The balance-of-payments crises view is revisited to explore if it can be applied to the euro area crisis. This paper focuses on the GIPS countries to examine common and idiosyncratic factors with this view. While the capital flight was generally observed, the extent of exhaustion was rather limited due mainly to the common settlement system within the monetary union. Redundancy and containing prices and labor costs worked for adjustments after current account reversals. Empirical analysis suggests that the adjustment process of the latest crisis deviates from that of the ERM crisis.

1. Introduction

It was early 2010 when the euro area sovereign debt crisis started after Greece admitted they had concealed the genuine figures of budget deficit in the previous year. Greece’s capacity of debt services received much concern and its contagion was observed in other periphery countries, since they also had borrowed heavily with lowered interest rates after joining the monetary union.

My previous research, Orii (2013), pointed out that current account imbalances were the main cause of the eurozone crisis. It proved theoretically that the high growths in the SEA countries were not sustainable. The intertemporal budget constraint could be violated when the productivity in
the peripheral economies failed to improve sufficiently and the imported capital was invested predominantly in the non-tradable goods sector with lower productivity. Empirical analysis also confirmed this by showing how the current account balances in the SEA countries deteriorated. Income levels, its growth rates, domestic credit booms, savings rates, and hikes in prices and labor costs were found significant determinants.

Several researches emphasized the balance-of-payments crises nature of the eurozone crisis. Sinn (2012) was skeptical about whether the periphery would succeed in creating equilibrium in the euro area. He criticized the ongoing rescue operations by the troika (the European Central Bank, the European Commission, and the International Monetary Fund) that they should maintain high prices and wages built up during the bubbles. Also arguing that this crisis was fundamentally a balance-of-payments crisis, Higgins and Klitgaart (2014), on the other hand, appreciated the role of common settlement mechanism in the euro area, without which “the periphery countries would have experienced even steeper recessions from the sudden withdrawal of foreign capital.”

It is well-known that the classical balance-of-payments crises model was introduced by Krugman (1979). What he assumed in his seminal paper was “a country with highly developed financial markets it can use open-market operations, intervention in the forward exchange market, and direct operations in foreign assets to defend an exchange parity.” He argued that a crisis in the balance of payments occurs when a government is no longer able to defend a fixed parity, because it finds its foreign reserves exhausted and its borrowing approaching a limit as a consequence of maximizing behavior by investors².

However, Krugman was unable to derive explicitly a solution for the time of collapse in a fixed exchange rate regime, because of his model’s nonlinearities. Flood and Garber (1984) proposed alternative situations in which a fixed exchange regime could collapse. In order to find a collapse
time, lying in connecting the fixed-rate regime to the post-collapse floating-rate regime, they introduced the concept of shadow floating exchange rate in a linear framework to show that an analytical solution for the collapse’s timing could be derived. Regrettably, the framework of the balance-of-payments crises models can no longer apply to the euro area crisis as it is. Exchange rate regime in the monetary union has been fixed ultimately and irreversibly. Member countries need not to stock massive reserve assets any more. It should be recommended, therefore, to explore how to modify the basic framework of balance-of-payments model in order to explain the latest financial crisis.

This paper engages in a pilot research to promote this line of approach. The remainder of this paper is structured as follows: the next section reviews sizable capital inflows, their sudden stops and current account reversals before and after the eurozone crisis. Section 3 surveys how the periphery adjusted their economies to recover international competitiveness, focusing on savings, redundancy, prices and labor costs. Section 4 attempts quantitative analysis by exploring significant factors to determine current account balances. It also seeks to probe whether the mechanism of the latest crisis is distinguished from that of the ERM crisis in the 1990s. The final section concludes.

2. Capital inflows and current account reversals

Massive capital inflows, sudden stops and current account reversals portray main properties of balance-of-payments crises. In this section, let us explore the periphery cases before and after the eurozone crisis. The existence of offsetting mechanism against capital flights distinguishes the euro area crisis from other crises.

