not to a decrease.
foreign nominal interest rate \((\sigma_i^*)\) and of technology \((\sigma_a^*)\) are set at 1%. The standard deviation of foreign output from the steady state is set to \(-1\%) over one period.

The inverse of the elasticity of substitution between oil and capital, \(\nu\), is calculated from the expression of the steady state of the oil to capital ratio as a function of the parameters \(\nu, \delta, \beta,\) and \(\iota\). We follow Kim and Loungani (1992) in setting the depreciation rate, \(\delta\), equals to 0.1225 and the discount rate, \(\beta\), equals to 0.96. The share of oil relative to capital stock, \((1-%i)\), is 0.10. Given these parameter values, \(\nu\) is calculated based on average energy-to-capital ratio of 0.65 for Indonesia; 0.59 for the Philippines; 0.46 for Malaysia; 0.45 for Thailand; 0.27 for the Republic of Korea; 0.22 for Singapore; 0.06 for Hong Kong, China; 0.05 for Taipei,China; and 0.11 for the United States (US), which is our benchmark country. These values are used to calculate \(\nu\) of 9.3 for Indonesia; 7.8 for the Philippines; 5.2 for Malaysia; 5 for Thailand; 3.1 for the Republic of Korea; 2.7 for Singapore; 1.45 for Hong Kong, China; 1.4 for Taipei,China; and 1.8 for the US. The estimates for the US are comparable to Kim and Loungani’s setting of \(\nu\) equals to 1.7 and an elasticity of substitution of 0.59 for the US. As a proxy for the parameter on the proportion of foreign goods in total consumption \((1-%gamma)\), we use imports over GDP of East Asian countries as shown in Table 1.

### IV. Simulation Results and Welfare

In this section, we report and discuss our simulation results, including estimates of welfare losses under alternative monetary policy regimes.

#### A. Impulse Responses under Various Monetary Policy Regimes

The simulated impulse responses in Figures 1–7 represent the dynamic responses of real output, inflation, terms-of-trade, nominal rates, and real exchange rates under seven monetary policy regimes: fixed or pegged exchange rate regime, strict (CPI) inflation targeting, exchange rate and CPI inflation targeting, the Taylor rule, strict (domestic) inflation targeting, nominal GDP targeting, and real GDP targeting.

---

11 The steady-state capital–oil ratio is given by 
\[
\left(\frac{K}{\delta}\right)^{-\nu} = \frac{(1-%i)^{\nu}}{1-i}, \text{ where } Z = \frac{1}{\beta} - 1 + \delta, \text{ which is the steady-state rental cost of capital. The details of the derivation are available from the authors upon request.}
\]

12 Data on energy use in kiloton of oil equivalent (KOE) and gross capital formation are from the World Economic Indicators for Hong Kong, China; Indonesia; the Republic of Korea; Malaysia; Philippines; Singapore; and the US. Data for Taipei,China are from the CEIC Database. We calculate energy use by multiplying energy use in KOE by the average price of a kiloton of crude oil in 2000 US dollars. We use the CPI to convert energy use in 2000 US dollars to 1985 international dollars in relation to the US. Data on CPI and the price of crude oil are from the International Financial Statistics online.
Figure 1: Impulse Responses to a Negative Shock in Foreign Output
Under Fixed/Pegged Exchange Rate

Source: Authors' estimates.

Figure 2: Impulse Responses to a Negative Shock in Foreign Output
Under CPI Inflation Targeting

CPI = consumer price index.
Source: Authors' estimates.
Figure 3: Impulse Responses to a Negative Shock in Foreign Output
Under Exchange Rate and CPI Inflation Targeting

CPI = consumer price index.
Source: Authors’ estimates.

Figure 4: Impulse Responses to a Negative Shock in Foreign Output
Under Taylor Rule

CPI = consumer price index.
Source: Authors’ estimates.
Figure 5: Impulse Responses to a Negative Shock in Foreign Output with Domestic Inflation Targeting

CPI = consumer price index.
Source: Authors’ estimates.

Figure 6: Impulse Responses to a Negative Shock in Foreign Output with Nominal GDP Targeting

CPI = consumer price index, GDP = gross domestic product.
Source: Authors’ estimates.
Figure 7: Impulse Responses to a Negative Shock in Foreign Output with Real GDP Targeting

CPI = consumer price index, GDP = gross domestic product.
Source: Authors’ estimates.

