

Estimating Permanent and Transitory Components of Economic Recovery:
A Case of Banking Crises

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Abstract

This dissertation aims to understand the the general recovery process of real GDP from banking crises from the perspective of permanent and transitory components of output.

In chapter 1, we investigate the general long-term effects of systemic banking crises on real GDP using a sample of a number of economies over 1960-2012. Our methodology is to estimate the response of the level of real GDP to a banking crisis by decomposing it into permanent and transitory components using the statistical framework of the Unobserved Components (UC) model (Harvey 1985 and 1989, Clark 1987). Our main empirical findings are summarized as follows. First, we reconfirm that the negative impact of banking crises on output is generally persistent. Second, and more importantly, advanced economies tend to be more adversely affected in magnitude of an output loss, but experience a stronger rebound from recessions. Third, an output loss in countries with well-developed financial markets is largely transitory, while for countries with less developed financial markets, the loss reflects mainly the permanent component.

In chapter 2, we investigate the effect of expansionary monetary policy on the recovery process of real GDP in response to a banking crisis using the empirical framework of the UC model. Our sample includes three major economies: US, Japan, and UK. We find that expansionary monetary policy can play an important role in the process of economic recovery. A positive shock of an increase in the money supply reduces more than 50 percent of the transitory losses during the first 4 quarters for the US and Japan, while the impact from monetary policy in the UK is very limited.

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Contents

Contents	v
List of Tables	vi
List of Figures	vi
1 Estimating Permanent and Transitory Components of Economic Recovery	1
1.1 Introduction	1
1.2 Empirical Framework	4
1.2.1 Model	4
1.2.2 Types of Economic Recovery	8
1.2.3 Data	10
1.3 Empirical Results	13
1.3.1 Global Picture	15
1.3.2 Country Group Analysis	19
1.4 Conclusion	22
2 Estimating the Effects of Monetary Policy on Recovery	23
2.1 Introduction	23
2.2 Empirical Framework	24
2.2.1 Model	24
2.2.2 Measurement of Monetary Policy Shock	25
2.3 Empirical Result	25
2.4 Conclusion	27
References	36

List of Tables

1	Effects of a Banking Crisis on Permanent and Transitory Components .	14
2	Parameter Estimates: UC Model with Banking Crisis Dummies	16
3	Parameter Estimates: UC Model with a Monetary Policy Shock	26

List of Figures

1	Real GDP before and after Banking Crises	2
2	Types of Output Recovery	12
3	Responses of Permanent Component, Transitory Component, and Over- all Output	18
4	Responses by Income Levels	20
5	Responses of Output: Three Countries	28

1 Estimating Permanent and Transitory Components of Economic Recovery

1.1 Introduction

The recent financial crisis originated in the US in 2007 set off a wave of systemic banking crises in many developed economies. Since the onset of the crisis, the pace of economic recovery of the US and other developed economies has been unusually sluggish from the perspective of recent history in terms of many macroeconomic indicators such as Gross Domestic Product (GDP) and employment growth.

This rather surprising outcome forces policy makers and the public to face more general questions about economic recovery from banking crises. Is it normal for recessions associated with banking crises to be particularly long? What is the long impact of the crises on the economy? Will part of an output loss from these recessions be permanent or can the loss be regained eventually?

Figure 1 shows the movements of real GDP for six countries (Finland, Sweden, Japan, Thailand, Indonesia, and Malaysia) before and after major banking crises.¹ A casual look at the past international experiences provides an impression of a long and sustained impact of crises on real GDP. All countries who experienced a sizable output contraction following banking crises rebounded after one to two years. However, the longer-term dynamics of output level vary across countries. For example, one group of countries (Finland and Sweden) experiences a rebound of output to the trend line. The other group (Japan, Indonesia, Thailand, and Malaysia) has more sluggish post-crisis movement. A negative deviation from the trend is so persistent that it does not return to the trend over the post-crisis 10-year

¹Reinhart and Rogoff (2008) call the crises in two Nordic countries and Japan “Big Crises.” Thailand, Indonesia, and Malaysia experienced the Asian financial crisis in which simultaneous crises in banking and currency occurred.

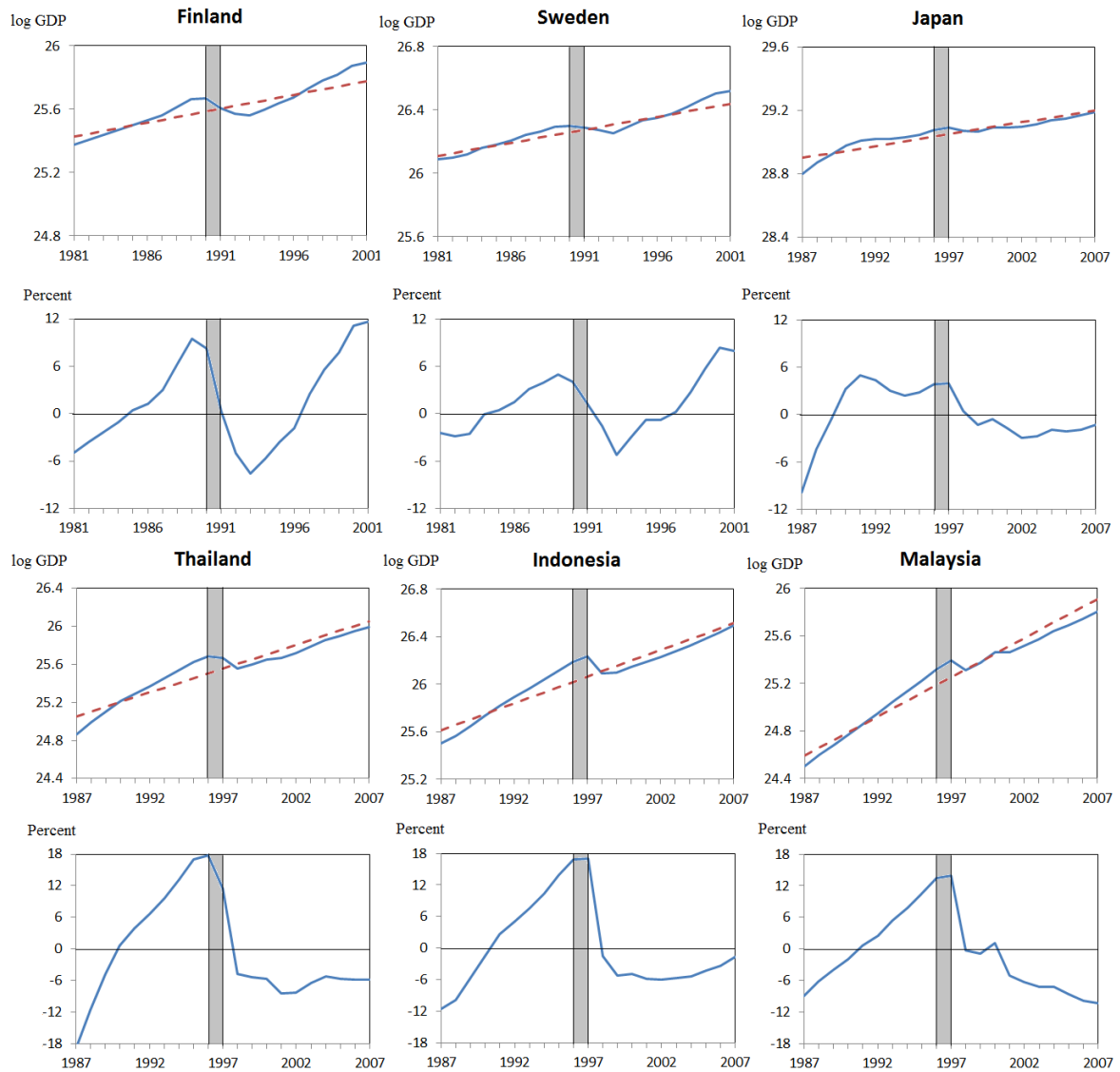


Figure 1: Real GDP before and after Banking Crises

Notes:

1. Each pair of panels for each country displays real GDP with a trend line (upper panel) and a percentage deviation of the actual level of output from the trend (lower panel) over the period before and after each country's major banking crisis (10 years before and after the onset of a crisis). The shaded area shows a starting year of the crisis.
2. The trend line (dashed line in the upper panel of each pair) is calculated by fitting a linear regression through the real GDP series during a 10 year pre-crisis period plus a 5 year post-crisis period starting on the third year from the onset of the crisis.

period. For Malaysia, the output loss even increases over the period. A question arises: what are the general patterns of recessions associated with banking crises and subsequent recoveries from the recessions?