2.1 External deficits and capital inflows

Prior to crises, balance of payments tends to deteriorate notice-
ably. As shown in Table 1, the periphery countries witnessed worst current account deficits (as percentage of GDP) in 2007 or 2008. The highest deficit ratio is recorded 15.1% in Greece, followed by 12.1% in Portugal and 9.6% in Spain. Italy’s external balance continued deteriorating until 2010 when it registered 3.5%.

In typical balance-of-payments crises, current accounts deficits are supposed to be caused by increased government budget deficits as Krugman (1979) assumed. However, in the euro area crisis, external imbalances are rather propelled by private sectors than by official sectors. Furthermore, as Higgins and Klitgaard (2014) describes, current account deficits in the periphery were mainly used more for consumption and housing investment than for other productive purposes. That is, they were not spent to enhance competitiveness of the periphery countries’ economies.

What enabled this was increased cross-border financing, mainly from northern countries, specifically from Germany and Scandinavian countries. After joining the monetary union, borrowing rates in the periphery converged rapidly to other members’ interest rates, which drove southern citizens to borrow more to finance their consuming and housing demands.

### 2.2 Current account reversals

The onset of the global recession in 2008, preceded by BNP Paribas shock in the previous year, forced the peripheral countries to improve external balances. This was precipitated further by the sovereign debt crisis in the euro area, which started in 2010.

Of the four countries of the periphery, Spain was the forerun-
ner in this adjustment race, followed by Portugal. Spain squeezed its deficits in as early as 2009 by more than 5% points compared with the previous year. In 2012, the current account became nearly balanced (−0.2%) and even registered surplus in 2013 (+1.5%). During the seven years from 2007 to 2014, these two countries improved their external balances by more than 10% points: Spain by 10.6% points and Portugal by 10.2% points.

Italy also managed to rebalance external accounts in 2013. It should be noted, however, that Italy’s deficit size was smaller than those of Spain and Portugal: Italy’s deficit ratio was contained at about a third of the latter two countries. Meanwhile, Greece still registered deficits in the latest years in spite of endeavoring after adjustments for many years. But it managed to contain its deficits ratios within a 2% range. It is also noteworthy that Greece improved external balance by as much as 13% points in the 7 years of 2007 to 2014.

2.3 Offsetting mechanisms against capital flight

Current account reversals are inevitable in crisis-hit countries. In the earlier period of the crisis (from the beginning of 2011 to the first half of 2012), total capital outflows from the periphery added up to 676 billion of euros. Member countries in the European Monetary Union are, however, blessed with offsetting mechanisms. One is liquidity providing by the central bank of the monetary union, and the other is the settlement system of the union.

First, the European Central Bank consistently assisted financing for crisis-hit national central banks in the periphery. In addition, the pledge by ECB President Mario Draghi’s in July of 2012 (“The ECB is ready to do ‘whatever to take’ to preserve the single currency,”) and the announcement of the Outright Monetary Transactions in the following month were both effective in reassuring markets.

Second, the intra-regional settlement system, TARGET2, contributed to alleviating the periphery from the collapse. TARGET2, or Trans-European Automated Real-time Gross
settlement Express Transfer system, is the real-time gross settlement system (RTGS system) in the euro-zone. The transfer between any two member countries within the monetary union is accomplished through a matching central bank transaction within the Eurosystem. This automatic and open-ended payments system supported the periphery facing the massive capital flight during the crisis period. Higgins and Klitgaard (2014) calculated that, during 18 months between the beginning of 2011 and the first half of 2012, official capital flows provided 835 billion euros, of which TARGET2 shouldered 665 billion euros, nearly covering net private outflows of 676 billion euros entirely.

3. Adjustment Process

In a monetary union, member countries can no longer resort to devaluations of national currencies as a means to address current account imbalances. They need, instead, to enhance competitiveness vis-à-vis their trading rivals by alternative measures such as improving saving balances, layoffs, or containing prices and unit labor costs.

