Macroeconomic determinants of credit risks: evidence from high-income countries

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Abstract

Purpose – The purpose of this paper is to empirically assess the significant indicators of macroeconomic environment that influence credit risk in high-income countries.
Design/methodology/approach – The study employs the system generalized method of moments estimator to avoid the dynamic panel bias and endogeneity issues. Different indices of economic growth are used in each model in order to find the most significant proxy of the economic cycle that influences problem loans. The analysis is carried out using a sample of 49 developed countries covering a 16-year period (2000–2015).
Findings – The overall empirical results highlight that the development of industrial sectors and exports are the main drivers of loan performance in high-income countries. The findings specifically recommend adopting an expansionary fiscal policy to boost per capita income and potential productivity for the safety of the banking system.
Practical implications – The findings have direct practical applicability for stabilizing the financial system. The study recommends the government to increase the productivity of export-oriented industries in order to boost employment and increase the payment obligations of individuals and business firms. More importantly, it highlights the essentiality of perfect economic policy to control default risks.
Originality/value – To the best of the authors' knowledge, this is the first empirical study that compares the relative effect of three alternative proxies of the economic cycle on credit risk and identifies the most significant proxy. The current study also empirically shows that industrial development could be one of the crucial factors to improve financial health in developed countries.

Keywords Financial stability, Trade openness, Industrial policy, National expenditure, Non-performing loan, Per capita income

Paper type Research paper

1. Introduction

The banking system is a fundamental part of an economy that makes low-cost economic transactions between the lender and the depositor possible. The banking system has a strong impact on the entire economy (Festić *et al.*, 2011; Rashid and Intartaglia, 2017;

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Rodríguez-Moreno and Peña, 2013) because financial resources cannot be allocated effectively in the absence of a sound banking system. The major portion of banking risks is covered by credit risk, which is one of the major causes of the economic downturn and an important indicator of financial vulnerability (Dudian and Popa, 2013). Empirical studies on the determinants of credit risks are, therefore, essential for a stable economy.

While financial institutions are influenced by non-performing loan (NPL), the NPL itself is influenced by economic growth. An economic downturn significantly influences the banking performance and this effect is much higher than the effect on other industries (Fiordelisi and Marques-Ibanez, 2013; Festic and Beko, 2008). Despite its strong impact on the financial institutions (Al-Jarrah, 2012; Castro, 2013), the macroeconomic environment is beyond the control of a banking system. A sound economy with an open financial policy is fundamental to preventing future financial crises (Dao, 2017). The 1997 Asian financial crisis and the global financial crisis 2007 have shown that poor economic policies are associated with rising NPL in the banking industries, which in turn are associated with the financial crisis. Therefore, a deeper understanding of the macroeconomic environment is essential for formulating effective economic policies in order to enable the financial institutions to cope up with the fluctuating economic cycle effectively.

As far as the impact of the macroeconomic environment on credit risk is concerned, the empirical literatures are vast and diverse. A common finding from these literature is that economic growth is a key driver of credit quality. The studies by Castro (2013), Festić *et al.* (2011), Jakubík and Reininger (2013), Roland *et al.* (2013) and Buncic and Melecky (2012) show that the credit risk is strongly affected by macroeconomic environments, especially during the recession period. Particularly, the GDP growth, share prices, exchange rates and lending rates have been identified as the most significant macroeconomic indicators of NPL by a majority of studies (Nkusu, 2011; Beck *et al.*, 2015). Furthermore, the studies on the European banking system (Baselga-Pascual *et al.*, 2015), the Eurozone banking system (Makri *et al.*, 2014), the Tunisian banking system (Abid *et al.*, 2014), the US banking system (Ghosh, 2015) and the Kenyan banking system (Warue, 2013) have revealed strong effects of public debt, inflation, gross domestic product and unemployment rate (UR) on the credit risk. The present study takes into consideration the empirical evidence from previous studies to identify the macroeconomic variables that have potentially significant effects on the NPL.

