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# Discerning Good from Bad Credit Booms: The Role of Construction

**Technical Appendices for SDN/20/02**

Giovanni Dell'Ariccia, Ehsan Ebrahimy, Deniz Igan, and Damien Puy

**DISCLAIMER: Staff Discussion Notes (SDNs) showcase policy-related analysis and research being developed by IMF staff members and are published to elicit comments and to encourage debate. The views expressed in Staff Discussion Notes are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.**

# Discerning Good from Bad Credit Booms: The Role of Construction

Prepared by Giovanni Dell'Ariccia, Ehsan Ebrahimy, Deniz Igan, and Damien Puy[†]

Authorized for distribution by Gita Gopinath

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# APPENDIX I. DATA SET CONSTRUCTION

## A. Industry Data

We use ISIC Rev. 4 (NACE Rev. 2) industry-level data for value added, employment, and total factor productivity from both EU and World KLEMS. When available, we use the 2017 vintage of the database. The 2012 vintage is used for countries for which no more recent data updates are available. EU KLEMS covers all EU member countries, whereas World KLEMS includes six non-European countries.

For simplicity, the 33 ISIC industries are aggregated into 11 larger sectors—namely, agriculture, construction, finance, information, manufacturing, mining, real estate, trade, utilities, other services, and public services. Appendix Table 1 provides a mapping of the individual industry series into the 11 larger sectors we consider in the analyses.

We also use industry data from national accounts to expand our set of countries beyond KLEMS. Data for value added are collected for these countries: Argentina (1993–2012), Bolivia (1980–2014), Brazil (1996–2014), Chile (1996–2014), Colombia (2005–14), Costa Rica (1991–2014), Iceland (1997–2014), Indonesia (2008–14), Jordan (1976–2014), Malaysia (1991–2014), Mexico (1993–2014), New Zealand (1977–2014), Peru (2007–14), the Philippines (1981–2014), Saudi Arabia (1970–2014), Serbia (2000–12),[1] South Africa (1970–2014), Thailand (1993–2014), and Turkey (1998–2014). These data are sourced from Haver Analytics and are classified into 11 sectors consistent with our aggregation for KLEMS data.

In total, our data set is an unbalanced panel of 55 countries and 11 industries, covering 1970 to 2014.

## B. Credit Data

Credit stocks used to identify credit boom episodes are measured primarily by domestic bank credit to the private nonfinancial sector series (line 22d) from the IMF *International Financial Statistics*.[2] We collect these series for all countries in our sample over the period 1970–2016. When possible, we also use a new, secondary cross-country credit data set based directly on central bank statistics. Although more restricted in its coverage, this auxiliary bank credit database allows us to delve further into the composition of credit during booms (for example, households versus firms), which we use in Section IV.

[1] Prior to 2006, these series cover Serbia and Montenegro. We correct for this break in the time series.

[2] Although there are other sources of financing, such as bond markets and nonbank financial intermediaries, in advanced and emerging market economies, bank credit represents the biggest source of credit for the private sector in an overwhelming majority of countries.

**Appendix Table 1. Industry-Sector Mapping**

| *ISIC 4 Rev. 2 Industry Code* | *Aggregated Industry* |
|---|---|
| Agriculture, Forestry and Fishing | Agriculture |
| Construction | Construction |
| Financial and Insurance Activities | Finance |
| Publishing, Audiovisual and Broadcasting Activities | Information |
| Telecommunications | Information |
| IT and Other Information Services | Information |
| Food Products, Beverages and Tobacco | Manufacturing |
| Textiles, Wearing Apparel, Leather and Related Products | Manufacturing |
| Wood and Paper Products; Printing and Reproduction of Recorded Media | Manufacturing |
| Chemicals and Chemical Products | Manufacturing |
| Rubber and Plastics Products, And Other Non-Metallic Mineral Products | Manufacturing |
| Basic Metals and Fabricated Metal Products, Except Machinery and Equipment | Manufacturing |
| Electrical and Optical Equipment | Manufacturing |
| Machinery and Equipment N.E.C. | Manufacturing |
| Transport Equipment | Manufacturing |
| Other Manufacturing; Repair and Installation of Machinery and Equipment | Manufacturing |
| Mining and Quarrying | Mining |
| Transport and Storage | Other Services |
| Accommodation and Food Service Activities | Other Services |
| Professional, Scientific, Technical, Administrative and Support Service Activities | Other Services |
| Arts, Entertainment, Recreation and Other Service Activities | Other Services |
| Postal and Courier Activities | Public Services |
| Public Administration and Defense; Compulsory Social Security | Public Services |
| Education | Public Services |
| Health and Social Work | Public Services |
| Real Estate Activities | Real Estate |
| Wholesale and Retail Trade and Repair of Motor Vehicles and Motorcycles | Trade |
| Wholesale Trade, Except of Motor Vehicles and Motorcycles | Trade |
| Retail Trade, Except of Motor Vehicles and Motorcycles | Trade |
| Electricity, Gas and Water Supply | Utilities |

Sources: KLEMS; IMF staff calculations.
Note: N.E.C. = not elsewhere classified.

## C. Credit Boom Identification

Following Dell'Ariccia and others (2016), we use a credit boom identification method tailored to capture "extraordinary" deviations in credit; that is, episodes during which credit grows beyond what economic growth would normally imply. We normalize the credit series by GDP.[3] Then we define a "credit boom" as an episode during which the ratio of credit to GDP grows faster than implied by its past trend.

In practice, for each country and year *t*, we compare the credit-to-GDP ratio to a country-specific, backward-looking rolling cubic trend estimated over the period between years *t-10* and *t*. Year *t* in country *i* is tagged as a boom if either of the following two conditions is satisfied: (1) the deviation

[3] To avoid abrupt changes in GDP, the credit-to-GDP ratio is constructed using the geometric average of GDP in years *t* and *t+1*.

from trend is greater than 1.5 times its standard deviation and the annual growth rate of the credit-to-GDP ratio exceeds 10 percent; or (2) the annual growth rate of the credit-to-GDP ratio exceeds 20 percent. The start of the boom is defined as the earliest year in which either (1) the credit-to-GDP ratio exceeds its trend by more than three-fourths of its historical standard deviation while its annual growth rate exceeds 5 percent; or (2) its annual growth rate exceeds 10 percent. Finally, a boom ends as soon as either (1) the growth of the credit-to-GDP ratio turns negative; or (2) the credit-to-GDP ratio falls within three-fourths of one standard deviation from its trend and its annual growth rate is lower than 20 percent.