3.1 Savings rates

Orii (2013) pointed out that the gross savings/GDP ratios were lower in the periphery in the pre-recession period (2004–07). The average rate of gross savings/GDP ratio was 18.3% in the periphery including Ireland, compared to 24.9% in the core (Austria, Belgium, Finland, France, Germany, and the Netherlands). Since the onset of the global recession, the savings rates declined rapidly in the periphery. It fell to 13.0% in the following three-year period (2008–10), compared to 22.7% in the core.

Let us explore net savings of private sectors, which is shown in Table 2. Net savings is calculated by subtracting gross capital formation from gross savings (% of GDP, respectively). Logically, the current account balance is equivalent to the aggregated amount of net savings of both private and government sectors.
In the pre-crisis years, all the four periphery economies registered high deficit ratios in net savings. Among the GIPS countries, the largest negative ratios are observed in 2007 or 2008: Greece (−14.6%), followed by Portugal (−13.0%) and Spain (−9.1%). However, net savings improved swiftly after they peaked out. The three countries except Greece turned to register moderate positive net saving ratios in 2013.

Examining more closely, however, gross capital formation is more volatile than gross savings. During the six years between 2007 and 2013, gross capital formation dropped 15.6% points (Greece), 12.2% points (Spain), 8.5% points (Portugal), 5.1% points (Italy), while gross savings fell 2 to 3% points, except Portugal which raised gross savings by 2.1% points. It is obvious that the net savings improved mainly due to the abrupt drops of capital formation rates. On the contrary, gross savings are slower to react.

### Table 2  Net Savings Ratios (% of GDP)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>6.8</td>
<td>5.6</td>
<td>5.7</td>
<td>5.6</td>
<td>6.1</td>
<td>7.0</td>
<td>6.7</td>
<td>−0.1</td>
</tr>
<tr>
<td>Italy</td>
<td>−1.2</td>
<td>−2.8</td>
<td>−1.9</td>
<td>−3.5</td>
<td>−3.1</td>
<td>−0.4</td>
<td>1.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Spain</td>
<td>−9.1</td>
<td>−8.7</td>
<td>−3.7</td>
<td>−3.3</td>
<td>−2.6</td>
<td>0.4</td>
<td>1.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Portugal</td>
<td>−10.2</td>
<td>−13.0</td>
<td>−10.5</td>
<td>−10.8</td>
<td>−5.9</td>
<td>−2.3</td>
<td>0.4</td>
<td>10.6</td>
</tr>
<tr>
<td>Greece</td>
<td>−14.4</td>
<td>−14.6</td>
<td>−12.6</td>
<td>−11.4</td>
<td>−9.9</td>
<td>−2.7</td>
<td>−0.7</td>
<td>13.7</td>
</tr>
</tbody>
</table>

Sources: Eurostat.

3.2 Redundancy

Whatever the periphery merited from the intra-regional financing system, they had to pay another painful cost, which is a sort of compensation for disposing of their own national currencies. One of such costs is the elevated unemployment rates, as shown in Table 3.

At the point of 2007, there observed little difference in unemployment rates between Germany and the periphery. Far from that, Italy registered lower jobless rates than Germany through 2008. After the crisis set in, however, divergence vis-à-vis Germany began widening. The periphery countries witnessed their unemployment rates skyrocketing as the global recession and eurozone crisis deepened while Germany improved jobless...
rates. Greece and Spain are among the hardest-hit countries. During the five years since 2007, their unemployment rates tripled, rising to higher than 24% in 2012. Jobless rates of Greece and Spain managed to peak out in 2013. Joblessness increased rapidly in Portugal and Italy as well. In these two countries, unemployment rates nearly doubled between 2007 and 2013. The highest unemployment rates recorded in Portugal and Italy were 16.4% (2013) and 12.7% (2014), respectively.

Inspecting more closely, younger generations are found more severely damaged. In 2013, unemployment rates for people less than 25 years were 58.3% in Greece, 55.5% in Spain, 40.0% in Italy, and 38.1% in Portugal. Asymmetric nature is apparent when we compare the unemployment rates of people from 25 to 74 years: 25.4% in Greece, 23.8% in Spain, 10.2% in Italy, and 14.7% in Portugal.