A negative foreign output shock has the biggest impact on domestic output under fixed or pegged exchange rate regime followed by CPI inflation and exchange rate targeting, CPI inflation targeting, domestic inflation targeting, Taylor-type rule, nominal GDP targeting, and the least under real GDP targeting. For a 1% decline in foreign output, real output declines from its steady state by 0.42% under fixed exchange rate regime, 0.41% under CPI inflation-cum-exchange rate targeting, 0.36% under CPI inflation targeting, 0.23% under domestic inflation targeting, 0.25% under Taylor rule, and 0.19% under nominal output. Under real output targeting, it rises by 0.03% in the first period before declining by 0.08%.

The mitigated effect on real output under real and nominal output targeting and to a lesser extent, Taylor-type rule, could be explained by the large and sharp depreciation in the nominal exchange rate following a negative foreign output shock. In the period following the 1% negative foreign output shock, nominal exchange rate depreciates from the steady state value by 0.64% for real output targeting, 0.35% for nominal output targeting, and 0.24% for Taylor-type rule. In turn, the large exchange rate depreciation increases the prices of oil and other imports, causing higher total CPI inflation. Likewise, expectations of higher inflation and further depreciation raise the nominal interest rate.

The impact on the nominal interest rate is shown in Figure 8 where a 1% negative foreign output shock increases nominal interest rate by 0.41%, 0.11%, and 0.08% from the steady state for nominal output targeting, real output targeting, and Taylor-type rule, respectively. In contrast, nominal exchange rate depreciates only by 0.08%, 0.02%,
and 0.017% for CPI inflation, domestic inflation, and CPI inflation-cum-exchange rate targeting, respectively. This leads to a reduction of CPI inflation from its steady state by 0.02% for CPI inflation targeting; 0.03% for pegged exchange rate regime, and CPI inflation and exchange rate targeting; and 0.06% for domestic inflation targeting two periods after the shock. Hence, nominal interest rate in Figure 8 shows a decline from steady state values of 0.02%, 0.06%, and 0.006% for CPI inflation, domestic inflation, and CPI inflation-cum-exchange rate targeting, respectively. The nominal interest rate hardly changes under pegged exchange rate regime. The impulse responses clearly show a tradeoff between lower output volatility and higher inflation and nominal interest rate volatility.

Figure 8: Impulse Responses of Interest Rate to a Negative Foreign Output Shock Under Various Monetary Policies

![Figure 8: Impulse Responses of Interest Rate to a Negative Foreign Output Shock Under Various Monetary Policies](image)

CPI = consumer price index.
Source: Authors' estimates.

B. Welfare Losses under Various Monetary Policies

We examine the impact of various monetary policies after a negative foreign output shock using a welfare loss function described in Section II, G and shown in Table 2 with the model parameters of oil-to-capital ratio of 0.25 and import-to-GDP ratio of 0.5 taken as average values for East Asian countries. The results show from least to most welfare losses as compared with the optimal monetary policy are as follows: CPI inflation targeting, CPI inflation-cum-exchange rate targeting, pegged exchange rate regime, domestic inflation targeting, Taylor-type rule, nominal output targeting, and real output...
targeting. With complete pass-through, CPI inflation targeting delivers the least welfare loss under negative foreign output shock.

### Table 2: Welfare Loss after a Negative Foreign Output Shock under Different Monetary Policies

<table>
<thead>
<tr>
<th>Monetary Policy</th>
<th>Weights in the Interest Rate Rule</th>
<th>Welfare Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed /pegged exchange rate regime</td>
<td>$\omega_n = 0$</td>
<td>$\omega_{nH} = 0$</td>
</tr>
<tr>
<td>CPI inflation targeting</td>
<td>$\omega_n = 1.5$</td>
<td>$\omega_{nH} = 0$</td>
</tr>
<tr>
<td>Exchange rate and inflation targeting</td>
<td>$\omega_n = 1.5$</td>
<td>$\omega_{nH} = 0$</td>
</tr>
<tr>
<td>Taylor-type rule</td>
<td>$\omega_n = 1.5$</td>
<td>$\omega_{nH} = 0$</td>
</tr>
<tr>
<td>Domestic inflation targeting</td>
<td>$\omega_n = 0$</td>
<td>$\omega_{nH} = 1.5$</td>
</tr>
<tr>
<td>Nominal output targeting</td>
<td>$\omega_n = 1.5$</td>
<td>$\omega_{nH} = 0$</td>
</tr>
<tr>
<td>Real output targeting</td>
<td>$\omega_n = 0$</td>
<td>$\omega_{nH} = 0$</td>
</tr>
</tbody>
</table>

CPI = consumer price index, GDP = gross domestic product.