The recent financial crisis, which had its origin in advanced economies and the increasing role of developed countries in the global economy have warranted studies evaluating the impact of macroeconomic indicators on banking stability in the developed countries (Nkusu, 2011; Kauko, 2012). However, only a handful of studies have analyzed high-income countries (classified as developed economies by the World Bank and International Monetary Fund (IMF)) with policy implications while investigating the determinants of problem loans. Moreover, previous studies have included only one variable (either GDP growth rate (GDPGR), GDP per capita or GNI per capita) as a proxy of economic cycle to link between economic growth and credit risk (e.g. Salas and Saurina, 2002; Jiménez and Saurina, 2006; Khemraj and Pasha, 2009; Louzis *et al.*, 2012; Rajan and Dhal, 2003; Dash and Kabra, 2010; Fofack, 2005; Škarica, 2014; Klein, 2013). These studies did not evaluate the relative contribution of alternative proxies in their analyses to identify the most significant proxy of the economic cycle. They also lack the panel of high-income countries as a sample. The present study contributes to the literature in four ways. First, the present study is among the limited studies that have applied different economic cycle proxies in a single paper. Second, the study chiefly focuses on finding the most significant proxy of the economic cycle that impacts the financial fragility. Third, the study evaluates the impact of the macroeconomic environment on credit risk using a unique data sample covering a large number of advanced economies (49 countries) (see Figure 1) over a much longer period (16 years) than most previous studies. Fourth, the study links the findings with specific recommendations for