### 3.3 Inflation rates

Once a country has parted with its national currency, there is no way of depreciating its currency nominally. Instead, containing domestic inflation rates enables to depreciate real exchange rate in order to regain competitiveness.

Table 4 shows annual average change in the HICP (Harmonized Index of Consumer Prices of the EU member states). In 2008, the HICP inflation rates peaked out in the periphery: 4.2% in Greece, 4.1% in Spain, 3.5% in Italy, and 2.7% in Portugal. All of them except Portugal were slightly higher than Germany by margins of 0.7 to 1.4% points.

With the outbreak of the crisis, adjustments in prices started. The periphery continued curtailing prices until they fell below...
Germany’s HICP in 2014, when all of the GIPS countries registered extremely low inflation rates of below or near 0%. Changes during the 6 years from 2008 to 2014 were also higher in the periphery (−4% points on average) than in Germany (−2% points). Price falls in the SEA countries supposedly contributed to recovering their competitiveness in the trade market14.

3.4 Unit labor costs

Under an ultimately fixed exchange rate regime of the monetary union, containing labor costs along with price levels is an alternative way of regaining international competitiveness. As is demonstrated in Table 5, the growth rates of unit labor costs in the periphery had been generally higher than in Germany through 2008. As the crisis broke out, however, they began to be restrained.

In the GIPS countries, unit labor costs were curbed. During the five years from 2010 and 2014, they dropped by 1 to 2 % points per annum on average. The fastest drop in the growths of costs is observed in Greece (−2.5%), followed by Spain (−1.4%) and Portugal (−1.1%). Meanwhile, labor costs generally continued rising in Italy, while the increasing speed remained about half of that in Germany.

Overall, the index of nominal unit labor cost based on persons (2010 = 100) fell most conspicuously in Greece with 87.2 in 2014, followed by Spain (94.9) and Portugal (95.8). All of them were lower than the euro area’s average (104.9). Italy’s increase (104.4) remained marginal, compared to Germany (108.3)15.

Rising unemployment and reduced labor costs might be
painful in point of view of welfare. But in a monetary union which abandoned national currencies as adjustment tools, containing costs in the producing sectors was inevitable in order to maintain memberships of a single currency.

4. Empirical approach

This section is engaged in empirical approach to confirm the insights described in the previous sections. After the targets, regression forms and data sources are introduced in the next subsection (5.1), regression results are reported with a couple of implications observed (5.2).

4.1 Regression framework

The empirical approach employed in this section attempts to explore if there were different mechanisms for adjusting current account imbalances between the pre-euro and post-euro periods. It will be focused on whether the periphery followed the same adjustment paths or not in the two crises that hit this area in the latest quarter century.

As in Orii (2013), determinants of current account balances are to be examined. The explained variable, current account balances, is to be regressed on a set of candidate explanatory variables, both contemporaneous and lagged. Regressors chosen here are general government net lending/borrowing (percent of GDP), net savings (percent of GDP), unemployment rates (percent of total labor force), unit labor costs, and exchange rates of national currencies vis-à-vis the ECU.

Table 5  Unit Labor Costs (Percent change over previous period)

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2010-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>—0.6</td>
<td>2.3</td>
<td>6.3</td>
<td>—1.2</td>
<td>0.7</td>
<td>3.3</td>
<td>2.2</td>
<td>1.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Italy</td>
<td>2.0</td>
<td>4.2</td>
<td>4.6</td>
<td>—0.1</td>
<td>0.7</td>
<td>1.4</td>
<td>0.9</td>
<td>1.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Spain</td>
<td>4.1</td>
<td>5.7</td>
<td>1.6</td>
<td>—1.6</td>
<td>—1.0</td>
<td>—2.9</td>
<td>—0.4</td>
<td>—0.9</td>
<td>—1.4</td>
</tr>
<tr>
<td>Portugal</td>
<td>1.0</td>
<td>2.8</td>
<td>2.7</td>
<td>—1.2</td>
<td>—2.0</td>
<td>—3.2</td>
<td>1.8</td>
<td>—0.9</td>
<td>—1.1</td>
</tr>
<tr>
<td>Greece</td>
<td>2.6</td>
<td>5.3</td>
<td>7.1</td>
<td>1.0</td>
<td>—1.4</td>
<td>—2.0</td>
<td>—7.4</td>
<td>—2.6</td>
<td>—2.5</td>
</tr>
</tbody>
</table>