Reviewing large archives of financial crises (including banking, currency, and sovereign debt crises) over the past eight centuries, Reinhart and Rogoff (2008, 2009a, 2009b) find that a slow recovery from a banking crisis is common across countries and over time. Although each crisis episode has different initial background conditions, recessions associated with banking crises tend to be severe and protracted. Cerra and Saxena (2008) analyze the general response pattern of post-crisis GDP using a simple time series model on a large sample of economies, and find that the conventional notion of economic recovery might be illusory in case of banking crises. They argue that the crisis lowers actual GDP relative to its pre-crisis path and that this persistent impact on output holds across countries.²

If a banking crisis produces particularly long and deep recessions, and hence is particularly detrimental to economic growth, how should we respond? What types of policies may help reduce the losses? What is the relationship between the level of a country's financial integration and the impacts of banking crises on the economy? A chance of having another banking crisis might increase as financial markets develop. Will a recession induced by such a crisis be even longer and deeper with more developed markets? Is there any chance that the potential cost outweighs the benefits from development of financial markets? These issues are particularly important in recent years since the public opinions about the role of financial markets are divided. One group prefers free and less controlled financial markets, while another group prefers a strong regulation and control of financial markets. Our paper presents some insights to address these issues.

²Studies on economic recovery are also performed by IMF (2009), Haugh et al. (2009), Howard et al.(2011), Furceri and Zdzienicka (2012), Furceri and Mourougane (2012), and Cerra and Saxena (2012).

In this chapter, we add two new angles to the existing empirical investigation of economic recovery. First, we decompose real GDP into the permanent and transitory components and analyze the economic recovery process through dynamic interactions of two components in response to a banking crisis. This provides an empirical base for a structural interpretation of economic recovery. Second, we attempt to capture differential patterns of such interactions of two components as the economy expands its financial markets. Since the degree of development of financial markets is roughly proportional to the size of the economy, we extend the dynamical analysis of the recovery process into four income groups of countries.

Our main empirical findings are summarized as follows. First, we reconfirm that the negative impact of banking crises on output is generally persistent as existing literature predicts. Second, and more importantly, advanced economies tend to be more adversely affected in magnitude of an output loss, but have a stronger rebound from the recessions. Third, an output loss in countries with well-developed financial markets is largely transitory, while for countries with less developed financial markets, the loss reflects mainly the permanent component.

The organization of this chapter is as follows. Section 1.2 presents an empirical framework and characterization of economic recovery. The empirical results are given in Section 1.3. Section 1.4 gives some concluding remarks.

1.2 Empirical Framework

1.2.1 Model

The simplest model to analyze economic recovery from a crisis is to express the output behavior as an autoregressive integrated process of order p , or ARIMA $(p, 1, 0)$ with a drift term shifting at the incident of a banking crisis. More specifically, we

consider the model

$$\Delta y_t = \alpha + \sum_{j=1}^l \beta_j \Delta y_{t-j} + \sum_{k=0}^m \gamma_k d_{t-k} + u_t, \quad (1)$$

where Δy_t is the log difference of output and d_t indicates a 0-1 variable reflecting the start year of the crisis. The γ_k 's capture the lagged impact of the crisis on the drift term α . The crisis is thought to be an event exogenous to the output process. This simple model can successfully describe the impact of the crisis and the economy's recovery from it, as Cerra and Saxena (2008) have shown.³ Strictly speaking, the event of a banking crisis can never be an exogenous incident, but the model captures a rough picture over numerous crises across countries.⁴ In fact, their empirical results are found very interesting as we see in later sections.

What lacks in Cerra and Saxena (2008) is, however, that it does not distinguish a permanent and a transitory movement of the output process during the course of economic recovery, and it fails to find the dynamic interaction of the two components. Actually, the impact of a banking crisis on the economy tend to be permanent in their model by design.

To address the above issue, we consider a model in which the output process is expressed as a sum of two orthogonal component processes, one purely permanent

³Cerra and Saxena (2008) use an autoregressive GDP growth model for panel data as follows:

$$\Delta y_{i,t} = \alpha_i + \sum_{j=1}^4 \beta_j \Delta y_{i,t-j} + \sum_{k=0}^4 \gamma_k d_{i,t-k} + u_{i,t},$$

where $i=1,2,\dots,N$ denotes an index number of sample countries.

⁴Teulings and Zubanov (2014) test the assumption that an incident of a banking crisis is exogenous to real GDP. They run a logit regression of the banking crisis dummy on lagged GDP levels. They find that lagged GDP level have no predictive power for the likelihood of a banking crisis for annual data.

and the other purely transitory. More specifically, the model is given by

$$y_t = \tau_t + c_t, \quad (2)$$

where τ_t and c_t are a permanent and a transitory component of output, respectively.

These two components follow their respective dynamics as

$$\tau_t = \mu + \tau_{t-1} + \sum_{j=0}^p \theta_j d_{t-j} + \eta_t, \quad (3)$$

$$\phi(L)c_t = \sum_{j=0}^q \delta_j d_{t-j} + \varepsilon_t, \quad (4)$$

where $d_t = 1$ if a crisis occurs at t and zero otherwise. η_t and ε_t are uncorrelated i.i.d. processes with zero mean and variances σ_η^2 and σ_ε^2 . Except for the inclusion of the crisis dummy variables, the model (2)-(4) is a standard version of the Unobserved Components (UC) model, frequently used in empirical business cycle studies (Harvey (1985, 1989), Clark (1987)). We assume $\phi(z) = 1 - \phi z$ with $|\phi| < 1$. Component τ_t may be interpreted as a “trend” of the output process, and Eq. (3) implies that it is a random walk with drift equal to $\mu_t^\tau = \mu + \sum_{j=0}^p \theta_j d_{t-j}$, where θ_j stands for the lagged impact of the crisis on the drift term. Component c_t is a “cycle” part of the output process, which is assumed to be stationary. Eq. (4) implies that the mean of c_t is equal to $\mu_t^c = \sum_{j=0}^q \phi^j \delta_j d_{t-j}$, where δ_j stands for the lagged impact of the crisis on the mean of the cycle term. Suppose now that there is a banking crisis starting at time T . Then, the h -period-ahead predicted trend (the permanent component) at $T - 1$ is given by

$$E(\tau_{T+h} | \tau^{T-1}, d_T = 1) = \tau_{T-1} + (h+1)\mu + \sum_{j=0}^{\min(h, p)} \theta_j, \quad (5)$$

for $h = 1, 2, \dots$, where $\tau^t = (\tau_t, \tau_{t-1}, \dots)$. Therefore, the shift of the trend

attributable to the crisis converges to a constant equal to $\sum_{j=0}^p \theta_j$ after the horizon h exceeds p . On the other hand, the h -period-ahead predicted cycle (the transitory component) at T-1 can be shown as

$$E(c_{T+h}|c^{T-1}, d_T = 1) = \phi^{h+1}c_{T-1} + \sum_{j=0}^{\min(h, q)} \phi^{h-j}\delta_j, \quad (6)$$

where $c^t = (c_t, c_{t-1}, \dots)$. Note that this component dies out eventually.

In terms of the first difference, expressions (5) and (6) imply

$$E(\Delta\tau_{T+h}|\tau^{T-1}, d_T = 1) = \mu + \sum_{j=0}^p \theta_j 1(h = j), \quad (7)$$

and

$$\begin{aligned} E(\Delta c_{T+h}|c^{T-1}, d_T = 1) &= -\phi^h(1 - \phi)c_{T-1} \\ &\quad - (1 - \phi) \sum_{j=0}^{\min(h-1, q)} \phi^{h-j-1}\delta_j + \delta_h 1(h - 1 < q), \end{aligned} \quad (8)$$

where $1(A)$ is equal to 1 if A is true and is zero otherwise.⁵ Finally, by combining expressions (5)-(6) and (7)-(8), the respective h -period-ahead predictions of the level and the growth rate of output are expressed as

$$E(y_{T+h}|\tau^{T-1}, c^{T-1}, d_T = 1) = E(\tau_{T+h}|\tau^{T-1}, d_T = 1) + E(c_{T+h}|c^{T-1}, d_T = 1), \quad (9)$$

$$E(\Delta y_{T+h}|\tau^{T-1}, c^{T-1}, d_T = 1) = E(\Delta\tau_{T+h}|\tau^{T-1}, d_T = 1) + E(\Delta c_{T+h}|c^{T-1}, d_T = 1). \quad (10)$$

⁵The mathematical proofs of expressions (5)-(8) are given in Appendix A

Expressions (5) and (6) show the capability of our model to capture the differential impacts of the crisis of the two components on the output process, which can reveal many interesting aspects of economic recovery. For example, if the sum of θ_j is found negative, it means that the output trend line has shifted down permanently due to the crisis. The net effect of a crisis on each component cannot be captured by the simple AR model which treats all impacts as permanent.

1.2.2 Types of Economic Recovery

Economic recovery is one of the most confusing concepts. Economists generally refer to the term “economic recovery” as the process starting from the bottom of a recession through restoration of a certain pre-crisis condition. However, there appears to be little consensus on exactly what feature of the economy consists of such a pre-crisis condition. There are at least three distinct types of economic recovery from a crisis, depending on the condition under which the economy is said to have recovered.