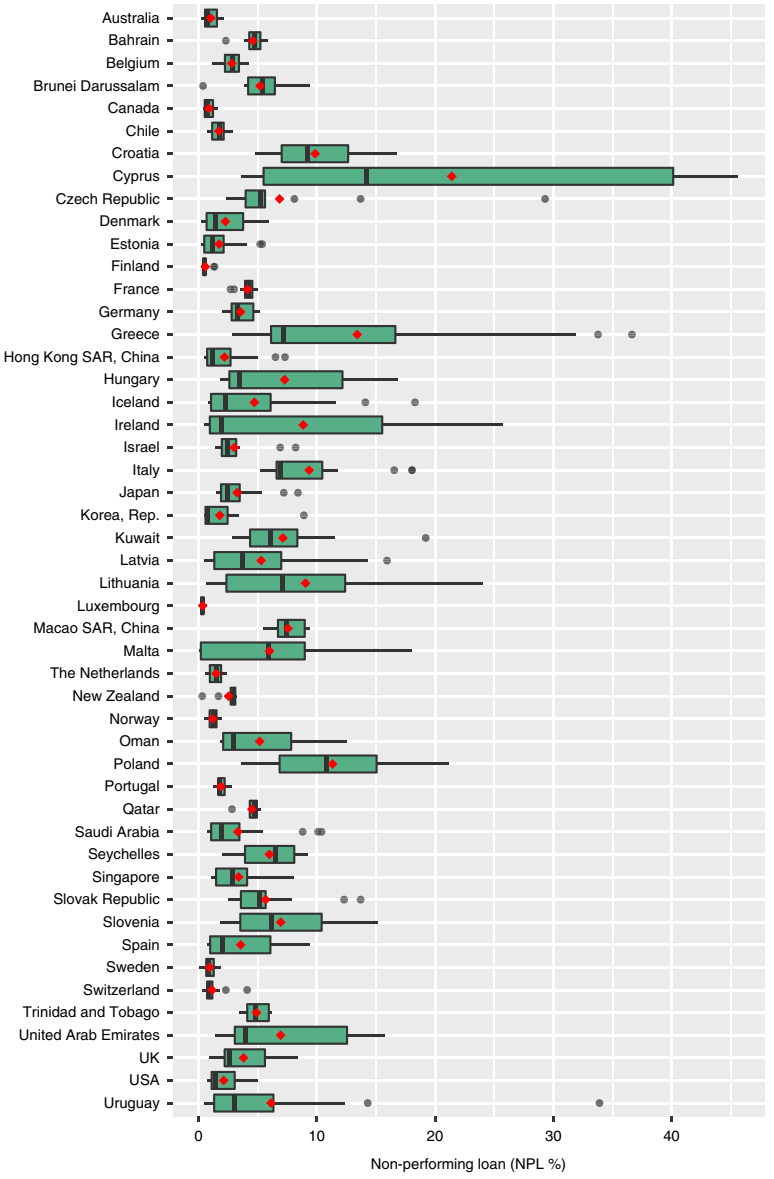

Figure 1.
Boxplot showing the lower quartile, upper quartile, median and mean values of the non-performing loans in 49 high-income countries for a 16-year period (2000–2015)

Notes: The left and right margins of the box represent the lower and upper quartile values, respectively. The gray dots represent the outliers. The thick black bar inside the box represents the median value and the red diamond represents the mean value

formulating effective economic policies to boost employment, per capita income, productivity and industrial output in the developed economies. The findings of the current study could be of considerable use to policymakers and supervisory authorities of high-income countries to control default risks.

2. Data and methods

2.1 Sources of data

The study includes 49 high-income countries classified as the developed economies by the World Bank and the IMF. The data span a period of 2000–2015 covering both the pre- and post-global financial crisis period and are on an annual basis. They are chiefly obtained from the IMF and the Global Financial Stability reports. The choice of the countries and the time period is based on the availability of data.

2.2 Macroeconomic variables

Based on the extensive review of the literature, eight macroeconomic variables are selected as the potential determinants of NPL. Their descriptions and the possible relations with the NPL are discussed below.

The trade openness policy is proxied by the exports of goods and services (EOGS), which is measured by the percent of GDP. A high volume of exports indicates the efficacy of the trade policy. Efficient trade policy is believed to improve the financial position of the corporate firms causing an overall economic growth of the nation. The studies by Clichici and Colesnicova (2014) in Moldova and Mileris (2014) in Lithuania suggested the need to raise exports to reduce credit risk, which indicates that export is negatively related to the NPL level.

The GDPGR, GDP per capita growth rate (GDPPCGR) and gross national income per capita growth rate (GNIPCGR) have been widely used as the proxies of the economic cycle. Among these, GDPGR is the most commonly used macroeconomic indicator. In this study, these three variables are alternatively used in each model in order to identify the most significant proxy determining the NPL level. As shown by Festic and Beko (2008), Kjosevski and Petkovski (2017) and Klein (2013), we expect their positive effect on banking stability.

Industry value added (IVA) reflects the industrial development and includes the compensation of employees, taxes on production, gross operating surplus, etc. The perfect industrial policy raises IVA values, which strengthens the productivity of the nation, enlarges the economic activities and ultimately improves the payment capacity.

Unemployment is the state of not having a job by the working age people. It is a widely used measure of the economic situation and an important predictor of credit risk (Gambera, 2000). Following previous studies (e.g. Bofondi and Ropele, 2011; Louzis *et al.*, 2012), we expect a positive association between UR and NPL.

The gross national expenditure (GNE) measures the final consumption of a nation and includes public and private expenditures. A high GNE value implies high economic activities and high economic growth that are essential for lowering default risks. Because GNE symbolizes the development of investment, a high GNE is expected to improve the overall credit quality.

Inflation is a proxy of monetary policy and measures the general increase in the price level. Inflation affects the performance of banking sectors in the form of money supply and price stability. Hyper-inflation not only increases the lending rate but also impedes the debtors' ability to service their loan payment on time (Klein, 2013; Baselga-Pascual *et al.*, 2015; Fofack, 2005). Hence, the inflation rate is assumed to have a positive effect on NPL.

The NPL is not immediately written down from the balance sheet. Therefore, this study incorporates the past realization of NPL using a dynamic panel model. Because the NPL ratio has been shown to be positively autoregressive (Balgova *et al.*, 2016; Chaibi and Ftiti, 2015; Kjosevski and Petkovski, 2017), the lagged dependent variable is used as an explanatory variable to evaluate its effect on the current NPL. A brief description and the expected signs of the study variables are shown in Table I.