After marking each country-year observation by this filter, standard cleaning procedures are applied to ensure the sample of booms we capture and their dating are meaningful. In line with the literature, we first exclude booms in countries with a credit-to-GDP ratio below 10 percent.[4] Second, we exclude booms that are picked up by our algorithms but that capture suspicious or abrupt changes in the underlying credit-to-GDP ratios. This might happen, for instance, because of breaks in credit series, abrupt changes in definitions in credit aggregates, or sudden drops in GDP that are not well controlled for by the GDP geometric averaging. Finally, some episodes that are close to the ad hoc thresholds used above are also reintegrated into the sample of booms.[5] After applying this cleaning procedure, our final sample includes 59 boom episodes in 40 countries between 1972 and 2008. The final list shown in Appendix Table 2 essentially mirrors the list of booms in Dell'Ariccia and others (2016), albeit with a few modifications.[6,7]

Appendix Table 2 also reports whether the credit boom is classified as a good boom or a bad boom; that is, whether a boom is followed by a systemic banking crisis or prolonged subpar economic performance—defined in reference to the trend of log real GDP. Specifically, growth is deemed to be subpar if the current level of log real GDP is below its trend calculated using a moving-average filter over the previous five years. Finally, a bust episode is identified when credit-to-GDP growth is negative up to six years following a boom.

[4] Countries with very low levels of credit tend to have more erratic data series, making it difficult to distinguish between trend growth and deviation from trends. Second, rapid credit expansion episodes in financially underdeveloped economies are more likely to capture financial deepening (rather than excessive credit growth), which is not the focus of this note.

[5] Such borderline cases are composed mostly of episodes during which the annual growth rate of the credit-to-GDP ratio is close to but slightly below 10 percent.

[6] New booms are identified in some countries between 1970 and 2010, mainly as a result of revisions to past credit data and/or GDP. Second, we record new booms between 2010 and 2013 because credit and GDP data are now available until 2016, as opposed to 2013 in Dell'Ariccia and others (2016). However, none of those new booms were in countries covered by KLEMS. As a result, those new episodes are not part of the analyses based on industry-level statistics.

[7] Obviously, there are other ways to define a credit boom, and the literature has used a variety of techniques. We refer the interested reader to the discussion in Dell'Ariccia and others (2016), in particular to their Appendix 1. Our main findings are robust to alternative boom definitions.

**Appendix Table 2. Boom Episodes**

| Country | Period | Bad? | Average Annual Credit-to-GDP Growth (%) | Credit-to-GDP at the Beginning of the Boom (%) | Duration (Years) |
|---|---|---|---|---|---|
| Argentina | 1992 - 1994 | Yes | 17 | 15 | 3 |
| Argentina | 2005 - 2007 | Yes | 11 | 11 | 3 |
| Australia | 1984 - 1986 | No | 13 | 32 | 3 |
| Belgium | 1988 - 1989 | No | 14 | 32 | 2 |
| Belgium | 2006 - 2007 | Yes | 11 | 82 | 2 |
| Bolivia | 1987 - 1993 | No | 20 | 15 | 7 |
| Brazil | 2006 - 2008 | Yes | 14 | 37 | 3 |
| Bulgaria | 2002 - 2008 | Yes | 26 | 20 | 7 |
| Colombia | 2006 - 2007 | Yes | 17 | 29 | 2 |
| Costa Rica | 1992 - 1993 | No | 12 | 14 | 2 |
| Costa Rica | 1996 - 2001 | No | 17 | 15 | 6 |
| Croatia | 2001 - 2006 | Yes | 11 | 37 | 6 |
| Cyprus | 1996 - 1999 | No | 9 | 106 | 4 |
| Cyprus | 2006 - 2008 | Yes | 18 | 149 | 3 |
| Czech Republic | 2005 - 2007 | Yes | 15 | 34 | 3 |
| Denmark | 1986 - 1988 | Yes | 19 | 37 | 3 |
| Estonia | 2002 - 2007 | Yes | 16 | 47 | 6 |
| Finland | 1985 - 1989 | Yes | 8 | 61 | 5 |
| Greece | 1999 - 2001 | No | 19 | 40 | 3 |
| Greece | 2005 - 2007 | Yes | 10 | 78 | 3 |
| Hungary | 2000 - 2000 | No | 27 | 34 | 1 |
| Hungary | 2003 - 2007 | Yes | 12 | 44 | 5 |
| Iceland | 1999 - 2000 | No | 23 | 74 | 2 |
| Iceland | 2003 - 2006 | Yes | 34 | 128 | 4 |
| India | 1999 - 2002 | No | 7 | 27 | 4 |
| India | 2004 - 2006 | No | 12 | 39 | 3 |
| Ireland | 2004 - 2006 | Yes | 17 | 133 | 3 |
| Japan | 1987 - 1988 | Yes | 8 | 158 | 2 |
| Jordan | 1978 - 1979 | No | 27 | 42 | 2 |
| Jordan | 2004 - 2006 | No | 11 | 79 | 3 |
| Korea | 1978 - 1980 | No | 10 | 38 | 3 |
| Korea | 1996 - 2002 | No | 8 | 53 | 7 |
| Latvia | 2002 - 2006 | Yes | 27 | 34 | 5 |
| Lithuania | 2003 - 2007 | Yes | 32 | 24 | 5 |
| Malaysia | 1995 - 1997 | Yes | 12 | 133 | 3 |
| Mexico | 1989 - 1994 | Yes | 13 | 18 | 6 |
| Mexico | 2006 - 2007 | Yes | 13 | 18 | 2 |
| Netherlands | 1998 - 2000 | Yes | 9 | 112 | 3 |
| New Zealand | 1984 - 1987 | Yes | 12 | 20 | 4 |
| Norway | 1984 - 1987 | Yes | 16 | 39 | 4 |
| Philippines | 1992 - 1997 | Yes | 21 | 21 | 6 |
| Poland | 2006 - 2008 | No | 20 | 34 | 3 |
| Portugal | 1995 - 2001 | Yes | 13 | 65 | 7 |
| Romania | 2003 - 2007 | Yes | 28 | 16 | 5 |
| Russia | 2003 - 2007 | Yes | 16 | 24 | 5 |
| Saudi Arabia | 2004 - 2005 | Yes | 15 | 35 | 2 |
| Serbia | 2004 - 2005 | No | 26 | 24 | 2 |
| Serbia | 2007 - 2008 | Yes | 18 | 36 | 2 |
| Slovak Republic | 1996 - 1997 | Yes | 22 | 45 | 2 |
| Slovakia | 2005 - 2007 | Yes | 12 | 36 | 3 |
| Slovenia | 1998 - 1999 | No | 13 | 31 | 2 |
| Slovenia | 2004 - 2007 | Yes | 18 | 49 | 4 |
| Spain | 2003 - 2007 | Yes | 12 | 114 | 5 |
| Thailand | 1987 - 1995 | Yes | 11 | 64 | 9 |
| Turkey | 2004 - 2008 | Yes | 16 | 19 | 5 |
| United Kingdom | 1972 - 1973 | Yes | 29 | 30 | 2 |
| United Kingdom | 1981 - 1984 | No | 11 | 33 | 4 |
| United Kingdom | 1988 - 1989 | Yes | 11 | 97 | 2 |
| United Kingdom | 2006 - 2008 | Yes | 10 | 159 | 3 |

Sources: IMF *International Financial Statistics*, Bank for International Settlements; IMF staff calculations.