The first type of recovery simply concerns the timing when the level of output returns to the pre-crisis level. We call this type of recovery the “level recovery.” The second type of recovery is related to the timing when the output growth rate reaches the pre-crisis level. We call this type the “growth recovery.” The third type of recovery concerns the timing when output bounces back to the trajectory that would have prevailed if there had not been a crisis. In other words, output rises enough to compensate the early loss and comes back to the pre-crisis trajectory as if no crisis had taken place. We call this type the “trend recovery.”⁶

We now consider implications of our UC model (2)-(4) on the three types of recovery

⁶Becker and Mauro (2006) define recovery as the first type. IMF (2009) follows the concept of “growth recovery.” The “trend recovery” is employed in a number of studies (Cerra and Saxena (2008), IMF (2009), Haugh et al.(2009), Wynne (2011), Laeven and Valencia (2012)), each of which uses a different method to estimate the trend.

mentioned above. The first type of recovery, the level recovery, requires a return of output to the pre-crisis level y_{T-1} , or

$$LR_h \equiv E(y_{T+h} | \tau^{T-1}, c^{T-1}, d_T = 1) - y_{T-1} \geq 0.$$

Since

$$LR_h = -(1 - \phi^{h+1})c_{T-1} + (h+1)\mu + \sum_{j=0}^{\min(h, p)} \theta_j + \sum_{j=0}^{\min(h, q)} \phi^{h-j} \delta_j,$$

it is easy to see that the requirement of the level recovery is the least stringent among the three types of economic recovery. As long as we have a positive linear trend μ , the economy would always reach the level recovery after the finite periods following the crisis.

Since the growth recovery at $T+h$ implies

$$E(\Delta y_{T+h} | \tau^{T-1}, c^{T-1}, d_T = 1) \geq E(\Delta y_T | \tau^{T-1}, c^{T-1}, d_T = 0) = \mu - (1 - \phi)c_{T-1},$$

it requires

$$GR_h \equiv (1 - \phi)(1 - \phi^h)c_{T-1} + \sum_{j=0}^p \theta_j 1(h = j) - (1 - \phi) \sum_{j=0}^{\min(h-1, q)} \phi^{h-j-1} \delta_j + \delta_h 1(h < q+1) \geq 0,$$

for $h = 1, 2, 3, \dots$. We assume that the growth rate declines at the moment of a crisis, which implies $GR_0 = \theta_0 + \delta_0 < 0$. Whether we have a growth recovery at $h = 1$, for example, depends on $(1 - \phi)^2 c_{T-1} + \theta_1 - (1 - \phi)\delta_0 + \delta_1 > 0$, and whether we have at $h = 2$ depends on $(1 - \phi)(1 - \phi^2)c_{T-1} + \theta_2 - (1 - \phi)(\phi\delta_0 + \delta_1) + \delta_2 > 0$ and so on. Since $E(c_{T-1}) = 0$, we will on average have $GR_h \rightarrow 0$ as $h \rightarrow \infty$, or will

eventually have a growth recovery even under the worst scenario.

Lastly, the third type of recovery, the trend recovery, requires that output gets back to the level along the trajectory expected before the crisis, or more specifically

$$E(y_{T+h}|\tau^{T-1}, c^{T-1}, d_T = 1) \geq E(y_{T+h}|\tau^{T-1}, c^{T-1}, d_t = 0).$$

From expression (9), we find

$$\begin{aligned} TR_h &\equiv E(y_{T+h}|\tau^{T-1}, c^{T-1}, d_T = 1) - E(y_{T+h}|\tau^{T-1}, c^{T-1}, d_T = 0) \\ &= \sum_{j=0}^{\min(h,p)} \theta_j + \sum_{j=0}^{\min(h,q)} \phi^{h-j} \delta_j \geq 0. \end{aligned}$$

Since $TR_h \rightarrow \sum_{j=0}^p \theta_j$ as $h \rightarrow \infty$, the trend recovery is ultimately determined by the non-negativeness of the sum of θ_j 's. It appears that not many banking crises recoveries can satisfy this condition. In the empirical analysis to follow, we examine the results from the standpoint of the all three types of economic recovery. Figure 2 illustrates these three types of economic recovery.

1.2.3 Data

Our data set covers 80 countries with 99 episodes of systemic banking crises over the period 1960-2012.⁷ Data on banking crisis dates are taken from Leaven and Valencia (2012). All crisis episodes are considered to be severe enough to have a major macroeconomic impact. We employ the World Development Indicators (WDI) as a source of annual real GDP in constant 2000 US dollars. We classify our samples into four country groups of (i) high income, (ii) upper middle income, (iii) lower middle income, and (iv) low income countries, as done by Cerra and Saxena (2008), to

⁷The list of countries is given in Appendix C.

examine the possibility of a differential impact in banking system across income levels. The classification of income group of countries is also based on WDI.⁸

⁸WDI divides economies into four groups according to 2012 GNI per capita. The groups are: low income, \$1,035 or less; lower middle income, \$1,036 - \$4,085; upper middle income, \$4,086 - \$12,615; and high income, \$12,616 or more.

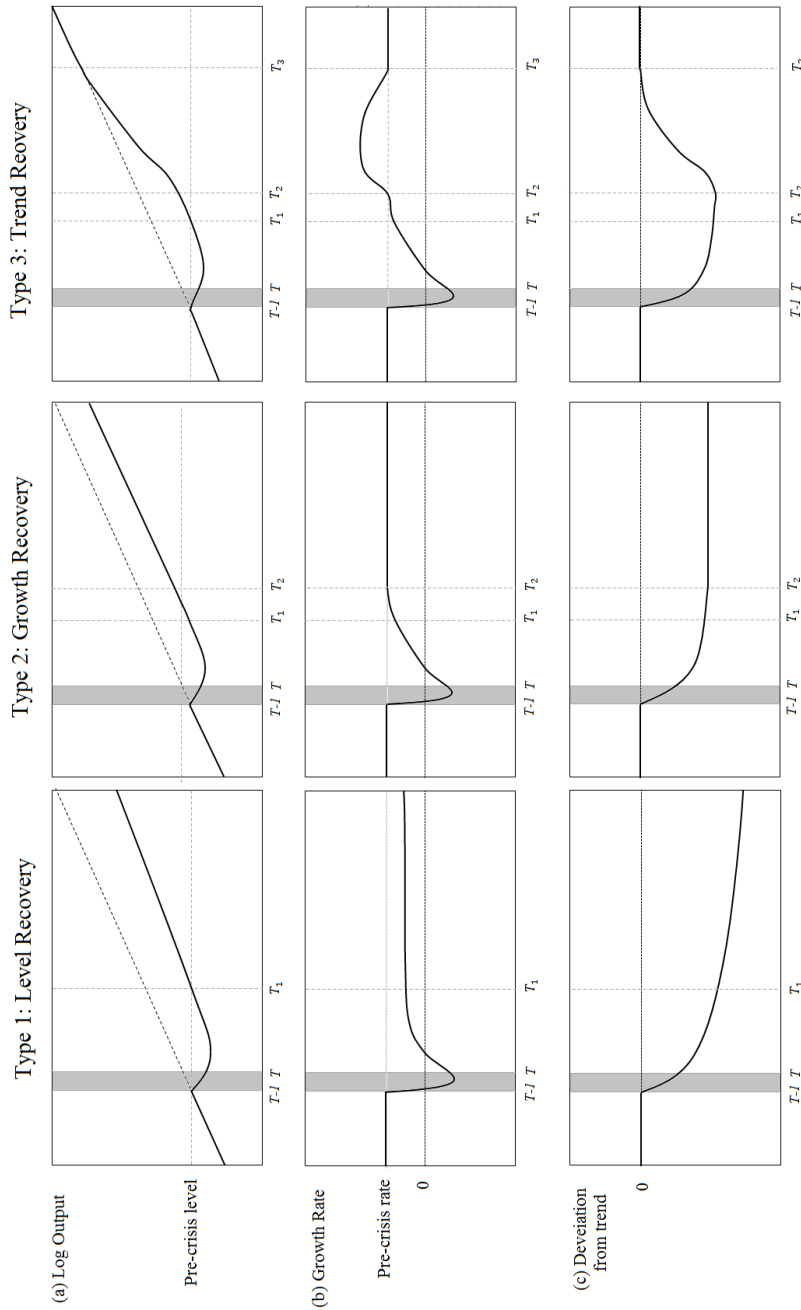


Figure 2: Types of Output Recovery

Notes:

1. Three different patterns of a post-crisis output movement are given for illustrating three types of economic recovery under a simplified assumption that the trend of output is linear and deterministic.
2. The panels in rows (a), (b), and (c) for each case report the log output, output growth rate, and output deviation from the trend.
3. T represents the time of an incident of a banking crisis. The top panels display the output level over the period before and after a crisis along with a trend. The second and third panels display the growth rate and output deviation from the trend, respectively.
4. The economy is said to recover at time T_1 in the sense of the “level recovery,” at time T_2 in the sense of the “growth recovery,” and at time T_3 in the sense of the “trend recovery.”