Sources: Eurostat.
For the pre-euro period before 1999, the following regression form is applied:

\[ ca_t = c + \beta_1 gvt_t + \beta_2 svg_t + \beta_3 uempt_t + \beta_4 cpi_t + \beta_5 ulc_t + \beta_6 exc_t + u_t \]  

(5.1)

For the post-euro period since 1999, (5.1) is slightly adjusted as follows, dropping exchange rate variables.

\[ ca_t = c + \beta_1 gvt_t + \beta_2 svg_t + \beta_3 uempt_t + \beta_4 cpi_t + \beta_5 ulc_t + u_t \]  

(5.2)

For both regressions, the first two regressors, that is, government net lending/borrowing and net savings, are the factors that help reduce the over-expanded demands. Declines in these are supposed to improve current account balances. Meanwhile, the last four variables are to help recover the weakened competitiveness. Adjustments by redundancy and/or declines in labor costs and exchange rates are also expected to rebalance externally.

Data sources are as follows: IMF’s World Economic Outlook Indicators provides indicators of current account balances as percentage of GDP \((ca)\), general government net lending/borrowing also as percentage of GDP \((gvt)\), net savings as percentage of GDP\(^{16}\) \((svg)\), unemployment rates as percent of total labor force \((uempt)\), annual consumer price’s percent change \((cpi)\). OECD Stat offers unit labor costs as annual growth rates \((ulc)\), while Eurostat provides exchange rates of national currencies vis-à-vis the ECU \((exc)\).

Data frequency is annual. Samples are prepared for the period of 25 years from 1990 to 2014, of which 1993–98 data are employed for the first (ERM crisis) regression and 2009–14 data applied for the second (euro area crisis) one. Balanced panel regression with ordinary least squares is applied for all models below.

4.2 Results

Regression results are shown in Table 6. In the ERM crisis period, all the determinants except government budget bal-
ances are found highly significant in the contemporaneous framework. However, the coefficient of unemployment is, contrary to our expectations, negative. If economies recover rather quickly due to rapid adjustments by devaluations of national currencies, it might not need to take redundancy measures. The alternative regression with lags, meanwhile, observes less numbers of significant determinants, while government net lending/borrowing and exchange rates remain significant at least at the 5% levels.

After the eurozone crisis set in, these determinants except net savings ratio lose significance. In the regression with a \((-1)\) time lag, however, unit labor cost joins significant variables with an expected sign. A decrease in labor cost will serve improvements in external balances\(^{17}\).

Despite this pilot framework with rather small size of samples, it may be argued that with national currencies at hand, adjustment processes will not need too long periods, since nominal depreciations of national currencies provide a quick remedy. Once this effective weapon is lost, it may take much longer periods to make adjustments. Private consumption and investments, mainly non-productive, could be saved immediately. But cost cutting in the production side is a harder and more time-consuming process\(^{18}\).

<table>
<thead>
<tr>
<th>Determinants</th>
<th>ERM Crisis (1) Contemporaneous</th>
<th>ERM Crisis (2) Lagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>3.507 (0.995) ***</td>
<td>−4.132 (2.075) *</td>
</tr>
<tr>
<td>Government.</td>
<td>−0.084 (0.070)</td>
<td>−0.169 (0.160) **</td>
</tr>
<tr>
<td>Net savings</td>
<td>1.178 (0.099) ***</td>
<td>0.527 (0.214) **</td>
</tr>
<tr>
<td>Unemployment</td>
<td>−0.113 (0.033) ***</td>
<td>0.097 (0.069)</td>
</tr>
<tr>
<td>Unit labor cost</td>
<td>−0.206 (0.050) ***</td>
<td>0.078 (0.105)</td>
</tr>
<tr>
<td>Unit labor cost</td>
<td>−0.002 (0.000) ***</td>
<td>0.002 (0.001) **</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.947</td>
<td>0.660</td>
</tr>
<tr>
<td>Observations</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

Notes: Standard errors are in parentheses. ***, **, * are significant at the 1%, 5%, and 10% levels, respectively.