# APPENDIX II. EMPIRICAL FRAMEWORK AND ROBUSTNESS CHECKS

## A. Credit Booms and the Real Sector

### Sector-Level Procyclicality

Building on Braun and Larrain (2005), we explore more formally the (excess) response of different sectors during booms and busts using the following regression framework:

$$\begin{aligned} PerformanceMeasure_{i,c,t} \\ &= \beta_1 Size_{i,c,t-1} + \beta_2\left(Boom_{c,t} \times SectorDummy_i\right) \\ &+ \beta_3\left(Bust_{c,t} \times SectorDummy_i\right) + \beta_4 GDPgrowth_{c,t} \\ &+ \beta_5\left(GDPgrowth_{c,t} \times SectorDummy_i\right) + \beta_6 FixedEffects + \varepsilon_{i,c,t} \end{aligned}$$

where $PerformanceMeasure_{i,c,t}$ is a measure of sectoral performance (for example, employment or value-added growth) for sector *i* in country *c* during year *t*. $Size_{i,c,t-1}$ is the share of sector *i* in country *c* total value added or employment in year *t*-1, and $Boom_{c,t}$ ($Bust_{c,t}$) is an indicator equal to 1 if country *c* is experiencing a boom (bust) in year *t*. $GDPgrowth_{c,t}$ is the change in real GDP in country *c* during year *t*. $FixedEffects$ is the vector of time, country, and sector fixed effects. Robust standard errors are clustered at the country level. Note that, in the baseline specification, we impose the inclusion of all 11 sector dummies and their interactions. This implies that we cannot then separately estimate the coefficient on boom and bust variables. We estimate the baseline both with and without interactions of sector dummies with GDP growth to understand how much of a sector's sensitivity to the credit cycle is above and beyond its procyclicality with the business cycle.

Full results of the estimates are provided for the whole sample in Appendix Table 3, columns 1–4, and for the sample restricted to pre-2002 (that is, no global financial crisis) in Appendix Table 3, columns 5–8. In unreported results, we confirm the robustness of these findings to an alternative set of fixed effects (for example, sector and country*time) as well as to alternative specifications for which we choose any one of the sectors as default (instead of imposing all 11 sector dummies and their interactions). This allows us to keep the variables that vary only by country and year (boom, bust, and GDP growth). We also run a version in which we include the boom/bust dummies and their interaction with a given sector dummy, one sector at a time, in separate regressions. For instance,

$$\begin{aligned} PerformanceMeasure_{i,c,t} \\ &= \beta_1 Size_{i,c,t-1} + \beta_2 Boom_{c,t} + \beta_3 Bust_{c,t} + \beta_4\left(Boom_{c,t} \times SectorDummy_i\right) \\ &+ \beta_5\left(Bust_{c,t} \times SectorDummy_i\right) + \beta_6 FixedEffects + \varepsilon_{i,c,t} \end{aligned}$$

where $i =$ "$construction.$" Results remain the same.