1.3 Empirical Results

Our main focus lies in depicting the movement of output from its outset through its recovery for a typical banking crisis, globally as well as for a certain group of countries. The net effect of a typical crisis on output is found as the predicted differentials between the output trajectory with a crisis and without a crisis after its incident. More specifically, it can be expressed as

$$z_h^\tau \equiv E(\tau_{T+h}|\tau^{T-1}, d_T = 1) - E(\tau_{T+h}|\tau^{T-1}, d_T = 0), \quad (11)$$

for the permanent component and as

$$z_h^c \equiv E(c_{T+h}|c^{T-1}, d_T = 1) - E(c_{T+h}|c^{T-1}, d_T = 0), \quad (12)$$

for the transitory component at horizon h . Combining the two expressions above, we obtain

$$z_h \equiv z_h^\tau + z_h^c = E(y_{T+h}|\tau^{T-1}, c^{T-1}, d_T = 1) - E(y_{T+h}|\tau^{T-1}, c^{T-1}, d_T = 0), \quad (13)$$

as the effect on the after-crisis output trajectory attributable to a banking crisis. The above approach is an extended version of the classical intervention analysis dated back to Box and Tiao (1975), and the effect on output can be calculated in a similar way to the conventional impulse response function although it is a response to an incident of a crisis rather than an impulse or shock. Roughly speaking, we distinguish two types of influence of a crisis on the output process. The one is a temporary shift in slope of the time path and the other is a temporary deviation from this path. Tables 1a and 1b summarize the h -period-ahead net effects of a banking crisis on the

Table 1: Effects of a Banking Crisis on Permanent and Transitory Components

(a) The effect on the permanent component

Horizon (h)	Net effect on level	Net effect on growth
0	θ_0	θ_0
1	$\theta_0 + \theta_1$	θ_1
2	$\theta_0 + \theta_1 + \theta_2$	θ_2
3	$\theta_0 + \theta_1 + \theta_2 + \theta_3$	θ_3
4	$\theta_0 + \dots + \theta_4$	θ_4
≥ 5	$\theta_0 + \dots + \theta_4$	0

(b) The effect on the transitory component

Horizon (h)	Net effect on level	Net effect on growth
0	δ_0	δ_0
1	$\phi\delta_0 + \delta_1$	$-(1 - \phi)\delta_0 + \delta_1$
2	$\phi^2\delta_0 + \phi\delta_1 + \delta_2$	$-(1 - \phi)(\phi\delta_0 + \delta_1) + \delta_2$
3	$\phi^3\delta_0 + \phi^2\delta_1 + \phi\delta_2 + \delta_3$	$-(1 - \phi)(\phi^2\delta_0 + \phi\delta_1 + \delta_2) + \delta_3$
4	$\phi^4\delta_0 + \phi^3\delta_1 + \phi^2\delta_2 + \phi\delta_3 + \delta_4$	$-(1 - \phi)(\phi^3\delta_0 + \phi^2\delta_1 + \phi\delta_2 + \delta_3) + \delta_4$
≥ 5	$\phi^h\delta_0 + \dots + \phi^{h-4}\delta_4$	$-(1 - \phi) \sum_{j=0}^4 \phi^{h-j-1} \delta_j$

Notes:

- Table (a) and (b) summarize the h -period-ahead net effect of a banking crisis on the permanent and transitory components, respectively under the assumption of $p = q = 4$.
- The second column of each panel reports the effect on the level of each component. The third column reports the effect on the growth rate of each component.

permanent and transitory components, respectively.⁹

In the next section, we start analyzing the four different dynamic responses to a banking crisis on the entire sample of countries. Then, we provide analysis on the sub-samples of four different income groups. To obtain the common pattern of output response, we calculate the mean of the parameters estimated separately for each country (Table 2).¹⁰ Our UC model is estimated using Markov Chain Monte Carlo

⁹In this chapter, we estimate our UC model with 4 lags of a banking crisis dummy (that is, $p = q = 4$). We do not observe significant coefficients in higher lags of a crisis dummy.

¹⁰We also calculate the mean of the responses generated from each country's estimated parameters. This methodology does not produce any large quantitative/qualitative difference from we report in this paper.

(MCMC) technique with 10,000 iterations and 2,000 burn-in draws.¹¹ We report the dynamic responses with one-standard-error bands to assess the statistical significance of the estimation results.

1.3.1 Global Picture

Panels of Figure 3 show the dynamic responses of the permanent component (Panel (a)), the transitory component (Panel (b)), and overall output (Panels (d) and (e)) at a time horizon from -1 to 10. Our results reconfirm the permanent impact of banking crises on output as existing literature suggest, but more importantly, they show that there exists a significant difference in the shape of the permanent and transitory components.

The permanent component exhibits an “L-shaped” response. The loss falls by about 0.5 percent initially and continuously decreases until the 4th year from the onset of the initial shock. In the subsequent years, the response stays at about -2 percent. The permanent impact of the crisis leads output to never recover from a banking crisis in the sense of the trend recovery and shifts down the future path of of real GDP permanently.

The transitory response exhibits a “V-shaped” response. More specifically, the transitory component experiences its initial loss of 0.4 percent and then reaches its trough of 0.8 percent after 1 year. From then on, the output loss starts to shrink quickly. After 6 years, the transitory response returns to zero. Panel (c) reports the shares of the permanent and transitory components at a 10-year horizon. The initial shock is almost equally shared by the two components. As time goes on, the contribution of the permanent component monotonically increases.

Finally, we combine the two effects to compare our results with those from the simple

¹¹See Appendix B for the state space representation of our empirical model and computational procedures.

Table 2: Parameter Estimates: UC Model with Banking Crisis Dummies

	(a) All countries	(b) High Income	(c) Upper Middle Income	(d) Lower Middle Income	(e) Low Income
θ_0	-0.400 (0.098)	-0.217 (0.173)	-0.612 (0.150)	-0.308 (0.178)	-0.400 (0.098)
θ_1	-0.486 (0.098)	-0.388 (0.184)	-0.689 (0.146)	-0.431 (0.178)	-0.486 (0.098)
θ_2	-0.377 (0.094)	-0.325 (0.179)	-0.486 (0.117)	-0.346 (0.174)	-0.377 (0.09)
θ_3	-0.320 (0.088)	-0.269 (0.178)	-0.318 (0.11)	-0.326 (0.176)	-0.320 (0.088)
θ_4	-0.303 (0.086)	-0.291 (0.183)	-0.308 (0.107)	-0.260 (0.162)	-0.303 (0.086)
μ	5.00 (0.388)	4.294 (0.685)	5.588 (0.916)	5.223 (0.731)	4.72 (0.68)
δ_0	-0.458 (0.067)	-0.731 (0.140)	-0.821 (0.139)	-0.126 (0.127)	-0.276 (0.127)
δ_1	-0.691 (0.069)	-1.197 (0.151)	-1.030 (0.142)	-0.424 (0.132)	-0.169 (0.130)
δ_2	-0.451 (0.067)	-1.012 (0.146)	-0.611 (0.133)	-0.231 (0.132)	-0.031 (0.128)
δ_3	-0.336 (0.065)	-0.647 (0.141)	-0.319 (0.127)	-0.178 (0.130)	-0.257 (0.127)
δ_4	-0.333 (0.066)	-0.687 (0.146)	-0.260 (0.127)	-0.150 (0.129)	-0.305 (0.127)
ϕ	0.231 (0.013)	0.210 (0.021)	0.236 (0.026)	0.233 (0.026)	0.241 (0.028)
σ_ε^2	33.51 (6.572)	26.30 (12.65)	39.29 (15.09)	32.96 (12.079)	33.89 (11.80)
σ_η^2	3.851 (0.590)	2.00 (0.552)	4.27 (1.660)	3.884 (0.905)	4.934 (1.052)

Notes:

1. The table reports the averaged estimates of parameters of Eqs. (3) to (4) and the standard errors of the average estimates for each income group.
2. We estimate the model for each country and then calculate an average of each parameter across the sample countries in the same income group. The averaged standard errors are reported in parenthesis.

AR model. Panel (d) and (e) show the responses of overall output estimated from our UC model and the simple AR model.^{12 13} The significant difference between the two models is the existence of the output rebound. In the UC model, the output loss is 1 percent at the incident of a shock and continues to accumulate for 4 years to reach 2.3 percent at the bottom of recession. In the 5th year after the crisis, output gains for the first time, that is, the economy recovers in the sense of growth recovery. This rebound is, however, partial and the response stays around at 2 percent loss beyond the 6th year. In contrast, the response from the simple AR model never exhibits any rebound from its deepest loss; in other words, it never closes the gap between actual output and the pre-crisis output trajectory which would be realized if there had been no banking crisis.¹⁴

¹²Note that, in the UC model, the dynamic response of overall output (real GDP) is the sum of the permanent and transitory responses.