2.3 Econometric estimation

The study variables are converted into logarithmic forms before the empirical analyses. Prior to estimation, the test for non-stationary (unit root) is performed by employing the

Augmented Dickey–Fuller (ADF) test, Levin, Lin and Chu test (Levin *et al.*, 2002) and Im, Pesaran and Shin *W*-stat test (Im *et al.*, 2003) in order to determine the integration of variables and to avoid the spurious regression coefficients. The unit root test results (see Table II) show that all variables are stationary in level with the exception of GNE, EOGS and IVA. The non-stationary variables in level become stationary after first differencing.

The past studies encourage designing a dynamic panel model for consistent estimation of parameters. The lagged dependent variable is treated as a regressor on the right-hand side to show some degree of persistence in the level of NPL:

$$\mathrm{NPL}_{it} = \alpha \mathrm{NPL}_{it-1} + \beta \mathrm{X}_{it} + \eta_i + \varepsilon_{it},\ |\alpha| < 1,\ i = 1, \ldots, N,\ t = 1, \ldots, T, \tag{1}$$

where subscripts i and t denote the cross-sectional and time dimension of the panel, respectively. X_{it} is the vector of macroeconomic variables other than the lagged NPL. α and β are the vector of coefficients to be estimated. η_i is the unobserved country-specific effect and ε_{it} is the error term. Equation (1) assumes that the error term ε_{it} satisfies the orthogonality conditions.

In Equation (1), NPL_{it-1} is correlated with the fixed effects, which is called the dynamic panel bias that cannot be solved by the static panel data models. In the presence of lagged dependent variable, ordinary least square estimation gives upward biased results. Similarly, the random effects estimator gives downward biased results in the dynamic panel data model (Baltagi, 2008). The within-group estimators also cannot solve the dynamic panel bias (Nickell, 1981; Bond, 2002). The generalized method of moments (GMM) proposed by Arellano and Bond (1991) and generalized by Arellano and Bover (1995) and Blundell and Bond (1998) is found to be more efficient in solving the dynamic panel bias. These general estimators address such problems by first differencing Equation (1) as follows:

$$\Delta \mathrm{NPL}_{it} = \alpha \Delta \mathrm{NPL}_{it-1} + \beta \Delta X_{it} + \Delta \varepsilon_{it}. \tag{2}$$

Variables	Description	Expected sign
Exports of goods and services (EOGS)	Exports as percent of GDP	(–)
GDP growth rate (GDPGR)	Percent change in GDP	(–)
GDP per capita growth rate (GDPPCGR)	Percent change in GDP per capita	(–)
GNI per capita growth rate (GNIPCGR)	Percent change in GNI per capita	(–)
Industry value to GDP (IVA)	Industry value as percent of GDP	(–)
Unemployment rate (UR)	Unemployed to labor force	(+)
Gross national expenditure (GNE)	National expenditure as % of GDP	(–)
Inflation rate (IR)	Percent change in CPI	(+)

Table I. Description of variables and their expected signs

Variables	Fisher type-ADF χ^2	Probability	Levin, Lin and Chu test	Probability	Im, Pesaran and Shin *W*-stat	Probability
NPL	124.017	0.039	−4.76373	0.000	−2.01626	0.0219
EOGS	77.9752	0.9323	−3.11016	0.000	0.70254	0.7588
GDPGR	209.907	0.000	−10.2124	0.000	−6.88212	0.000
GDPPCGR	211.393	0.000	−9.79517	0.000	−6.94987	0.000
GNIPCGR	208.933	0.000	−8.10699	0.000	−6.87863	0.000
IVA	79.6461	0.8546	−3.46993	0.000	0.29531	0.6161
UR	140.231	0.0022	−5.10928	0.000	−2.59173	0.0048
GNE	71.7170	0.9788	−0.81665	0.2071	1.21767	0.8883
IR	161.117	0.000	−5.97564	0.000	−3.76590	0.000