Note: Welfare loss is calculated based on the average percentage of imports over real GDP of 50% for the six East Asian countries excluding Hong Kong, China and Singapore, which have percentage imports over GDP of 172% and 191%, respectively. The average oil-to-capital ratio is 0.25 and the average elasticity of substitution of oil-to-capital is 3.14, excluding the Philippines and Indonesia, which have an average oil-to-capital (elasticity of substitution of oil for capital) of 0.58 (7.8) and 0.90 (9.3), respectively. In the model, the import to GDP is $(1-\gamma)$ equals 0.5 while the elasticity of substitution of oil and capital is $\psi$. $\omega_n$, $\omega_{nH}$, $\omega_y$, and $\omega_z$ are the weights on overall inflation, domestic inflation, output gap, and exchange rate in the interest rate rule equation. \( \rho = \sigma = 1 \) in which optimal monetary policy under flexible price equilibrium is domestic inflation targeting as in Gali and Monacelli (2005).

Source: Authors’ estimates.

Since there are large variations in import-to-GDP ratio among East Asian countries, we conduct sensitivity analysis based on this ratio, represented by the parameter $(1-\gamma)$. This is the proportion of import in household consumption in the model. Table 3 shows the estimates of welfare losses due to a 1% negative output shock for various ratios of import-to-GDP given an oil-to-capital ratio of 0.25 under different monetary policy regimes. The results show that for an economy with import-to-GDP ratio of 1, CPI inflation targeting, pegged exchange rate regime, and a combination of CPI inflation and exchange rate targeting minimize the welfare losses.

For an economy with import-to-GDP ratio of 0.1, domestic inflation targeting delivers the least welfare loss, followed by CPI inflation targeting, and then Taylor-type rule. For countries with import-to-GDP ratios of 0.3–0.9, CPI inflation targeting delivers the least welfare loss. For import-to-GDP of 1.0, CPI inflation targeting, exchange rate peg, and CPI inflation cum exchange rate peg have equivalent welfare losses. Hence, countries with a large import component could control inflation just as well by targeting exchange rates since imported inflation makes up a large proportion of overall or CPI inflation. These results are consistent with the literature under complete exchange rate pass through. In a relatively closed economy, domestic inflation targeting stabilizes domestic prices and output. As the level of openness—proxied by the import-to-GDP ratio—rises, increasing the ratio of foreign goods in the consumption basket so that CPI targeting stabilizes overall prices and output.\(^{13}\)

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\(^{13}\) Chung, Jung, and Yang (2007) note that the lower levels of openness could be less relevant with incomplete exchange rate pass through.
Table 3: Welfare Loss after a Negative Foreign Output Shock Under Different Monetary Policies and Various Values of Import over GDP