¹³We estimate ARIMA(4,1,0) model as done by Cerra and Saxena (2008).

¹⁴Cai and Denhaan (2009) find that the simple AR model is likely to predict that the impact of the shock is only permanent.

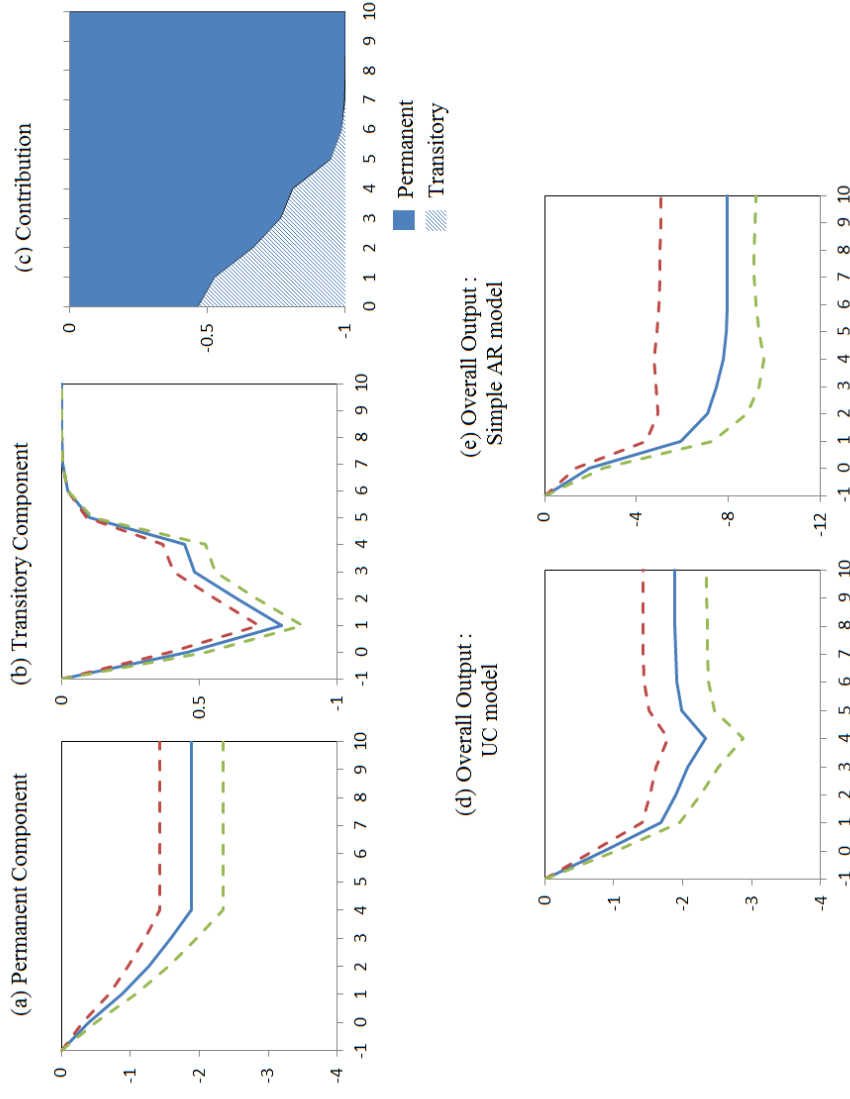


Figure 3: Responses of Permanent Component, Transitory Component, and Overall Output

Notes:

1. Panel (a), (b), and (d) report the dynamic responses (solid lines) of permanent component, transitory component, and overall output with plus/minus one S.E. confidence intervals (dashed lines). 0 on the horizontal axis corresponds to the time of an incident of a crisis, i.e., $t = T$. Similarly, 1 corresponds to $t = T + 1$. The responses are derived from the estimates in the first column of Table 2.
2. Panel (c) reports what percentage of the output loss (vertical axis) is attributed to the permanent component and the transitory component over years from a shock (horizontal axis).
3. Panel (e) reports the output response estimated from the simple AR model.

1.3.2 Country Group Analysis

Now, we analyze the dynamic responses across different income levels of economies. Panels of Figure 4 show the dynamic responses of the two components (Rows (a) and (b)), the contribution of each component (Row (c)), and the overall output responses estimated from the UC model and the simple AR model (Rows (d) and (e)) for each income group. Two distinctive features between the permanent and transitory responses stand out from the income-group-wise comparison.

First, in the permanent component, we find that the size of a loss tends to be with in a similar level except the group of upper middle income countries. The group of middle income counties experiences the largest output loss, which accounts for 2.5 percent 4 years after. The smallest loss (1.5 percent) is experienced by the group of high income countries.

In contrast, the size of a transitory loss is rather in proportion to a country's income level. The group of high income countries suffers the most severe loss of around 1.4 percent one year after the shock. The magnitude of the deepest loss proportionally decreases as a country's income level goes down. Lower middle and lower income countries experience only 0.4 percent losses at the bottom. The relative importance of the transitory component also declines as the income level lowers. In particular, around 75 percent of the initial shock in high income countries is driven by the transitory component. However, the transitory shock accounts for only 30 percent on impact of a crisis in the low income group.¹⁵

Panels in Row (d) in Figure 4 present the overall output response for each income group estimated by the UC model. While the persistent loss is common for all income groups (that is, there is no trend recovery), we find that all income groups recover in the sense of growth recovery along with an output rebound. In particular, the output

¹⁵Aguiar and Gopinath (2007) find that the primary source of fluctuations in developing countries are highly volatile permanent shocks rather than the transitory shocks.

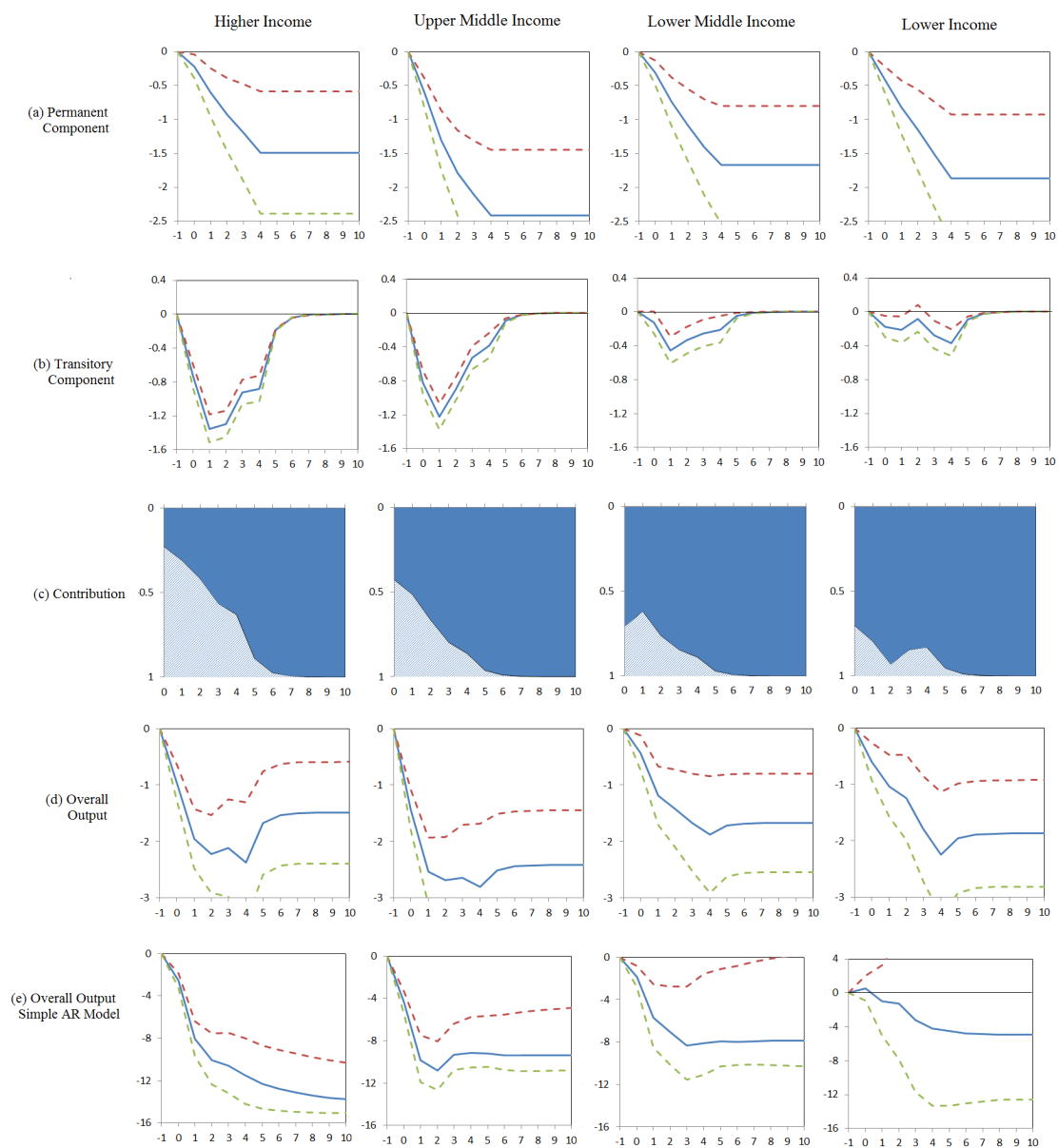


Figure 4: Responses by Income Levels

Notes:

1. The panels in Rows (a), (b), and (d) for each income group report the responses of the permanent component, the transitory component, and the overall output, respectively. The dashed lines denote plus/minus one SE confidence intervals.
2. The panels in Row (c) report what percent of the output loss is attributed to trend and cycle (vertical axis) at a 10-year time horizon from the onset of a crisis shock.
3. The panels in Row (e) for each country report the response of output estimated by the simple AR model.

rebound is strongest in the groups of high income countries in which more than 20 percent of the output loss at the trough is recuperated in subsequent years while the rebounds are insignificant in less developed countries.

This feature is not shared by the simple AR model (Panels in Row (e)), which tends to treat a shock as a permanent shock. Three income groups except the group of higher middle income countries do not exhibit any output rebounds from the recessions. In particular, high income countries experience a continuous fall in output. The results from our UC model may be interpreted as a transition from an elementary stage of financial development to a more advanced stage of development. At a very elementary level of financial development, an economy with undeveloped financial markets is not likely to suffer a nation-wide market crisis. The lack of the economy-wide banking system does not allow an impact of a local bank failure to spread over the entire economy holding down the size of the impact of banking crises. However, at the same time, developing countries lack in a strength of macroeconomic fundamentals as a shock absorber. Even if the shock is small, it may have a sustained and long-lasting impact on the economy.

As a bank finance penetrates into the economy and grows in scale, the economy becomes correspondingly more vulnerable to an adverse shock to any local part of the system. However, further development of financial systems may help limit the large banking-crisis shock to a temporary shock. When a scale expansion of banking network is followed by a widening of the channels of financial arrangements beyond bank loans (such as corporate bonds or equity finances), the negative impact of banking crises, even when spread over the whole economy, would be more likely to be absorbed by other channels before paralysing the entire economy.¹⁶

¹⁶Adler and Tovar (2012) find a country's strength of macroeconomic fundamentals as well as a country's degree of financial integration to affect the economic impact of financial shocks on the economy.

1.4 Conclusion

In this section, using the Unobserved Components model with a banking-crisis dummy, we quantify the general effects of systemic banking crises on real GDP and its two components, the permanent component and the transitory component, over the past five decades across a wide range of economies. In addition to reconfirming the persistent impact of banking crises as existing studies suggest, we find that more advanced economies tend to be more adversely affected in terms of the magnitude of the output loss, but experience a larger rebound of the output from recessions. This result is attributable to the different contribution of the permanent component and the transitory component to the overall output loss across different income levels of economies. The output loss in higher income countries is explained by the transitory component rather than the permanent component. Meanwhile, in less developed countries, the majority of the loss reflects the permanent component, leading to no bounce-back.

2 Estimating the Effects of Monetary Policy on Recovery

2.1 Introduction

In chapter 1, using an annual data set of real GDP for a number of countries, we analyze the general dynamic response of real GDP to banking crises in terms of the permanent and transitory components, and we find interesting patterns of the recovery process across different income groups of economies. In this chapter, shifting our focus to each country's response, we investigate the effect of monetary policy on economic recovery from banking crises.

While knowledge on how to conduct monetary policy during a banking crisis exists, few studies focus on how such policy affects the dynamics of output in the aftermath of crises.¹⁷ If there were no monetary policy actions to the crisis, what losses would the economy have experienced? Does monetary policy help reduce the losses?

We add an exogenous monetary policy variable into the framework of our UC model to investigate the effect of expansionary monetary policy on the post-crisis dynamics of real GDP. Estimating the dynamic output response from a monetary policy shock, we show a counter-factual path of output if there was no policy reaction. To capture the short-run dynamics, we employ quarterly data for 3 major economies: US, Japan, and UK.

Our primary finding is that monetary policy (an increase in the money supply) is important in influencing the recovery process. Nearly 50 percent of the transitory losses are reduced after the onset of the crisis for the US and Japan while the UK experiences a very limited impact from monetary policy.

¹⁷One exception is Furceri and Zedzienia (2012). They analyze the role of structural and fiscal/monetary policy variables and find that monetary policy limits the negative effect of banking crises in the medium term using a local projection method in generating impulse response functions on a sample of developing countries.

2.2 Empirical Framework

2.2.1 Model

We modify our UC model with a banking crisis dummy as follows:

$$y_t = \tau_t + c_t \quad (14)$$

$$\tau_t = \mu + \tau_{t-1} + \sum_{j=0}^p \theta_j d_{t-j} + \eta_t \quad (15)$$

$$\phi(L)c_t = \sum_{j=0}^q \delta_j d_{t-j} + \gamma_0(L)x_t + \gamma_1(L)x_t d_t + \epsilon_t \quad (16)$$

$$\gamma_i(L) = \sum_{k=1}^r \gamma_{ik} L^k \quad (17)$$

where x_t is a scalar variable to measure a monetary policy shock. We assume that monetary policy has no real effect in the long run, and thus allow x_t to impact only the transitory component. This model is assumed to capture the potential differential impact of monetary policy on output during the course of recovery from the crisis. γ_0 captures the lagged impact of monetary policy on the transitory component in normal times and γ_1 measures its impact during the post-crisis period.¹⁸ As we discuss in the later section, the monetary policy shock is estimated from a simple Vector Autoregression (VAR) model.¹⁹

¹⁸We set $\gamma_i(L) = \sum_{k=1}^4 \gamma_{ik} L^k$ since we do not have any significant coefficients in the higher lags.

¹⁹Lo and Piger (2005) apply the similar empirical approach. They treat d_t as a Markov regime-switching variable representing the period of expansions and contractions to capture asymmetric impact of monetary policy during recessions.

2.2.2 Measurement of Monetary Policy Shock

For the monetary policy variable x_t , we construct a money-based monetary policy shock from a VAR.²⁰ The VAR contains Money (M1), Income (real GDP), Unemployment rates, Prices (the GDP deflator), Wages (hourly earnings) and Import prices. The recursive VAR in the above order is estimated, and we refer to a residual in the money equation as a “monetary policy shock” in the sense that it is a component of money which is not predicted from the past information of the six variables. To capture the short-term impact of monetary policies on real economic activity, we employ quarterly data over the period from the first quarter of 1960 to the fourth quarter of 2012. Real GDP, monetary aggregate, hourly earnings, and unemployment rates are taken from a database of OECD Stats. The other variables are from the International Financial Statistics managed by the International Monetary Fund. We transform all of the variables except the unemployment rate into the natural logarithm.

2.3 Empirical Results

Our interest is centered on the role of monetary policy in influencing the process of economic recovery from banking crises. As in chapter 1, we compute the dynamic responses of the transitory component and overall output to the banking crisis shock. In addition, we generate a response of the transitory component to a monetary policy shock by simulating a positive unitary shock to the money supply (M1). Table 3 presents the parameter estimates of Eq. (16). Panels of each country in Figure 5 show the responses of the transitory component and overall output, respectively, at a time horizon from -1 to 12 (quarters). The dotted lines in the panels represent the counter-factual path of the dynamic output responses if there was no monetary policy

²⁰We use the model specification of Sims (1980)’s 6-variable VAR. The number of lags are determined by Akaike Information Criteria. We use 4 lags for US and UK and 2 lags for Japan.