Table II. Panel unit root test results

In Equation (2), the fixed effect is removed but the lagged dependent variable is still correlated with the new error term. Such endogeneity problems are also solved by the GMM estimations. Both difference GMM and system GMM are designed to remove the dynamic panel bias (Arellano and Bond, 1991; Arellano and Bover, 1995; Holtz-Eakin *et al.*, 1988) through instrumental variables. However, the system GMM is an extended form of difference GMM and is more reliable in estimating robust results.

GMM is a popular econometric trick designed for a short time dimension with a large number of cross sectionals' panel, and where all the independent variables are not strictly exogenous. It is precisely the case in our sample where $T = 16$ and $N = 49$. In order to elude the problem of dynamic panel bias and endogeneity in autoregressive panel data, this study uses system GMM proposed by Arellano and Bover (1995) and Blundell and Bond (1998). To ensure reliable estimation results, the number of instruments does not exceed the number of cross-sections (countries) over the study period in all specifications (Roodman, 2006). Literature has shown that the system GMM estimator has a lower bias and higher efficiency than all the other estimators, including the standard first-differences GMM estimator (Soto, 2009).

This study builds six dynamic models with different economic proxies and a varying number of instruments in order to examine highly significant proxy of the economic cycle and evaluate consistency in the magnitude of the study variables. Both one and two period lagged values are used as instruments for estimations. The number of instruments used in Models 1–3 is different from those used in Models 4–6. For example, 35 instruments (both one and two period lagged values) are used in Models 1–3 and 48 instruments (both one and two period lagged values) in Models 4–6. The main aim of using different specifications is to cross verify the estimated results. In order to identify the most significant proxy of the economic cycle, the three economic proxies (GDPGR, GDPPCGR and GNI per capita growth rate) are alternatively used in six models. For example, the specifications 1 and 4 contain GDPGR, specifications 2 and 5 contain GDPPCGR, while specifications 3 and 6 contain GNI per capita growth rate as the proxy of the economic cycle.

In order to check the fitness of GMM specification models, we apply two specification tests suggested by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). First, we perform the over-identifying restrictions test via Sargan specification to check the validity of the instruments used as the moment conditions. Second, we test the fundamental assumption of serial uncorrelated error.

Table III details the correlation between the variables used in this study. The GDPPCGR and the GDPGR are strongly correlated ($r = 0.88$), which can bias the model output. However, these variables are alternatively used in each model. Therefore, the model does not suffer from multicollinearity problem.

Table III. Correlation matrix of sample indices

	EOGS	GDPGR	GDPPCGR	GNIPCGR	IVA	UR	GNE	IR
EOGS	1	0.137	0.051	0.067	−0.086	−0.080	−0.477	0.007
GDPGR		1	0.887	0.561	0.148	−0.083	−0.142	0.116
GDPPCGR			1	0.681	0.008	0.023	0.060	0.082
GNIPCGR				1	−0.039	0.047	0.017	0.127
IVA					1	0.021	−0.192	0.138
UR						1	0.140	−0.092
GNE							1	0.101
IR								1

3. Results and discussions of findings

Figure 1 shows the proportions of NPL in 49 high-income countries for a 16-year period (2000–2015). The median NPL ratio across high-income countries ranges from less than 1 percent in Luxembourg to about 14 percent in Cyprus. Among the 49 high-income countries, Luxembourg, Sweden, Finland, Switzerland, Norway and Canada have a fairly constant NPL ratio below 2 percent throughout the 16-year period, which indicates high economic stability in these countries. The wide dispersion in the level of NPL across other high-income countries could be likely due to varying UR, economic growth rates, productivity and government policies.