<table>
<thead>
<tr>
<th>Imports over GDP</th>
<th>Monetary Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed/Pegged Exchange Rate Regime</td>
</tr>
<tr>
<td></td>
<td>CPI Inflation Targeting</td>
</tr>
<tr>
<td></td>
<td>Exchange Rate and Inflation Targeting</td>
</tr>
<tr>
<td></td>
<td>Taylor-type Rule</td>
</tr>
<tr>
<td></td>
<td>Domestic Inflation Targeting</td>
</tr>
<tr>
<td></td>
<td>Nominal Income Targeting</td>
</tr>
<tr>
<td></td>
<td>Real Income Targeting</td>
</tr>
<tr>
<td>1.0</td>
<td>−0.44</td>
</tr>
<tr>
<td></td>
<td>−0.44</td>
</tr>
<tr>
<td></td>
<td>−0.44</td>
</tr>
<tr>
<td></td>
<td>−55.65</td>
</tr>
<tr>
<td></td>
<td>−10.04</td>
</tr>
<tr>
<td></td>
<td>−246.11</td>
</tr>
<tr>
<td></td>
<td>−693.19</td>
</tr>
<tr>
<td>0.9</td>
<td>−0.57</td>
</tr>
<tr>
<td></td>
<td>−0.37</td>
</tr>
<tr>
<td></td>
<td>−0.51</td>
</tr>
<tr>
<td></td>
<td>−42.18</td>
</tr>
<tr>
<td></td>
<td>−8.56</td>
</tr>
<tr>
<td></td>
<td>−187.02</td>
</tr>
<tr>
<td></td>
<td>−515.26</td>
</tr>
<tr>
<td>0.7</td>
<td>−1.53</td>
</tr>
<tr>
<td></td>
<td>−0.51</td>
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<tr>
<td></td>
<td>−1.22</td>
</tr>
<tr>
<td></td>
<td>−22.37</td>
</tr>
<tr>
<td></td>
<td>−5.91</td>
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<tr>
<td></td>
<td>−101.58</td>
</tr>
<tr>
<td></td>
<td>−265.77</td>
</tr>
<tr>
<td>0.5</td>
<td>−2.35</td>
</tr>
<tr>
<td></td>
<td>−0.71</td>
</tr>
<tr>
<td></td>
<td>−1.91</td>
</tr>
<tr>
<td></td>
<td>−10.13</td>
</tr>
<tr>
<td></td>
<td>−3.69</td>
</tr>
<tr>
<td></td>
<td>−49.25</td>
</tr>
<tr>
<td></td>
<td>−122.14</td>
</tr>
<tr>
<td>0.3</td>
<td>−2.33</td>
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<tr>
<td></td>
<td>−0.78</td>
</tr>
<tr>
<td></td>
<td>−1.97</td>
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<tr>
<td></td>
<td>−3.47</td>
</tr>
<tr>
<td></td>
<td>−1.06</td>
</tr>
<tr>
<td></td>
<td>−19.92</td>
</tr>
<tr>
<td></td>
<td>−47.48</td>
</tr>
<tr>
<td>0.1</td>
<td>−1.42</td>
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<tr>
<td></td>
<td>−0.61</td>
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<tr>
<td></td>
<td>−1.28</td>
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<tr>
<td></td>
<td>−0.64</td>
</tr>
<tr>
<td></td>
<td>−0.53</td>
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<tr>
<td></td>
<td>−5.60</td>
</tr>
<tr>
<td></td>
<td>−13.56</td>
</tr>
</tbody>
</table>

CPI = consumer price index, GDP = gross domestic product.

Note: We use import over GDP as a proxy for (1−γ) in the model. The elasticity of oil-to-capital is set at 3.14 as in Table 2. 

\[ \rho = \sigma = 1 \] in which optimal monetary policy under flexible price equilibrium is domestic inflation targeting as in Gali and Monacelli (2005).

Source: Authors' estimates.

We also calibrate the model for a pair of economies based on their ratios of oil to capital and of import to GDP and calculate the welfare losses under various monetary policy regimes. The pairs of economies are Hong Kong, China and Singapore; the Republic of Korea and Taipei, China; Malaysia and Thailand; and Indonesia and the Philippines. The estimates of welfare losses under various monetary policy regimes are shown in Table 4. They show that either fixed/pegged exchange rate regimes or CPI inflation targeting deliver the least welfare loss for Hong Kong, China and Singapore. On the other hand, CPI inflation targeting delivers the least welfare loss for Indonesia; the Republic of Korea; Malaysia; the Philippines; Taipei, China; and Thailand.