**Appendix Table 3. Sectoral Activity during Booms and Busts**

| | Whole Sample | | | | Excluding the Global Financial Crisis | | | |
|---|---|---|---|---|---|---|---|---|
| | Value-Added Growth | Employment Growth | Value-Added Growth | Employment Growth | Value-Added Growth | Employment Growth | Value-Added Growth | Employment Growth |
| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $Size_{t-1}$ | -0.083*** | -0.028* | -0.086*** | -0.015 | -0.087*** | -0.017 | -0.082*** | -0.005 |
| | (0.016) | (0.016) | (0.015) | (0.017) | (0.022) | (0.019) | (0.019) | (0.018) |
| Boom x Construction | **3.763*** ** | **3.539*** ** | **1.767*** ** | **1.662*** ** | **3.017*** ** | 1.182 | **2.039*** ** | 0.443 |
| | (0.626) | (0.739) | (0.539) | (0.579) | (0.784) | (0.763) | (0.724) | (0.814) |
| Bust x Construction | **-3.402*** ** | **-3.170*** ** | **-2.130** ** | **-2.183** ** | **-3.713** ** | **-2.507* ** | **-2.902** ** | -2.145 |
| | (0.986) | (0.981) | (0.918) | (0.908) | (1.448) | (1.326) | (1.293) | (1.421) |
| Boom x Finance | **2.830*** ** | **1.343*** ** | **2.818*** ** | **1.432** ** | 1.777 | 0.817 | 1.674 | 0.803 |
| | (0.903) | (0.483) | (0.907) | (0.545) | (1.074) | (0.762) | (1.092) | (0.764) |
| Bust x Finance | **-1.652** ** | -0.557 | **-1.656** ** | -0.598 | -1.819 | -1.009 | -1.731 | -1.013 |
| | (0.750) | (0.468) | (0.746) | (0.463) | (1.095) | (0.888) | (1.075) | (0.883) |
| Boom x Manufacturing | 0.570 | -0.410 | -0.304 | **-1.084*** ** | 0.0437 | -0.621 | -0.293 | **-0.944* ** |
| | (0.393) | (0.365) | (0.604) | (0.398) | (0.466) | (0.448) | (0.574) | (0.513) |
| Bust x Manufacturing | 0.196 | -0.0286 | 0.769 | 0.336 | 0.113 | 0.0901 | 0.424 | 0.260 |
| | (0.478) | (0.303) | (0.529) | (0.326) | (0.672) | (0.345) | (0.678) | (0.304) |
| Boom x Trade | 0.748 | 0.313 | 0.169 | 0.320 | -0.306 | 0.405 | -0.528 | 0.394 |
| | (0.482) | (0.265) | (0.536) | (0.273) | (0.572) | (0.375) | (0.588) | (0.383) |
| Bust x Trade | **-1.186** ** | -0.317 | **-0.796* ** | -0.331 | -0.759 | 0.176 | -0.549 | 0.163 |
| | (0.469) | (0.439) | (0.405) | (0.443) | (0.668) | (0.795) | (0.651) | (0.794) |
| Boom x Information | **1.187* ** | 0.281 | **1.307** ** | 0.133 | 1.505 | 0.564 | 1.417 | 0.277 |
| | (0.613) | (0.513) | (0.582) | (0.547) | (1.052) | (0.633) | (1.026) | (0.682) |
| Bust x Information | -0.825 | 0.281 | -0.902 | 0.344 | -0.891 | -0.477 | -0.808 | -0.358 |
| | (0.571) | (0.659) | (0.545) | (0.697) | (0.609) | (0.827) | (0.595) | (0.813) |
| Boom x Agriculture | **-2.881*** ** | **-1.259** ** | **-1.930*** ** | -0.252 | **-1.567** ** | 0.331 | -1.059 | 0.705 |
| | (0.579) | (0.611) | (0.565) | (0.539) | (0.700) | (0.737) | (0.717) | (0.716) |
| Bust x Agriculture | 0.912 | 0.730 | 0.303 | 0.115 | **1.252** ** | 0.298 | 0.892 | 0.123 |
| | (0.606) | (0.697) | (0.565) | (0.612) | (0.601) | (1.066) | (0.605) | (0.998) |
| Boom x Mining | 0.300 | -0.096 | -0.233 | 0.522 | 0.529 | 2.513 | 0.198 | 2.920 |
| | (0.943) | (0.845) | (0.983) | (0.911) | (1.502) | (2.147) | (1.460) | (2.261) |
| Bust x Mining | 0.679 | 0.272 | 1.012 | -0.053 | 1.703 | 0.772 | 2.032 | 0.562 |
| | (0.927) | (1.185) | (0.903) | (1.097) | (1.206) | (2.082) | (1.217) | (2.197) |
| Boom x Utilities | -0.510 | **-1.332*** ** | 0.117 | -0.666 | 0.293 | **-1.191* ** | 0.547 | -0.960 |
| | (0.499) | (0.431) | (0.446) | (0.510) | (0.742) | (0.632) | (0.709) | (0.678) |
| Bust x Utilities | **1.233** ** | -0.0130 | 0.803 | -0.376 | 0.908 | 0.360 | 0.700 | 0.237 |
| | (0.555) | (0.486) | (0.566) | (0.453) | (0.741) | (0.610) | (0.793) | (0.656) |
| Boom x Real Estate | **-1.077* ** | 0.402 | -0.0121 | -0.216 | -1.289 | 1.339 | -0.788 | 1.122 |
| | (0.625) | (0.895) | (0.584) | (0.994) | (0.889) | (1.239) | (0.900) | (1.269) |
| Bust x Real Estate | 0.164 | -1.058 | -0.453 | -0.728 | -0.222 | -0.734 | -0.398 | -0.674 |
| | (0.567) | (0.868) | (0.483) | (0.829) | (0.811) | (1.155) | (0.779) | (1.190) |
| Boom x Public Services | **-1.691*** ** | **-0.844** ** | -0.362 | -0.132 | -0.560 | 0.009 | 0.111 | 0.285 |
| | (0.388) | (0.392) | (0.327) | (0.315) | (0.436) | (0.544) | (0.422) | (0.521) |
| Bust x Public Services | -0.0182 | 0.119 | **-0.812*** ** | -0.263 | -0.456 | 0.882 | **-0.813** ** | 0.726 |
| | (0.345) | (0.421) | (0.270) | (0.424) | (0.333) | (0.596) | (0.331) | (0.654) |
| Boom x Other Services | 0.137 | 0.185 | 0.347 | 0.304 | -0.128 | 0.547 | 0.083 | 0.573 |
| | (0.395) | (0.305) | (0.463) | (0.325) | (0.471) | (0.451) | (0.499) | (0.463) |
| Bust x Other Services | 0.442 | -0.309 | 0.305 | -0.367 | 0.048 | 0.075 | -0.058 | 0.047 |
| | (0.534) | (0.415) | (0.503) | (0.412) | (0.596) | (0.502) | (0.544) | (0.497) |

**Appendix Table 3. Sectoral Activity during Booms and Busts (cont'd)**

| | Whole Sample | | | | Excluding the Global Financial Crisis | | | |
|---|---|---|---|---|---|---|---|---|
| | Value-Added Growth | Employment Growth | Value-Added Growth | Employment Growth | Value-Added Growth | Employment Growth | Value-Added Growth | Employment Growth |
| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| GDP Growth | 0.788*** | 0.454*** | | | 0.727*** | 0.450*** | | |
| | (0.093) | (0.060) | | | (0.123) | (0.076) | | |
| GDP Growth x Construction | | | 1.664*** | 1.229*** | | | 1.494*** | 1.158*** |
| | | | (0.232) | (0.149) | | | (0.289) | (0.190) |
| GDP Growth x Finance | | | 0.784*** | 0.419*** | | | 0.804*** | 0.454*** |
| | | | (0.153) | (0.065) | | | (0.228) | (0.071) |
| GDP Growth x Manufacturing | | | 1.170*** | 0.730*** | | | 0.991*** | 0.767*** |
| | | | (0.242) | (0.085) | | | (0.329) | (0.115) |
| GDP Growth x Trade | | | 1.043*** | 0.449*** | | | 0.913*** | 0.443*** |
| | | | (0.174) | (0.064) | | | (0.231) | (0.084) |
| GDP Growth x Information | | | 0.733*** | 0.509*** | | | 0.787*** | 0.679*** |
| | | | (0.073) | (0.064) | | | (0.084) | (0.131) |
| GDP Growth x Agriculture | | | 0.360*** | 0.014 | | | 0.319* | 0.0654 |
| | | | (0.124) | (0.092) | | | (0.167) | (0.095) |
| GDP Growth x Mining | | | 1.013*** | 0.195 | | | 0.999*** | 0.039 |
| | | | (0.165) | (0.203) | | | (0.247) | (0.196) |
| GDP Growth x Utilities | | | 0.497*** | 0.180** | | | 0.497*** | 0.213 |
| | | | (0.115) | (0.087) | | | (0.154) | (0.134) |
| GDP Growth x Real Estate | | | 0.332*** | 0.703*** | | | 0.308*** | 0.649*** |
| | | | (0.079) | (0.123) | | | (0.104) | (0.137) |
| GDP Growth Public Services | | | 0.198*** | 0.168*** | | | 0.166** | 0.184*** |
| | | | (0.067) | (0.056) | | | (0.078) | (0.061) |
| GDP Growth x Other Services | | | 0.685*** | 0.408*** | | | 0.534*** | 0.399*** |
| | | | (0.130) | (0.060) | | | (0.159) | (0.070) |
| Observations | 15,468 | 11,625 | 15,468 | 11,625 | 9,044 | 7,118 | 9,044 | 7,118 |
| R-squared | 0.200 | 0.141 | 0.234 | 0.165 | 0.168 | 0.153 | 0.198 | 0.172 |

Source: IMF staff estimates.