The empirical estimation results are reported in Table IV. The lagged NPL is strongly positively significant in all models, which confirms the presence of strong persistence in the credit risk (Ghosh, 2015; Espinoza and Prasad, 2010; Kjosevski and Petkovski, 2017). The result shows that the previous years' NPL explains 79–87 percent of the current NPL, which indicates that the NPL shock likely has a prolonged effect in the banking system.

The specifications 2 and 3 show a significant negative effect of export (EOGS) on NPL, which confirms that effective trade policy is essential for prudent banking behavior. This is consistent with the findings of Mileris (2014), Festić *et al.* (2011) and Clichici and Colesnicova (2014). The current finding together with previous findings suggests that a high volume of export reduces the ratio of problem loans. This is clearly exemplified by the Ireland economy in 2015, which shows a decline in problem loans from 20.65 to 14.94 percent with an increase in exports from 113.71 to 121.42 percent of GDP. Similarly, Luxembourg, which has the highest export percent of GDP in the world, has the lowest problem loans. The high export volume prevents trade deficit and increases the national saving that can be mobilized for economic development, which proportionately reduces the problem loans. This is likely the reason for a decreasing trend of NPL ratio in Switzerland, Luxembourg and Germany. Furthermore, Fofack (2005) showed that in Sub-Saharan Africa, the depreciation in the exchange rate makes exports more competitive and imports more expensive due to the cost-push inflation and hence increases the overall credit quality.

In the remaining specifications (1, 4, 5 and 6), the coefficient of exports is very small as well as statistically insignificant, which is consistent with the finding of Balgova *et al.* (2016). This indicates that the degree of trade openness of some developed countries is not well enough to control problem loans. It can also explain why the loan portfolios for the export-oriented firms are comparatively low in some high-income countries, such as Chile, Lithuania, New Zealand, Greece and Uruguay. The export can significantly reduce the NPL level only in countries where export policy plays a significant role to increase productivity (e.g. the USA, Germany, France and the Netherlands). Our results confirm that the boost in exports improves the NPL ratio and suggests increasing the lending activities when the export trade is high because, during that period, there is high industrial production, high economic activities and also high earnings of individuals.

The estimation results show a strong influence of the economic cycle on NPL suggesting that business cycles determine the level of credit quality in the banking system. The overall estimations show the negative linkage between the economic cycle and NPL. This indicates that during an economic downturn, the credit quality could degrade in the banking system. The higher and significant negative coefficients of the GDPGR, GNI per capita growth rate and GDPPCGR explain that the slowdown in economic activities causes high problem loans in the financial system. For instance, during an economic recession, the demand for loan portfolios decreases, which lowers down the economic transactions. Consequently, the revenue income decreases, which hinders the debt servicing ability of the borrowers and hence increases the NPL level (Dash and Kabra, 2010; Festić *et al.*, 2011; Nkusu, 2011; Buncic and Melecky, 2012; Louzis *et al.*, 2012; Roland *et al.*, 2013; Tanasković and Jandrić, 2015; Võ *et al.*, 2016; Kjosevski and Petkovski, 2017). In 2015, the GDPGR, GDPPCGR and GNI

Table IV.
GMM estimation results of high-income countries

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Lagged NPL	0.8588*** (46.93)	0.8772*** (47.53)	0.8267*** (33.38)	0.8265*** (18.78)	0.8405*** (19.64)	0.7938*** (17.71)
Exports	−0.1582 (−1.49)	−0.1713* (−1.69)	−0.2735** (−2.39)	−0.1612 (−0.82)	−0.2101 (−1.29)	−0.2482 (−0.95)
GDP growth rate	−1.0796*** (−13.51)			−1.0499*** (−4.34)		
GDPPC growth rate		−1.1488*** (−12.85)			−1.0872*** (−4.49)	
GNIPC growth rate			−4.1763*** (−9.69)			−4.4885*** (−5.16)
Industry value	−0.5052*** (−5.71)	−0.5379*** (−6.48)	−0.5932*** (−4.50)	−0.5362** (−2.11)	−0.5290** (−2.13)	−0.7193*** (−2.58)
Unemployment	0.2438*** (7.13)	0.2296*** (7.73)	0.3249*** (7.49)	0.2876*** (2.93)	0.2720*** (3.01)	0.3322*** (3.66)
Gross national exp.	−0.2907 (−1.05)	−0.3557 (−1.31)	−0.4244 (−1.24)	−0.4409 (−0.71)	−0.6266 (−1.12)	−0.5583 (−0.91)
Inflation	0.0597 (1.03)	0.0535 (0.98)	0.1033 (1.29)	0.0974 (0.79)	0.0803 (0.69)	0.1033 (0.74)
Sargan test *p*-value	0.0518	0.0481	0.0534	0.2979	0.276	0.2433
A-B AR (2) test p value	0.3348	0.3519	0.1112	0.3134	0.3255	0.1103
Observations	735	735	723	735	735	723