Table 4: Welfare Loss after a Negative Foreign Output Shock under Different Monetary Policies Calibrated for Various East Asian Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Monetary Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed/Pegged Exchange Rate Regime</td>
</tr>
<tr>
<td></td>
<td>CPI Inflation Targeting</td>
</tr>
<tr>
<td></td>
<td>Exchange Rate and Inflation Targeting</td>
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<tr>
<td></td>
<td>Taylor-type Rule</td>
</tr>
<tr>
<td></td>
<td>Domestic Inflation Targeting</td>
</tr>
<tr>
<td></td>
<td>Nominal Income Targeting</td>
</tr>
<tr>
<td></td>
<td>Real Income Targeting</td>
</tr>
<tr>
<td>Hong Kong, China and Singapore</td>
<td>−0.47</td>
</tr>
<tr>
<td></td>
<td>−0.47</td>
</tr>
<tr>
<td></td>
<td>−0.47</td>
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<tr>
<td></td>
<td>−56.90</td>
</tr>
<tr>
<td></td>
<td>−10.97</td>
</tr>
<tr>
<td></td>
<td>−258.76</td>
</tr>
<tr>
<td></td>
<td>−720.08</td>
</tr>
<tr>
<td>Korea, Rep. of and Taipei, China</td>
<td>−2.44</td>
</tr>
<tr>
<td></td>
<td>−0.77</td>
</tr>
<tr>
<td></td>
<td>−2.02</td>
</tr>
<tr>
<td></td>
<td>−5.98</td>
</tr>
<tr>
<td></td>
<td>−1.87</td>
</tr>
<tr>
<td></td>
<td>−29.93</td>
</tr>
<tr>
<td></td>
<td>−79.34</td>
</tr>
<tr>
<td>Malaysia and Thailand</td>
<td>−0.93</td>
</tr>
<tr>
<td></td>
<td>−0.39</td>
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<tr>
<td></td>
<td>−0.77</td>
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<tr>
<td></td>
<td>−31.01</td>
</tr>
<tr>
<td></td>
<td>−17.66</td>
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<tr>
<td></td>
<td>−134.55</td>
</tr>
<tr>
<td></td>
<td>−357.72</td>
</tr>
<tr>
<td>Indonesia and the Philippines</td>
<td>−2.27</td>
</tr>
<tr>
<td></td>
<td>−0.73</td>
</tr>
<tr>
<td></td>
<td>−1.87</td>
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<tr>
<td></td>
<td>−6.47</td>
</tr>
<tr>
<td></td>
<td>−1.87</td>
</tr>
<tr>
<td></td>
<td>−31.53</td>
</tr>
<tr>
<td></td>
<td>−70.50</td>
</tr>
</tbody>
</table>

CPI = consumer price index, GDP = gross domestic product.

Note: Hong Kong, China and Singapore have an average import over GDP of 1, and elasticity of substitution of 2.1. The Republic of Korea and Taipei, China have an average import over GDP of 0.4 and an elasticity of substitution of oil and capital of 2.3. Malaysia and Thailand have an average import over GDP of 0.8 and an elasticity of substitution of oil and capital of 5.1. Indonesia and the Philippines have an average import over GDP of 0.4 and an elasticity of substitution of oil and capital of 8.5.

8.5. \[ \rho = \sigma = 1 \] in which optimal monetary policy under flexible price equilibrium is domestic inflation targeting as in Gali and Monacelli (2005).

Source: Authors' estimates.
C. Summary of Simulation Results and Welfare

Consistent with the empirical evidence documented by Hoffman (2007), the comparison between responses of alternative monetary policy regimes suggests that (i) both fixed exchange rate regime and inflation targeting tend to stabilize real exchange rate and inflation at the expense of substantial instability in the real economy; (ii) the mitigated decline in real output under the Taylor-type rule is explained by the large depreciation of nominal and real exchange rates; and (iii) inflation rate is lowest under CPI inflation targeting. In addition, the decline in output is smallest under nominal and real GDP targeting due to the higher rate of nominal and real exchange rate depreciation. However, both output targeting also led to the worst inflation outcome. Consistent with Friedman’s predictions, long run differences across regimes are not significant.

We also compare the welfare effects of the various monetary policy regimes as compared with the optimal monetary policy under flexible prices using a quadratic social welfare loss function. We show that with an average oil-to-capital ratio of 0.27 and import-to-GDP ratio of 0.5, CPI inflation targeting leads to the least welfare loss, followed by inflation and exchange rate targeting, pegged or fixed exchange rate regime, domestic inflation targeting, Taylor-type rule, and nominal and real output targeting. The simulation results show that a negative output shock causes the inflation rate and subsequently the nominal interest rate to decline under CPI inflation targeting. In contrast, inflation rises under Taylor-type rule or nominal and real output targeting due to the large depreciation in the nominal and real exchange rates. These findings are consistent with de Carvalho Filho (2010).

If the import-to-GDP ratio is 1, the welfare loss of countries with CPI inflation-cum-exchange rate targeting is comparable to countries with either pegged exchange rate or CPI inflation targeting. However, if the ratio is between 0.5 and 0.9, CPI inflation-cum-exchange rate targeting is only second best to CPI inflation targeting. If the ratio is less than 0.5, it is worse than either Taylor-type rule or CPI inflation or domestic inflation targeting.