Note: This table shows regression results where the dependent variable is *Value-Added (Employment) Growth* and the independent variables are $Size_{t-1}$, *Boom, Bust,* and sector dummies with their respective interactions with *Boom* and *Bust*. *Value-Added (Employment) Growth* is the log change in real value added (employment) for each sector in a country for a given year. $Size_{t-1}$ is the sectoral share of real value added (employment) over total country-year value added (employment) in the previous year. *Boom* and *Bust* are dummy variables that take the value of 1 when a country is in a credit boom or bust episode, respectively, and 0 otherwise. Sector dummies take a value of 1 for each stated sector and 0 otherwise. All specifications include country, sector, and year fixed effects. Robust standard errors are clustered at the country level and displayed in parentheses. Statistical significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively. The sample covers 11 sectors in 55 countries over 1970-2014 at annual frequency. Coefficients of interest are shown in **bold**.

## Sector Characteristics and Credit Booms

We examine whether some attributes make a sector more likely to move with the credit cycle. We focus on three characteristics—namely, (i) tradability, (ii) labor intensity, and (iii) external finance dependence. We capture tradability using a dummy for the three sectors: agriculture, mining, and manufacturing. Labor intensity is computed as the ratio of employee compensation to nominal value added for each sector. External finance dependence is based on Rajan and Zingales (1998). Stylized facts about the ranking of sectors on selected dimensions are reported in Appendix Figure 1.

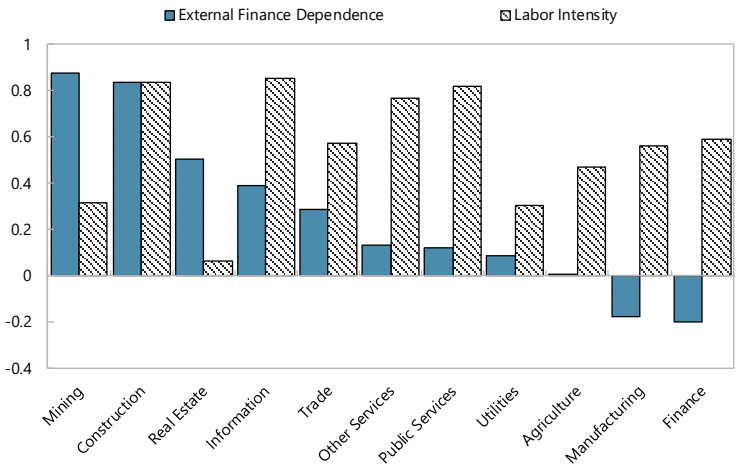
In practice, we estimate the following regression:

$$
\begin{aligned}
PerformanceMeasure_{i,c,t} &= \beta_1 Size_{i,c,t-1} + \beta_2\left(Boom_{c,t} \times SectorCharacteristic_i\right) \\
&+ \beta_3\left(Bust_{c,t} \times SectorCharacteristic_i\right) + \beta_4 GDPgrowth_{c,t} \\
&+ \beta_5\left(GDPgrowth_{c,t} \times SectorCharacteristic_i\right) + \beta_6 FixedEffects + \varepsilon_{i,c,t}
\end{aligned}
$$

where $PerformanceMeasure_{i,c,t}$ is a measure of sectoral performance (for example, employment or value-added growth) for a sector *i* in country *c* during year *t*. $Size_{i,c,t-1}$ is the share of sector *i* in country *c* total value added or employment in year *t*-1, and $Boom_{c,t}$ ($Bust_{c,t}$) is an indicator equal to 1 if country *c* is experiencing a boom (bust) episode in year *t*. $FixedEffects$ is the vector of time, country, and sector fixed effects. Robust standard errors are clustered at the country level.

Results of the estimations are provided for the whole sample in Table 3 in the main text. Findings are robust in subsamples and to employing an alternative set of fixed effects (these additional tables are available on request).

**Appendix Figure 1. Sectoral Characteristics**



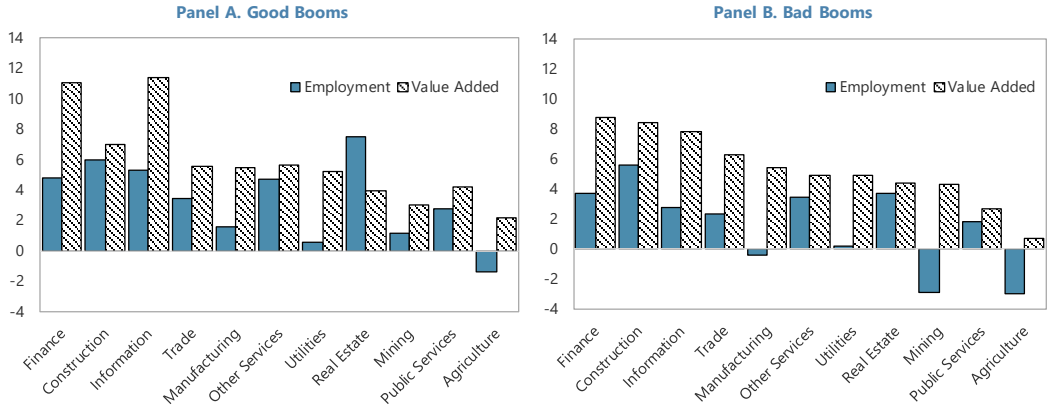

Sources: EU and World KLEMS, Braun and Larrain (2005).
Note: This figure shows the average annual levels of *External Finance Dependence* and *Labor Intensity* indicators by sector over the full sample. *External Finance Dependence* is calculated following Rajan and Zingales (1998) as the median across all US firms in a given industry of the ratio of total capital expenditures minus current cash flow to total capital expenditures and aggregated to the sector level using value-added shares as weights (see Appendix Table 1 for aggregation of industries into sectors). *Labor Intensity* is computed as the cross-sector share of labor compensation over total value added for the United States; a sample average is used for each sector, giving a country- and time-invariant sector characteristic.

## B. Credit Booms and the Real Sector: The Good and the Bad

### Sectoral Activity during Good and Bad Booms

Appendix Figure 2 shows the ranking of sectors by value-added and employment growth observed during credit booms, separately for good and bad booms.

**Appendix Figure 2. Sectoral Activity during Credit Booms**




Sources: EU and World KLEMS, Haver Analytics, IMF *International Financial Statistics*, IMF *World Economic Outlook*.
Note: This figure shows the average sectoral value-added and employment growth rates during good and bad boom episodes. The growth rates are first computed at the country and sector levels and then regressed on a country, sector, and year dummy conditional on being in a boom episode. The adjusted growth rates are calculated as the residuals from these regressions. The figure shows the cross-country average of these adjusted value-added and employment growth rates during all good booms in panel A and during all bad booms in panel B.