Table 6  Determinants of the Current Accounts
5. Concluding remarks

This paper aimed at drawing useful implications for the eurozone crisis mainly by revisiting the balance-of-payments crises view.

The periphery, taking advantage of converged interest rates after the launch of the euro, witnessed massive capital inflows mainly from the northern countries. That they were generally expended for non-productive purposes such as consuming and housing demands failed to prevent them from fending off reversals of capital flows. It is fortunate, however, they have been provided with the intra-regional financing mechanisms like the Outright Monetary Transactions and the TARGET2 system, which contributed to mitigating precipitated and colossal capital outflows.

In the monetary union which parted with national currencies, the GIPS countries were forced to enhance productivity by redundancy or containing prices and labor costs in order to regain international competitiveness. Empirical research suggests this plot, and implies further that between the ERM crisis and the eurozone crisis, there are different mechanisms with reference to current account reversals and adjustments of external balances.

<table>
<thead>
<tr>
<th>ERM Crisis (1)</th>
<th>ERM Crisis (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contemporaneous</strong></td>
<td><strong>Lagged</strong></td>
</tr>
<tr>
<td>0.214 (0.400)</td>
<td>1.000 (1.502)</td>
</tr>
<tr>
<td>0.078 (0.071)</td>
<td>0.110 (0.153)</td>
</tr>
<tr>
<td>0.891 (0.055) ***</td>
<td>0.662 (0.118) ***</td>
</tr>
<tr>
<td>0.011 (0.033)</td>
<td>0.012 (0.103)</td>
</tr>
<tr>
<td>0.008 (0.050)</td>
<td>−0.259 (0.139) *</td>
</tr>
<tr>
<td>0.987</td>
<td>0.836</td>
</tr>
<tr>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>
Stylized Linear Model of Balance-of-Payments Crises

The linear balance-of-payments model by Agenor, Bhandari, and Flood (1992) is summarized as follows. The notations used herein are the nominal money stock \( m \), the price levels \( p \), the domestic supply \( y \), the domestic interest rate \( i \), the foreign interest rate \( i^* \), the domestic credit \( D \), the foreign reserves \( R \), and the spot exchange rate \( s \). All variables except interest rates \( i \) and \( i^* \) are measured in logarithms.

A. Collapse of the fixed exchange rate regime

This linear model starts with the following 5 equations.

A1. Real money demand is a positive function of income and a negative function of the domestic interest rate. Domestic supply of the good exogenously is fixed \( y \).

\[
m - p = \phi \bar{y} - ai \quad (\phi > 0, \ \alpha > 0) \tag{1}
\]

Setting \( \bar{y} = 0 \), (1) is transformed as \( m - p = - ai \). \( (1') \)

A2. Money stock is linked with domestic credit and reserves.

\[
m = \gamma D + (1 - \gamma) R \quad (0 < \gamma < 1) \tag{2}
\]

A3. Domestic credit is assumed to expand at a constant growth rate.

\[
\dot{D} = \mu \quad (\mu > 0) \tag{3}
\]

A4. Purchasing power parity holds.

\[
p_t = s p_t^* \tag{4}
\]

When the price level of the foreign country \( p_t^* \) is fixed at unity, the domestic price level is equal to the nominal
exchange rate. Then, the equation (4) is modified as

\[ p_i = s_i. \]  

(4’)

A5. Uncovered interest rate parity holds.

\[ i_t = i^* + E_t \hat{s}_t. \]  

(5)

Under perfect foresight \((E_t \hat{s}_t = \hat{s}_t)\), (5) is transformed as

\[ i_t = i^* + \hat{s}_t. \]  

Setting \(i^* = 0\), (5) is further modified as

\[ i_t = \hat{s}_t. \]  

(5’)