Notes: *t*-statistics are given in parentheses. The number of instruments used in Models 1–3 is different from those used in Models 4–6 (35 vs 48 instruments). The specifications 1 and 4 contain GDP growth rate, specifications 2 and 5 contain GDP per capita growth rate, while specifications 3 and 6 contain GNI per capita growth rate as the proxy of economic cycle. *,**,***Significant at 10, 5 and 1 percent levels, respectively

growth rate of Uruguay, respectively, declined from 3.24 to 0.98 percent, 2.89 to 0.63 percent and 0.042 to 0.012 percent, causing an increase in the NPL ratio from 1.28 to 1.6 percent. The empirical results reconfirm that poor economic condition is one of the major causes of problem loans. More specifically, the results show that the GNI per capita growth rate has stronger explanatory power compared to the GDPGR and the GDPPCGR over the study period. This implies that the per capita income level is a stronger indicator than the GDPGR to forecast the NPL level. Furthermore, it clearly shows that the financial obligation of debtors is very sensitive to the purchasing power of the inhabitants. The findings of the current study indicate that the gradually worsening per capita income is the initial symptom of a banking crisis.

The IVA influences problem loans negatively, stating that the boost in industry improves credit quality. In the overall analysis, the effect of IVA on NPL is unchanged and statistically significant, which indicates that high IVA accelerates the productivity of the nation and consequently increases the purchasing capacity of the individuals and corporate firms. The expansion of the industrial sector increases productivity, employment opportunities as well as the firm's profitability, which proportionately increases the payment capacity of the borrowers. The negative significant effect of IVA on NPL in all the models of empirical estimations indicates that high-income countries usually have high industrial development, which enables them to break the vicious cycle of problem loans.

The entire estimation results show a statistically significant positive relation between NPL and the UR. This is plausible because high unemployment lowers the demand for consumption and reduces the economic activities. In return, the repayment debt obligation becomes poor and the NPLs increase (Salas and Saurina, 2002; Jiménez and Saurina, 2006; Klein, 2013). The studies of Bofondi and Ropele (2011), Vogiazas and Nikolaidou (2011), Makri *et al.* (2014), Škarica (2014), Mileris (2014) and Donath *et al.* (2014) confirmed that failure to control unemployment invites low economic activities, higher default risk and proportionately initial banking crises. Such a situation can be seen in Greece, Spain, Italy and Cyprus, where unemployment and NPL are comparatively high. The findings indicate that perfect economic policies could bring a significant change in the unemployment level in the economy. On these views, the government should guarantee to provide equal job opportunities through perfect fiscal, monetary, trade and industrial policies.

The governments in these high-income countries are apparently providing regular incentives to manufacturing companies to make optimal use of scarce resources thereby making a larger contribution to the gross national income. As the income levels of citizens in the industrially developed countries are generally higher, it enhances their capacity to save and repay loans. The problem loans, therefore, decline when IVA increases.