Results in Tables 4 and 5 in the main text are based on the following regressions for which the sample is restricted to boom periods:

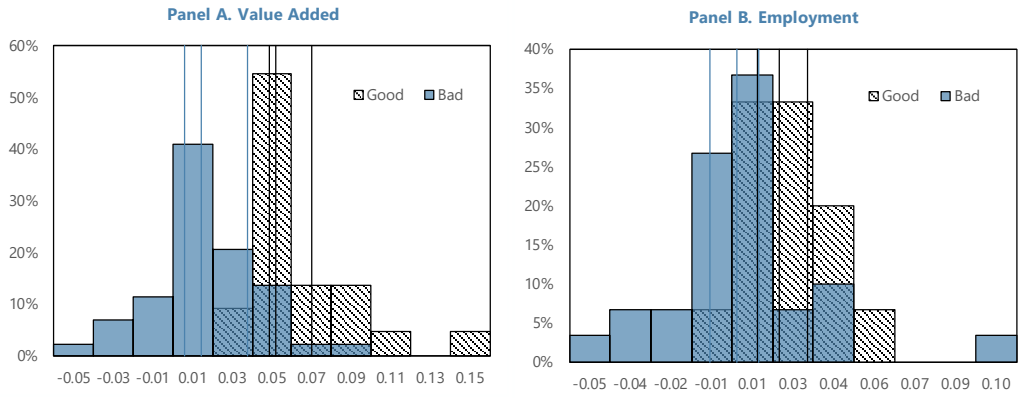
$$PerformanceMeasure_{i,c,t} = \beta_1 Size_{i,c,t-1} + \beta_2 Bad_{c,t} + \beta_3\left(Bad_{c,t} \times SectorDummy_i\right) + \beta_4 GDPgrowth_{c,t} + \beta_5 FixedEffects + \varepsilon_{i,c,t}$$

where $PerformanceMeasure_{i,c,t}$ is a measure of sectoral performance (for example, employment or value-added growth) for sector *i* in country *c* during year *t*. $Size_{i,c,t-1}$ is the share of sector *i* in country *c* total value added or employment in year *t*-1, and $Bad_{c,t}$ is an indicator equal to 1 if country *c* is experiencing a bad boom in year *t*. $FixedEffects$ is the vector of time, country, and sector fixed effects.

Appendix Table 4 reports the full set of results for all sectors, on value-added growth in Panel A and on employment growth in Panel B. In the main text, only the findings for the construction sector are reported. Specifically, Table 5 summarizes the results for construction, both in the whole sample and in various subsamples, while Table 6 shows the results in a subsample for which house price data are available and when controlling for the average annual growth in house prices and asset prices over the boom phase.

## Distribution of Value-Added and Employment Growth after Good and Bad Booms

**Appendix Figure 3. Distribution of Sectoral Activity after Credit Booms**




Sources: EU and World KLEMS, Haver Analytics, IMF *International Financial Statistics*, IMF *World Economic Outlook*.
Note: This figure shows the distribution of average sectoral value-added and employment growth rates observed in the three-year period following good and bad boom episodes. The growth rates are first computed at the country and sector levels and then regressed on a country, sector, and year dummy conditional on being in a boom episode. The adjusted growth rates are calculated as the residuals from these regressions. The figure shows the cross-country average of the adjusted value-added growth rates for good and bad booms in panel A and the cross-country average of the adjusted employment growth rates for good and bad booms in panel B.

**Appendix Table 4. Sectoral Activity during Bad vs. Good Booms**

| | Panel A. Value-Added Growth | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| $Size_{t-1}$ | -0.080** | -0.080** | -0.080** | -0.080** | -0.083** | -0.088** | -0.081** | -0.078** | -0.080** | -0.082** | -0.082** |
| | (0.035) | (0.035) | (0.035) | (0.035) | (0.034) | (0.036) | (0.035) | (0.034) | (0.035) | (0.036) | (0.035) |
| Bad Boom | -1.949** | -1.780** | -1.684** | -1.928** | -1.511** | -1.549** | -1.748** | -1.554** | -1.659** | -1.555** | -1.739** |
| | (0.765) | (0.742) | (0.723) | (0.749) | (0.723) | (0.744) | (0.770) | (0.711) | (0.746) | (0.728) | (0.737) |
| Bad Boom x Construction | **2.817**** | | | | | | | | | | |
| | (1.057) | | | | | | | | | | |
| Bad Boom x Finance | | 0.836 | | | | | | | | | |
| | | (1.448) | | | | | | | | | |
| Bad Boom x Manufacturing | | | -0.167 | | | | | | | | |
| | | | (1.061) | | | | | | | | |
| Bad Boom x Trade | | | | **2.410**** | | | | | | | |
| | | | | (0.921) | | | | | | | |
| Bad Boom x Information | | | | | -2.134 | | | | | | |
| | | | | | (1.349) | | | | | | |
| Bad Boom x Agriculture | | | | | | -1.671 | | | | | |
| | | | | | | (1.066) | | | | | |
| Bad Boom x Mining | | | | | | | 0.552 | | | | |
| | | | | | | | (1.895) | | | | |
| Bad Boom x Utilities | | | | | | | | -1.667 | | | |
| | | | | | | | | (1.418) | | | |
| Bad Boom x Real Estate | | | | | | | | | -0.432 | | |
| | | | | | | | | | (1.137) | | |
| Bad Boom x Public Services | | | | | | | | | | **-1.627**** | |
| | | | | | | | | | | (0.671) | |
| Bad Boom x Other Services | | | | | | | | | | | 0.447 |
| | | | | | | | | | | | (0.802) |
| Observations | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 | 2,165 |
| R-squared | 0.198 | 0.196 | 0.195 | 0.197 | 0.197 | 0.196 | 0.196 | 0.196 | 0.195 | 0.196 | 0.195 |