Combining equations (1’), (4’) and (5’) generates

\[ m_t = s_t - a \hat{s}_t. \]  

(6)

Fixed exchange rate \((\hat{s}_t = 0\) at \(\bar{s}\)) modifies (6) into

\[ m_t = \bar{s}. \]  

(6’)

Combining (2) and (6’) yields

\[ R = \frac{\bar{s} - \gamma D}{1 - \gamma}. \]  

(7)

Differentiating by time and using (3) generates

\[ \dot{R} = \frac{\gamma}{1 - \gamma} \mu. \]  

(8)

If domestic credit expands excessively, reserves will be exhausted at a rate proportional to the rate of credit expansion. At an announcement of the central bank that it will not continue to defend the current fixed exchange rate at a lower reserve bound of \(R\), rational agents will anticipate the ultimate collapse of the fixed exchange rate regime.
B. Shadow floating rate and the collapse time

The shadow floating rate is expected to take the following linear form

\[ s_t = \kappa_0 + \kappa \cdot m_t. \]  

(9)

Under the floating rate, (2) will be

\[ m_t = \gamma D_t. \]  

(2')

The time derivative of (2') will be

\[ \dot{m}_t = \gamma \dot{D}_t. \]  

(2'')

Differentiating (9) by time combined with (2') and (3) generates

\[ \ddot{s}_t = \kappa \gamma \mu. \]  

(10)

Substituting (10) in (6) makes the post-collapse regime, in which the exchange rate steadily depreciates in proportion to the rate of growth of domestic credit

\[ s_t = \kappa_0 + m_t. \]  

(11)

Equations (9) and (11) demonstrates

\[ \kappa_0 = a \kappa \gamma \mu = a \gamma \mu \]  

(11')

\[ \kappa_0 = 1 \]  

(11’’)

Meanwhile, domestic credit \((D_t)\) is expressed from the equation (3) as

\[ D_t = D_0 + \mu t. \]  

(3')
Substituting \((2')\), \((11'')\) and \((3')\) in \((11)\) yields

\[ s_\cdot = \alpha \gamma \mu + \gamma D_\cdot = \alpha \gamma \mu + \gamma (D_\cdot + \mu t) = \gamma (D_\cdot + \alpha \mu) + \gamma \mu t \quad (12) \]

At the time of collapse, the prevailing exchange rate \((\tilde{s})\) will be the shadow exchange rate \((s_\cdot)\). The exact time of collapse \((t_c)\) is acquired by substituting \(s_\cdot = \tilde{s}\) in \((12)\) as

\[ t_c = \frac{\tilde{s} - \gamma (D_\cdot + \alpha \mu)}{\gamma \mu} = \frac{\tilde{s} - \gamma D_\cdot}{\gamma \mu} - a \quad (13) \]

Combining \((2)\) and \((6)\) at the time \(0\) \((t = 0)\) produces

\[ \tilde{s} = \gamma D_\cdot + (1 - \gamma) R_0 \quad (6'') \]

Substituting \((6'')\) in \((13)\) yields

\[ t_c = \frac{\gamma D_\cdot + (1 - \gamma) R_0 - \gamma D_0}{\gamma \mu} = \frac{(1 - \gamma) R_0}{\gamma \mu} - a = \left[\frac{1 - \gamma}{\gamma \mu}\right] \frac{1}{\mu} R_0 - a \quad (13') \]

\((13')\) implies that the higher the initial stock of reserves, the longer it will take before the collapse occurs. Furthermore, the larger \(a\) is, or the larger the initial proportion of domestic credit in the money stock \((\gamma)\) is, the sooner the collapse will come.