Table 3: Parameter Estimates: UC Model with a Monetary Policy Shock

Parameter	US	Japan	UK
γ_{01}	0.02 (0.03)	0.18 (0.06)	-0.017 (0.05)
γ_{02}	0.037 (0.03)	-0.017 (0.06)	0.01 (0.05)
γ_{03}	-0.01 (0.04)	-0.05 (0.06)	0.07 (0.05)
γ_{04}	-0.06 (0.05)	-0.20 (0.07)	0.05 (0.05)
γ_{11}	0.45 (0.50)	0.21 (0.50)	0.058 (0.54)
γ_{12}	0.37 (0.51)	0.27 (0.52)	0.12 (0.54)
γ_{13}	0.57 (0.51)	0.57 (0.52)	0.20 (0.55)
γ_{14}	1.04 (0.49)	0.48 (0.52)	0.27 (0.55)

Note:

The table reports the parameter estimates of Eq. (16) and the standard errors of the estimates for each country.

shock. Our results suggest that monetary policy effectively reduces the output loss from the banking crises although the degree of the policy impact varies across the countries. For the United States, the simulated response of the transitory component starts at -0.4 percent and reaches its trough of -2.3 percent 5 quarters after the onset of a crisis. Our results show that the output loss would be much larger if there was no monetary policy reaction. The initial transitory loss would become 0.9 percent, which is almost twice as large as the expected loss with monetary policy. A monetary policy shock in Japan also attenuates the negative impact of a banking crisis. At the 4th quarter, almost 70 percent of the transitory loss is reduced by the monetary policy reaction. Meanwhile, for the United Kingdom, the conduct of monetary policy has a limited impact on output.

2.4 Conclusion

In this chapter, we investigate the impact of monetary policy under the framework of the UC model with a banking crisis dummy variable. We find that a positive shock of the money supply significantly reduces the loss in the transitory component of real GDP. More than 50 percent of the transitory losses are reduced during the first 4 quarters after the onset of the crisis for US and Japan. In contrast, UK experiences a very limited impact from monetary policy.

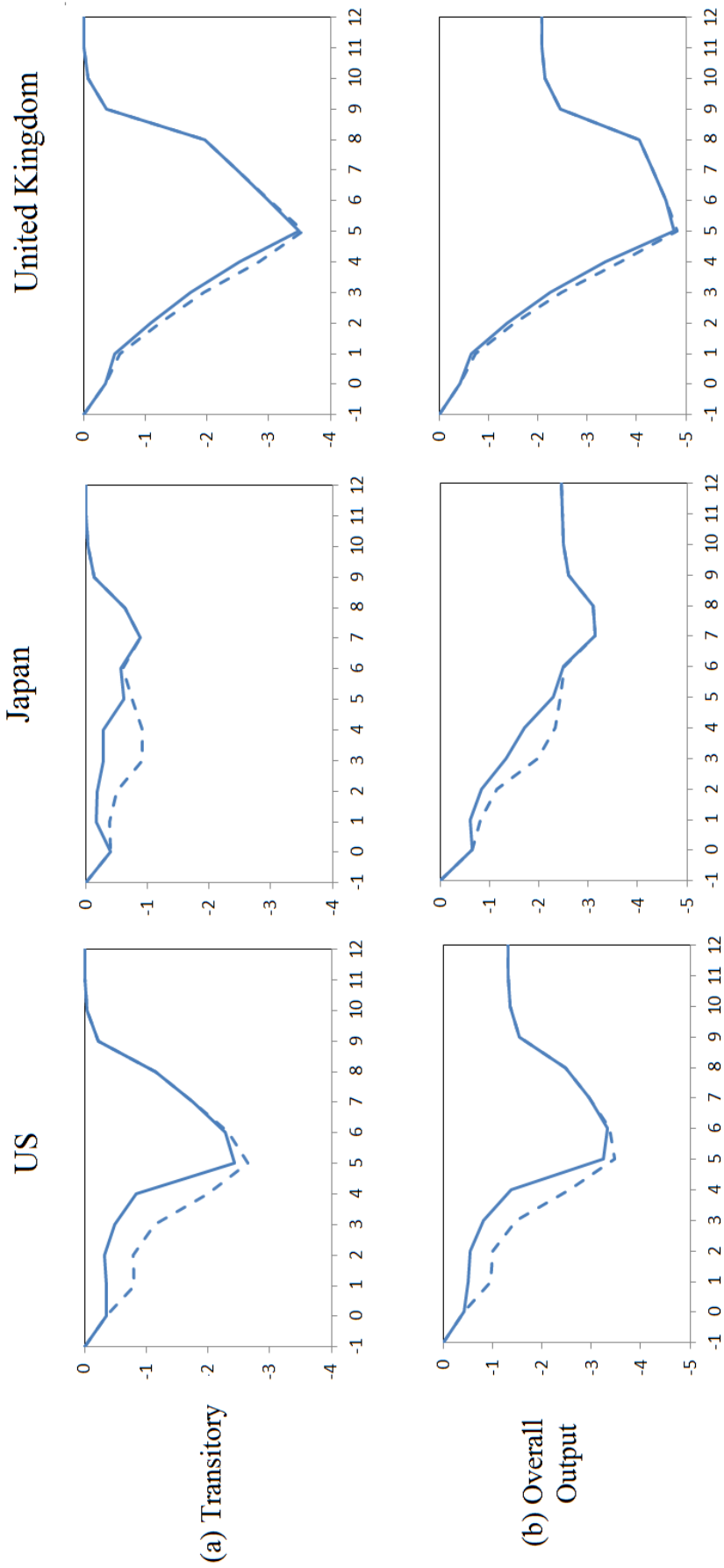


Figure 5: Responses of Output: Three Countries

Note:
 The panels in Rows (a) and (b) for each country report the responses of the transitory component and overall output, respectively. The dashed lines represent the estimated responses if there was no monetary policy.

Appendix A: Mathematical Proofs

In this section, we prove expressions (7) and (8) by mathematical induction from expressions (5) and (6). All of the expressions are given as:

$$E(\tau_{T+h}|\tau^{T-1}, d_T = 1) = \tau_{T-1} + (h+1)\mu + \sum_{j=0}^{\min(h,p)} \theta_j \text{ for } h = 1, 2, \dots, \quad (5)$$

$$E(c_{T+h}|c^{T-1}, d_T = 1) = \phi^{h+1}c_{T-1} + \sum_{j=0}^{\min(h,q)} \phi^{h-j}\delta_j, \quad (6)$$

$$E(\Delta\tau_{T+h}|\tau^{T-1}, d_T = 1) = \mu + \sum_{j=0}^p \theta_j 1(h=j), \quad (7)$$

$$\begin{aligned} E(\Delta c_{T+h}|c^{T-1}, d_T = 1) &= -\phi^h(1-\phi)c_{T-1} \\ &\quad - (1-\phi) \sum_{j=0}^{\min(h-1,q)} \phi^{h-j-1}\delta_j + \delta_h 1(h-1 < q). \end{aligned} \quad (8)$$

For expression (5), let $\Omega_T = (\tau^{T-1}, d_T = 1)$. By definition, the expected value of the h -period-prediction of $\Delta\tau$ given Ω_T is expressed as

$$\begin{aligned} E(\Delta\tau_{T+h}|\Omega_T) &= E(\tau_{T+h} - \tau_{T+h-1}|\Omega_T) \\ &= E(\tau_{T+h}|\Omega_T) - E(\tau_{T+h-1}|\Omega_T). \end{aligned} \quad (\text{A.1})$$

For $h = 1$, the 1-period-ahead prediction of $\Delta\tau_T$ is

$$E(\Delta\tau_{T+1}|\Omega_T) = E(\tau_{T+1}|\Omega_T) - E(\tau_T|\Omega_T). \quad (\text{A.2})$$

Using expression (5), this becomes

$$E(\Delta\tau_{T+1}|\Omega_T) = \begin{cases} \mu & \text{for } p < 1, \\ \mu + \theta_1 & \text{for } 1 \leq p. \end{cases}$$

Therefore, we satisfy

$$E(\Delta\tau_{T+1}|\Omega_T) = \mu + \sum_{j=0}^p \theta_j 1(1 = j). \quad (\text{A.3})$$

Now, suppose some arbitrary integer k which satisfies (A.3), that is,

$$E(\Delta\tau_{T+k}|\Omega_T) = \mu + \sum_{j=0}^p \theta_j 1(k = j). \quad (\text{A.4})$$

We consider the $(k + 1)$ -period-ahead prediction of $\Delta\tau_T$ as follows:

$$\begin{aligned} E(\Delta\tau_{T+(k+1)}|\Omega_T) &= E(\tau_{T+(k+1)}|\Omega_T) - E(\tau_{T+k}|\Omega_T) \\ &= E(\tau_{T+(k+1)}|\Omega_T) - E(\tau_{T+(k-1)}|\Omega_T) - E(\Delta\tau_{T+k}|\Omega_T). \end{aligned} \quad (\text{A.5})$$

If (A.4) is true, then (A.5) becomes

$$E(\Delta\tau_{T+(k+1)}|\Omega_T) = \begin{cases} \mu & \text{for } p < k + 1, \\ \mu + \theta_{k+1} & \text{for } k + 1 \leq p, \end{cases}$$

or

$$E(\Delta\tau_{T+k+1}|\Omega_T) = \mu + \sum_{j=0}^p \theta_j 1(k + 1 = j). \quad (\text{A.6})$$

Therefore, by mathematical induction from (A.3) and (A.4)-(A.6), we prove

$$E(\Delta\tau_{T+h}|\Omega_T) = \mu + \sum_{j=0}^p \theta_j 1(h = j) \text{ for } h = 1, 2, 3, 4, \dots \quad (\text{A.7})$$

Next, we prove expression (8) in the same manner. By definition, we have

$$E(\Delta c_{T+h}|\Psi_T) = E(c_{T+h} - c_{T+h-1}|\Psi_T) = E(c_{T+h}|\Psi_T) - E(c_{T+h-1}|\Psi_T), \quad (\text{A.8})$$

where $\Psi_T = (c^{T-1}, d_T = 1)$.