| | Panel B. Employment Growth | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| $Size_{t-1}$ | -0.041 | -0.039 | -0.039 | -0.039 | -0.039 | -0.045 | -0.039 | -0.040 | -0.037 | -0.037 | -0.039 |
| | (0.041) | (0.041) | (0.041) | (0.041) | (0.041) | (0.038) | (0.041) | (0.041) | (0.040) | (0.040) | (0.041) |
| Bad Boom | -1.701 | -1.469 | -1.441 | -1.430 | -1.290 | -1.295 | -1.314 | -1.536 | -1.103 | -1.346 | -1.389 |
| | (1.041) | (1.069) | (1.023) | (1.033) | (1.055) | (1.053) | (0.905) | (1.062) | (1.044) | (1.037) | (1.025) |
| Bad Boom x Construction | **3.308**** | | | | | | | | | | |
| | (1.302) | | | | | | | | | | |
| Bad Boom x Finance | | 0.761 | | | | | | | | | |
| | | (0.986) | | | | | | | | | |
| Bad Boom x Manufacturing | | | 0.449 | | | | | | | | |
| | | | (0.686) | | | | | | | | |
| Bad Boom x Trade | | | | 0.329 | | | | | | | |
| | | | | (0.533) | | | | | | | |
| Bad Boom x Information | | | | | -1.210 | | | | | | |
| | | | | | (1.040) | | | | | | |
| Bad Boom x Agriculture | | | | | | -1.150 | | | | | |
| | | | | | | (1.010) | | | | | |
| Bad Boom x Mining | | | | | | | -0.970 | | | | |
| | | | | | | | (3.926) | | | | |
| Bad Boom x Utilities | | | | | | | | 1.497 | | | |
| | | | | | | | | (0.904) | | | |
| Bad Boom x Real Estate | | | | | | | | | -3.257 | | |
| | | | | | | | | | (2.004) | | |
| Bad Boom x Public Services | | | | | | | | | | -0.588 | |
| | | | | | | | | | | (1.119) | |
| Bad Boom x Other Services | | | | | | | | | | | -0.123 |
| | | | | | | | | | | | (0.668) |
| Observations | 1,610 | 1,610 | 1,610 | 1,610 | 1,610 | 1,610 | 1,610 | 1,610 | 1,610 | 1,610 | 1,610 |
| R-squared | 0.156 | 0.153 | 0.153 | 0.153 | 0.153 | 0.153 | 0.153 | 0.154 | 0.156 | 0.153 | 0.153 |

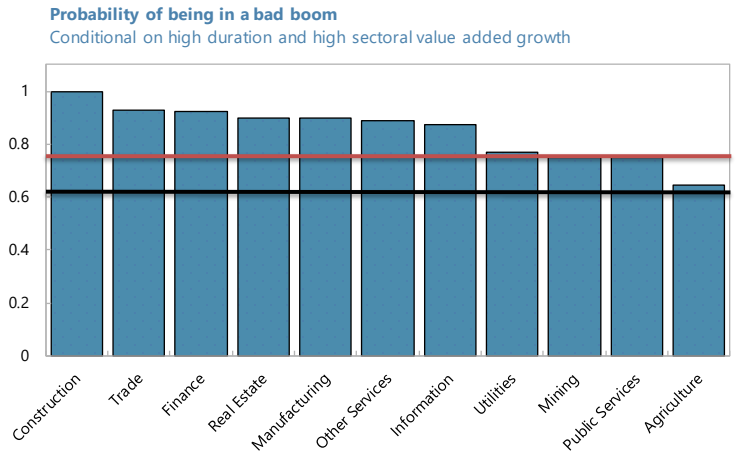
Source: IMF staff estimates.

Note: This table shows regression results conditional on the existence of a boom episode, where the dependent variable is *Value-Added Growth* in Panel A and *Employment Growth* in Panel B. The independent variables are $Size_{t-1}$, *Bad Boom*, and sector dummies with their respective interactions with *Bad Boom*. *Value-Added (Employment) Growth* is the log change in real value added (employment) for each sector in a country for a given year. $Size_{t-1}$ is the sectoral share of real value added (employment) over total country-year value added (employment) in the previous year. *Bad Boom* is a dummy variable that takes the value of 1 when a country is in a credit boom that is followed by a recession or subpar GDP growth, and 0 otherwise. Sector dummies take a value of 1 for each stated sector and 0 otherwise. All specifications include country, sector, and year fixed effects. Robust standard errors are clustered at the country level and displayed in parentheses. Statistical significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively. The sample covers 11 sectors in 55 countries over 1970-2014 at annual frequency. Coefficients of interest with statistical significance at conventional levels are shown in **bold**.

# C. Why Construction Matters

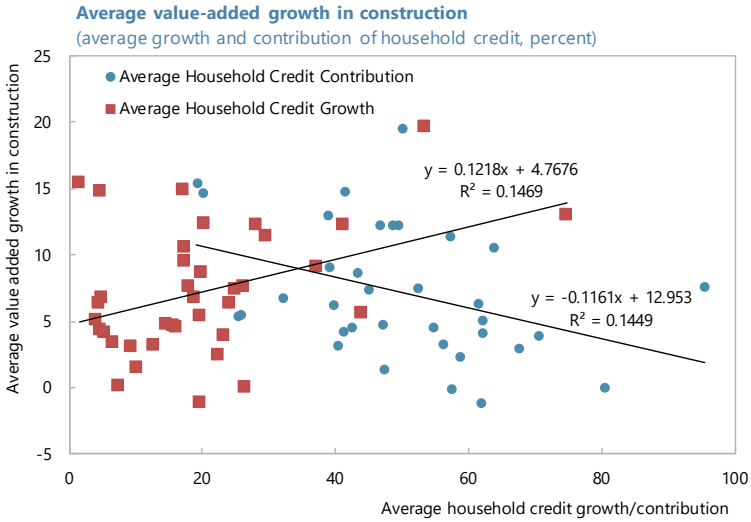
## Predicting Bad Booms: Stylized Facts

**Appendix Figure 4. When Are Booms Bad?**




Sources: EU and World KLEMS, Haver Analytics, IMF *International Financial Statistics*, Bank for International Settlements; IMF staff calculations.
Note: This figure shows the share of bad booms over total booms conditional on being in a long boom and having high value-added growth in a given sector. Long booms are those with duration exceeding the sample average. High growth is defined as experiencing above-average annual value-added growth during a boom, compared with all boom episodes. Average value-added growth rates are calculated separately for advanced economies and emerging markets and are detrended. The red line is the share of bad booms conditional only on being in a long boom. The black line is the unconditional share of bad booms.

**Appendix Figure 5. Construction Growth vs. Composition of Credit**




Sources: EU and World KLEMS, IMF *International Financial Statistics*, Bank for International Settlements; IMF staff calculations.
Note: This figure plots the correlation of the average annual value-added growth in construction and the average annual growth and contribution of household credit growth to total credit growth during all booms. The contribution of household credit growth is calculated as the ratio of household credit growth to total credit growth over the boom duration.