Notes
1. In this paper, the “periphery” countries involve the four southern euro area (SEA) countries of Greece, Italy, Portugal and Spain, the GIPS in another name, while they sometimes include other non-core countries of the eurozone such as Ireland, Malta, and Cyprus.
2. His scenario of how a balance-of-payments crisis occurs was as follows: “A country will have a pegged exchange rate; for simplicity, assume that pegging is done solely through direct intervention in the foreign exchange market. At that exchange rate the government’s reserves gradually decline. Then at some point, generally well before the gradual depletion of reserves would have exhausted them, there is a sudden speculative attack that rapidly eliminates the last of the reserves. The government then becomes unable to defend the exchange rate any longer.”
4. Glick and Hutchison (2011) provide a comprehensive survey of studies on currency crises. They discuss analytical models of the causes of currency and associated crises, present basic measures of incidence of crises, evaluate the accuracy of empirical models in predicting crises, and review work measuring the consequences of crises on the real economy.

5. In August 2007, BNP Paribas suspended three of its funds: Parvest Dynamic ABS, BNP Paribas ABS Euribor, and BNP Paribas ABS Eonia funds. It was reported that the France’s biggest listed bank became prevented from calculating their value due to problems in the U.S. subprime mortgage sector.

6. This is made up of liquidations of the periphery assets by foreign investors, and buying foreign assets by domestic investors. Hereafter, the data in this section is quoted from Higgins and Klitgaard (2014). Net capital outflows during these 18 months were 317 billion euros in Spain, 191 billion euros in Italy, 111 billion euros in Greece, and 56 billion euros in Portugal.

7. Outright Monetary Transactions (OMT) is a financing program introduced in 2012 by the ECB, which decided to purchase an unlimited amount of shorter maturity sovereign bonds from the SEA countries.

8. TARGET is owned and operated by the Eurosystem. Traget2 is the second-generation of TARGET, which is replaced in 2007. As of 2014, TARAGET2 has 1,007 direct participants, 837 indirect participants and 5,037 correspondents. It processes a daily average of 354,263 payments with a daily average value of 1.9 trillion euros. TARGET2’s share in total large-value payment system traffic in euro is 91% in value terms and 61% in volume terms. (See ECB’s website.)


10. It is noteworthy that, during these turbulent years, Germany maintained positive and stable net savings ratios: between 2007 and 2013 they ranged between 5.6% and 7.0%.

11. Younger women were more vulnerable in the post-crisis period. The most conspicuous case is Greece, where unemployment rate for females of less than 25 years was 63.8% in 2013, compared to 53.8% for males. This is also the case for other peripheral countries except Spain, where the male unemployment rate (56.2%) was marginally higher than the female one (54.6%) in 2013.

12. The real exchange rate $Q$ defined with respect to a general or overall price level such as the CPI is described as $Q = S P^* / P$, where $S$ is the exchange rate denominated in the home currency, and $P$ and $P^*$ stand for price levels of the home and foreign countries, respectively. When the exchange rate ($S$) is ultimately fixed by joining the monetary union, containing the domestic price level ($P$) becomes the only measure to depreciate the real exchange rate ($Q$), given the price level of foreign country ($P^*$) unchanged.

13. They seem moderate in historical archives. In early 1990s the CPI inflation rates were much higher: for example, 20.3% (Greece), 13.4% (Portugal), 6.7% (Spain), and 6.4% (Italy).

14. Producer Price Index shows more drastic changes. During the same 6 year period, the PPI of the GIPS countries fell 10.4% points in Greece, 7.2% points in Spain, and 6.6% points in Italy, compared to 4.7% points in Germany. The PPI of Portugal is not available in the Eurostat.

15. Other countries in the monetary union whose unit labor cost index (2010 = 100) went under 100 are Ireland (94.8) and Cyprus (95.0). They also suffered severely in the euro area crisis.

16. Net savings here are calculated as gross national savings less total investment.

17. Regressions employing the entire sample of 25 years generate less unambiguous results. In the contemporaneous regression, the net saving remains the only signif-
significant variable at least at the 10% level. In the lagged regression, the government lending/borrowing and net saving are significant. These might imply that, as adjustment elements for economies in a monetary union, the demand sides matter more than the supply sides as a whole.

18. Unlike my study focusing on the periphery in the monetary union, Pancaro (2013) studies current account reversals in industrial countries across different exchange rate regimes, finding that triggers of current account reversals differ between exchange regimes and that real exchange rate affects the probability of experiencing a reversal only under flexible arrangements.

References