The coefficient of inflation is positive in all the specifications. It is assumed that inflation decreases the purchasing power of money in the economy. Hence, the borrowers (both individuals and investors) have less income and profit to pay back their interest and principal. This leads to the growth in NPL but this effect is not statistically significant in the overall analyses, which supports the findings of Tanasković and Jandrić (2015), Makri *et al.* (2014) and Dimitrios *et al.* (2016). However, this is in contrast to most previous studies (Abid *et al.*, 2014; Ghosh, 2015; Kjosevski and Petkovski, 2017) who found a statistically significant effect of inflation on NPL. Our findings confirm that the tool of monetary policy is not as effective as expected in the advanced economy. Although the coefficient of GNE is negative in all the models, the effect is not statistically significant. The results show that the GNE is not a significant mediator to reduce NPL level in the developed countries.

The results of the Sargan test suggest that the selected instruments are valid in all specifications. The *p*-values of the autoregressive (AR) meet the requirements of the Arellano Bond test for autocorrelation. The results of these two tests indicate that the estimated results are consistent and reliable. Similarly, the magnitudes of the macroeconomic environment

remain unchanged with the change in proxies of the economic cycle and the number of instruments, which confirm that our estimated models are free from bias and could be reliable for forecasting.

4. Conclusions

This study reassesses the vulnerability of the banking industries using aggregate NPL data of 49 high-income countries over 2000–2015 by linking it with the macroeconomic variables (GDPGR, GDPPCGR, GNI per capita growth rate, unemployment, exports, IVA, GNE and inflation). The statistically significant and large coefficients of the GDPGR, GNI per capita growth rate, GDPPCGR and UR confirm that the economic cycle fluctuation heavily influences the credit risk taking trend. More importantly, the per capita income has a strong explanatory power compared to other variables in the entire analyses. This indicates that the purchasing power of the citizens is the most significant macroeconomic indicator that can lead to a faster change in the NPL level and could be strictly used as a significant predictor of the NPL ratio. In addition, our results reveal exports, IVA and gross national income as the significant indicators of NPLs other than the GDPGR, share price, nominal effective exchange rate of the local currency, unemployment, current account, house price, equity price and lending rate shown by previous studies (e.g. Beck *et al.*, 2015; Nkusu, 2011; Kauko, 2012). Moreover, full employment is found to be beneficial for improving loan performance. In the same vein, the findings suggest that the payment ability of debtors in high-income countries can be mainly improved by increasing productivity and competitive export trade. The negative coefficient of exports and IVA show that the incentives provided for industrial development and trade openness greatly reduce the possibility of a financial crisis. Therefore, policymakers should focus more on providing incentives that could be helpful to manufacturing companies and export trade. This could be achieved by reducing taxes, providing low-cost loans, exploring the new international market and making special free trade agreements with the neighboring countries.

With respect to the economic policies proxies, the per capita income, employment, industrial development and trade openness seem to be crucial for improving the overall credit quality. The present study highlights the importance of perfect fiscal policy, industrial policy and trade openness policy in reducing the possibility of the financial crisis in high-income countries. The study suggests increasing the per capita income and employment by promoting industrial development and offering free trade services. The findings recommend the government to focus more on increasing exports and developing the industrial sectors. The study also recommends increasing incentives that could directly help to improve the per capita income. The negative coefficient of GNE indicates the essentiality of government spending to increase aggregate demand and consumption. The findings of this research could be useful to the supervisory authorities, government and banking institutions for forecasting NPL and stress testing. The outcome could be equally useful in formulating the perfect economic and credit policies according to the changing monetary, trade, industrial and fiscal policies.

The main findings of the current study have practical applicability and policy implications related to industrial development, trade openness, employment generation and economic growth. Similarly, the evidence highlights the importance of economic policies (industrial policy, fiscal policy and trade policy) in controlling default risks. The findings specifically recommend adopting an expansionary fiscal policy to boost employment, per capita income, productivity and industrial output so as to maintain a stable banking system. The findings of this study could be particularly useful to some developed countries, such as Germany, the USA, Japan, Italy and Canada that are top ranked in terms of the manufacturing environment, trade openness and industrial output to improve their economic policies, cost considerations, workforce investments and infrastructures.

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