Since East Asian economies vary a lot with respect to the ratio of import-to-GDP, ranging from 27% for Indonesia to more than 100% for Singapore and Hong Kong, China, we calculate the welfare loss of various monetary policy regimes for ratios between 10% and 100%. We find that with import-to-GDP ratio of 1, welfare loss under the fixed or pegged regime is almost equivalent to the welfare loss under CPI inflation targeting. This is consistent with the Chow and McNelis (2010) finding that Singapore’s welfare loss will not be significantly less if it switches to a more flexible exchange rate system and inflation targeting. Economies that depend heavily on imports such as Singapore and Hong Kong, China can moderate imported inflation by pegging the exchange rate. In contrast, for imports-to-GDP ratio of 0.10, the domestic inflation targeting delivers the least welfare loss as it also stabilizes output. When import-to-GDP ratio is between 0.3 and 0.9, CPI inflation targeting delivers the outcome with the least welfare loss.
V. Conclusions

The global financial and economic crisis of 2008–2009 underlined the vulnerability of small open economies to adverse external output shocks. Although East Asia’s financial systems were largely immune from the global financial instability, their real economies were severely affected by the deep recession of the advanced economies. This reignites the debate about the appropriate monetary policy regime for a small open economy subject to external shocks. The primary objective of our paper is to evaluate and compare the welfare impact of external output shocks acting through the trade channel in eight East Asian countries with different monetary policy regimes. To do so, we use a simple dynamic stochastic general equilibrium model with sticky prices and imperfect competition in the goods market. The alternative monetary policy regimes considered are fixed or pegged exchange rate regime, CPI and domestic inflation targeting, CPI inflation-cum-exchange rate targeting, the Taylor-type rule, and nominal and real output targeting.

Although our DSGE model is highly simplified, we can use its simulation results to scrutinize Hoffman’s empirical evidence and identify significant differences in responses to foreign output shocks across monetary policy regimes. Compared to a Taylor-type rule and nominal and real output targeting, fixed or pegged exchange rate regimes and inflation targeting prevent nominal exchange rate and inflation from adjusting and thus prevents the real exchange rate from depreciating. The negative impact of a fall in foreign output is thus largely passed to the domestic economy. The mitigated decline in real output under a Taylor-type rule and nominal and real targeting is explained by a larger depreciation of the nominal and real exchange rates. We also verify that inflation rate is lowest under CPI inflation targeting and nominal exchange rate is stable under pegs. Our simulation results are consistent with the de Carvalho Filho (2010) findings that inflation targeting countries have lower interest rates than noninflation-targeting countries.

Our simulation results are also broadly consistent with the stylized facts of the East Asian experience during the 2008–2009 economic crisis. As Table 1 shows, Hong Kong, China; Singapore; and Taipei, China, which target the exchange rate, experienced the smallest volatility in exchange rate but suffered the largest cumulative reduction in real GDP growth. On the other hand, the other East Asian countries, which practice inflation targeting, experienced larger currency depreciation but suffered a smaller cumulative reduction in real GDP growth. In addition, two of the inflation targeting countries, Indonesia and Thailand, experienced CPI deflation, as predicted by the model.

Our welfare analysis shows that Hong Kong, China and Singapore’s pegged exchange rate regimes give the least welfare losses in light of their high ratios of imports to GDP. This is consistent with the Chow and McNelis (2010) finding for Singapore. We also find inflation targeting to be appropriate for Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand since it offers the least welfare loss. This is consistent with the study of Chung, Jung, and Yang (2007) for the Republic of Korea. However, we find that
Malaysia and Taipei, China could reduce their welfare losses by moving from CPI inflation-cum-exchange rate targeting toward targeting only inflation.

At a broader level, our analysis can provide some guidance about monetary policy regimes for small open economies. For such economies, which depend heavily on exports and trade for growth, the capacity of monetary policy to cushion the impact of adverse external output shocks is one of the most important criteria for the appropriate policy regime. The pronounced impact of the recession in the advanced economies on the small open economies during the global crisis of 2008–2009 underlines this point. Our highly simplified DSGE model simulation results suggest that CPI inflation targeting delivers the least welfare loss for most East Asian small open economies except for those with an exceptionally high degree of import. Therefore, an important additional benefit of CPI inflation targeting for small open economies may be that it protects them better from external output shocks.
References


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A Welfare Evaluation of East Asian Monetary Policy Regimes under Foreign Output Shock
Joseph D. Alba, Wai-Mun Chia, and Donghyun Park assess the welfare impact of external shocks under different monetary policy regimes in East and Southeast Asia. To do so, they numerically solve and calculate the welfare loss function of a dynamic stochastic general equilibrium (DSGE) model with complete exchange rate pass through. Their DSGE model simulation results suggest that consumer price index inflation targeting delivers the least welfare losses for most small open economies in East and Southeast Asia.

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