For $h = 1$, (A.8) becomes

$$E(\Delta c_{T+1}|\Psi_T) = E(c_{T+1}|\Psi_T) - E(c_T|\Psi_T). \quad (\text{A.9})$$

Using expression (6), this is equal to

$$\begin{aligned} E(\Delta c_{T+1}|\Psi_T) &= (\phi^2 c_{T-1} + \sum_{j=0}^{\min(2,q)} \phi^{1-j} \delta_j) \\ &\quad - (\phi c_{T-1} + \sum_{j=0}^{\min(1,q)} \phi^{-j} \delta_j). \end{aligned} \quad (\text{A.10})$$

For any q , the following expression holds:

$$\begin{aligned} E(\Delta c_{T+1}|c^{T-1}, d_T = 1) &= -\phi(1 - \phi)c_{T-1} \\ &\quad - (1 - \phi) \sum_{j=0}^{\min(0,q)} \phi^{-j} \delta_j + \delta_1 1(0 < q). \end{aligned} \quad (\text{A.11})$$

Now, we consider h is some arbitrary integer k and suppose $E(\Delta c_{T+k})$ satisfies expression (8), that is,

$$\begin{aligned} E(\Delta c_{T+k}|c^{T-1}, d_T = 1) &= -\phi^k(1 - \phi)c_{T-1} \\ &\quad - (1 - \phi) \sum_{j=0}^{\min(k-1,q)} \phi^{k-j-1} \delta_j + \delta_k 1(k - 1 < q). \end{aligned} \quad (\text{A.12})$$

Consider $E(\Delta c_{T+(k+1)})$ as

$$\begin{aligned} E(\Delta c_{T+(k+1)}|\Psi_T) &= E(c_{T+(k+1)}|\Psi_T) - E(c_{T+k}|\Psi_T) \\ &= E(c_{T+(k+1)}|\Psi_T) - E(c_{T+(k-1)}|\Psi_T) - E(\Delta c_{T+k}|\Psi_T). \end{aligned} \quad (\text{A.13})$$

If (A.12) is true, then (A.13) is equal to

$$E(\Delta c_{T+(k+1)}|\Psi_T) = -\phi^{k+1}(1-\phi)c_{T-1} - (1-\phi) \sum_{j=0}^{\min(k,q)} \phi^{k-j}\delta_j + \delta_{k+1}1(k < q). \quad (\text{A.14})$$

Finally, by mathematical induction from (A.10) and (A.11)-(A.14), we prove

$$\begin{aligned} E(\Delta c_{T+h}|\Psi_T) &= -\phi^h(1-\phi)c_{T-1} \\ &\quad - (1-\phi) \sum_{j=0}^{\min(h-1,q)} \phi^{h-j-1}\delta_j + \delta_h1(h-1 < q) \text{ for } h = 1, 2, 3, \dots \end{aligned} \quad (\text{A.15})$$

Appendix B: State-Space Representation of the UC Model and Sampling Procedure

Eqs. (2)-(4) can be written in a state-space form as follows:

$$y_t = \begin{bmatrix} 1 & 1 \end{bmatrix} \begin{bmatrix} \tau_t \\ c_t \end{bmatrix} \quad (\text{A.1})$$

$$\begin{bmatrix} \tau_t \\ c_t \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & \phi \end{bmatrix} \begin{bmatrix} \tau_{t-1} \\ c_{t-1} \end{bmatrix} + \begin{bmatrix} \sum_{i=0}^p \theta_i d_t \\ \sum_{j=0}^q \delta_j d_t \end{bmatrix} + \begin{bmatrix} \mu \\ 0 \end{bmatrix} + \begin{bmatrix} \eta_t \\ \epsilon_t \end{bmatrix} \quad (\text{A.2})$$

$$\begin{bmatrix} \eta_t \\ \epsilon_t \end{bmatrix} \sim i.i.d.N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} \sigma_\eta^2 & 0 \\ 0 & \sigma_\epsilon^2 \end{bmatrix} \right) \quad (\text{A.3})$$

Once a dynamic system of the model is written in a state-space form, the Kalman filter computes the optimal estimates of the unobserved state vector $[\tau_t \ c_t]'$, conditional on the parameters and the information set of Ψ_{t-1} . We apply a Bayesian estimation method, Markov Chain Monte Carlo (MCMC) to estimate our empirical model, in which the parameters and the state variables are treated as random variables. We follow the sampling algorithm in Kim and Nelson (1999). We assume the standard setting of conjugate priors for the unknown parameters. In particular, we specify an Inverse-Gamma prior distribution for the standard errors and a Normal prior distribution for the other coefficients. The initial values of the parameters are obtained from the linear estimation on the HP filtered trend and cycle. We define the vectors of the state variables and hyperparameters as

$$\theta = \{\theta_0, \theta_1, \theta_2, \theta_3, \theta_4, \mu\}$$

$$\delta = \{\delta_0, \delta_1, \delta_2, \delta_3, \delta_4\}$$

$$\tau = \{\tau_t\}_{t=1}^T$$

$$c = \{c\}_{t=1}^T.$$

Then, Gibbs Sampling algorithm is described as follows:

1. Initialize $\theta, \delta, \phi, \tau, c, \sigma_\eta, \sigma_\epsilon$;
2. Sample $\tau|\theta, \sigma_\eta, \sigma_\epsilon, y$;
3. Sample $c|\delta, \phi, \sigma_\epsilon, y$;
4. Sample $\theta|\tau, \sigma_\eta, y$;
5. Sample $\sigma_\eta|\theta, \tau, y$;
6. Sample $\phi|\delta, c, \sigma_\epsilon, y$;
7. Sample $\delta|\phi, c, \sigma_\epsilon, y$;
8. Sample $\sigma_\epsilon|\delta, \phi, c, y$.

Finally, we set up the following prior distributions for the hyperparameters:

$$\sigma_\eta^2 \sim IG(1, 1000);$$

$$\sigma_\epsilon^2 \sim IG(1, 100);$$

$$\theta \sim N(0, 100 \times I_6);$$

$$\delta \sim N(0, 100 \times I_5);$$

$$\phi \sim N(0, 100).$$

Appendix C: Banking Crises Episodes

High Income	Upper Middle Income	Lower Middle Income	Low Income
Austria 2008	Algeria 1990	Albania 1994	Burundi 1994
Belgium 2008	Argentina 1981	Bolivia 1986	Benin 1988
Denmark 2008	Argentina 1989	Bolivia 1994	Burkina Faso 1990
Finland 1991	Argentina 2001	Cape Verde 1993	Bangladesh 1987
Germany 2008	Azerbaijan 1995	Cameroon 1987	Central Africa 1976
Ireland 2008	Bulgaria 1996	Cameroon 1995	Central Africa 1995
Israel 1997	Belarus 1995	Congo Rep 1992	Chad 1983
Italy 2008	Brazil 1994	Egypt 1980	Chad 1992
Japan 1997	Chile 1976	El Salvador 1989	Congo, DR 1983
Netherlands 2008	Chile 1981	Ghana 1982	Congo, DR 1991
Norway 1991	Colombia 1982	Georgia 1991	Congo, DR 1994
Portugal 2008	Colombia 1998	India 1993	Kenya 1985
Slovakia 1998	Dominican Rep 2003	Indonesia 1997	Kenya 1992
Spain 1977	Ecuador 1981	Morocco 1980	Kyrgyzstan 1995
Spain 2008	Ecuador 1998	Nigeria 1991	Liberia 1991
Sweden 1991	Hungary 1991	Nigeria 2009	Madagascar 1988
United Kingdom 2007	Jordan 1989	Nicaragua 1990	Mali 1987
United States 2007	Macedonia 1993	Nicaragua 2000	Mozambique 1987
	Mexico 1994	Philippines 1983	Mauritania 1984
	Malaysia 1997	Paraguay 1995	Niger 1983
	Panama 1988	Senegal 1988	Nepal 1988
	Peru 1983	Ukraine 1998	Sierra Leone 1990
	Romania 1990	Ukraine 2008	Togo 1993
	Russia 1998	Vietnam 1997	Uganda 1994
	Thailand 1983	Yemen 1996	Zimbabwe 1995
	Thailand 1997	Zambia 1995	
	Turkey 1982		
	Turkey 2000		
	Uruguay 1981		
	Uruguay 2002		

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