## Predicting Bad Booms: Probit Regressions

Formally, we model the probability of a boom being bad as follows:

$$\Pr(y = 1|x) = F(X\beta),$$

where *y* takes the value 1 if the boom is bad (and zero otherwise), *F* denotes the cumulative standard normal distribution, and *X* is the vector of variables of interest (for example, construction performance, duration or credit growth over the boom). $\beta$ coefficients are estimated using maximum likelihood. Appendix Table 5 reports estimation results when using value-added and employment growth in construction, respectively. Partial effects, which we report in Section IV, refer to average partial effects. However, partial effects at the mean are of similar magnitudes.

**Appendix Table 5a. Predicting Bad Booms**

| | Signaling by Construction Value-Added Growth | | | | Signaling by Construction Employment Growth | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Construction Growth | 0.066 | **0.078*** | **0.091*** | **0.088*** | **0.175**** | **0.210***** | **0.214***** | **0.221**** |
| | (0.042) | (0.044) | (0.048) | (0.049) | (0.071) | (0.081) | (0.0830) | (0.088) |
| Duration | | 0.172 | 0.175 | 0.200* | | 0.387** | 0.384** | 0.462** |
| | | (0.115) | (0.116) | (0.118) | | (0.189) | (0.190) | (0.205) |
| Credit/GDP Growth | | | -0.023 | -0.008 | | | -0.007 | 0.010 |
| | | | (0.030) | (0.032) | | | (0.030) | (0.034) |
| Start Credit/GDP | | | | 0.010 | | | | 0.013* |
| | | | | (0.006) | | | | (0.008) |
| Constant | 0.131 | -0.533 | -0.255 | -1.013 | -0.198 | -1.578** | -1.473* | -2.761** |
| | (0.268) | (0.520) | (0.633) | (0.802) | (0.313) | (0.765) | (0.887) | (1.227) |
| Observations | 59 | 59 | 59 | 59 | 44 | 44 | 44 | 44 |
| Pseudo R-squared | 0.03 | 0.07 | 0.08 | 0.12 | 0.14 | 0.23 | 0.23 | 0.30 |

Source: IMF staff estimates.

Note: This table shows probit results with the dependent variable being equal to 1 when a boom is classified as bad, conditional on being in a boom. *Construction Growth* is the average annual detrended value-added growth rate during a boom episode in columns 1-4 and the average annual detrended employment growth rate during a boom episode in columns 5-8. *Duration* is the length of each boom. *Credit/GDP Growth* is the average annual credit-to-GDP growth during each boom, while *Start Credit/GDP* is the credit-to-GDP ratio at the beginning of each boom. Statistical significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively. Coefficients of interest are shown in **bold**.

**Appendix Table 5b. Predicting Bad Booms: Robustness to Household Credit Growth**

| | Signaling by Construction Value-Added Growth | | | | Signaling by Construction Employment Growth | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Construction Growth | | **0.134**** | **0.163**** | **0.182**** | | **0.161*** | **0.205*** | **0.234*** |
| | | (0.064) | (0.074) | (0.081) | | (0.091) | (0.107) | (0.126) |
| Household Credit Growth | -0.004 | | -0.025 | -0.028 | 0.010 | | -0.043 | -0.033 |
| | (0.019) | | (0.023) | (0.036) | (0.036) | | (0.050) | (0.062) |
| Duration | | | | 0.243 | | | | 0.278 |
| | | | | (0.166) | | | | (0.253) |
| Credit/GDP Growth | | | | -0.009 | | | | -0.029 |
| | | | | (0.056) | | | | (0.057) |
| Start Credit/GDP | | | | -0.002 | | | | 0.012 |
| | | | | (0.008) | | | | (0.012) |
| Constant | 0.877** | 0.329 | 0.669 | 0.158 | 0.878 | 0.431 | 0.924 | -0.599 |
| | (0.402) | (0.315) | (0.448) | (1.029) | (0.615) | (0.439) | (0.740) | (1.481) |
| Observations | 38 | 38 | 38 | 38 | 26 | 26 | 26 | 26 |
| Pseudo R-squared | 0.00 | 0.13 | 0.17 | 0.23 | 0.00 | 0.19 | 0.22 | 0.34 |

Source: IMF staff estimates.

Note: This table shows probit results with the dependent variable being equal to 1 when a boom is classified as bad, conditional on being in a boom. *Construction Growth* is the average annual detrended value-added growth rate during a boom episode in columns 1-4 and the average annual detrended employment growth rate during a boom episode in columns 5-8. *Household Credit Growth* is the average annual household credit growth rate during each boom. *Duration* is the length of each boom. *Credit/GDP Growth* is the average annual credit-to-GDP growth during each boom, while *Start Credit/GDP* is the credit-to-GDP ratio at the beginning of each boom. Statistical significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively. Coefficients of interest are shown in **bold**.

**Appendix Table 5c. Predicting Bad Booms: Robustness to House Price Growth**

| | Signaling by Construction Value-Added Growth | | | | Signaling by Construction Employment Growth | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Construction Growth | | 0.083 | 0.087 | **0.111*** | | **0.188**** | **0.183**** | **0.235*** |
| | | (0.052) | (0.054) | (0.067) | | (0.089) | (0.092) | (0.134) |
| House Price Growth | 0.007 | | -0.006 | 0.008 | 0.029 | | 0.007 | 0.023 |
| | (0.022) | | (0.025) | (0.031) | (0.029) | | (0.029) | (0.045) |
| Duration | | | | 0.347** | | | | 0.508** |
| | | | | (0.157) | | | | (0.254) |
| Credit/GDP Growth | | | | -0.023 | | | | 0.020 |
| | | | | (0.046) | | | | (0.073) |
| Start Credit/GDP | | | | 0.009 | | | | 0.033 |
| | | | | (0.007) | | | | (0.024) |
| Constant | 0.548** | 0.278 | 0.308 | -1.064 | 0.357 | -0.030 | -0.076 | -3.999* |
| | (0.268) | (0.283) | (0.312) | (0.898) | (0.349) | (0.387) | (0.433) | (2.146) |
| Observations | 44 | 44 | 44 | 44 | 34 | 34 | 34 | 34 |
| Pseudo R-squared | 0.00 | 0.05 | 0.06 | 0.22 | 0.03 | 0.15 | 0.15 | 0.46 |

Source: IMF staff estimates.

Note: This table shows probit results with the dependent variable being equal to 1 when a boom is classified as bad, conditional on being in a boom. *Construction Growth* is the average annual detrended value-added growth rate during a boom episode in columns 1-4 and the average annual detrended employment growth rate during a boom episode in columns 5-8. *House Price Growth* is the average annual house price growth rate during each boom. *Duration* is the length of each boom. *Credit/GDP Growth* is the average annual credit-to-GDP growth during each boom, while *Start Credit/GDP* is the credit-to-GDP ratio at the beginning of each boom. Statistical significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively. Coefficients of interest are shown in **bold**.

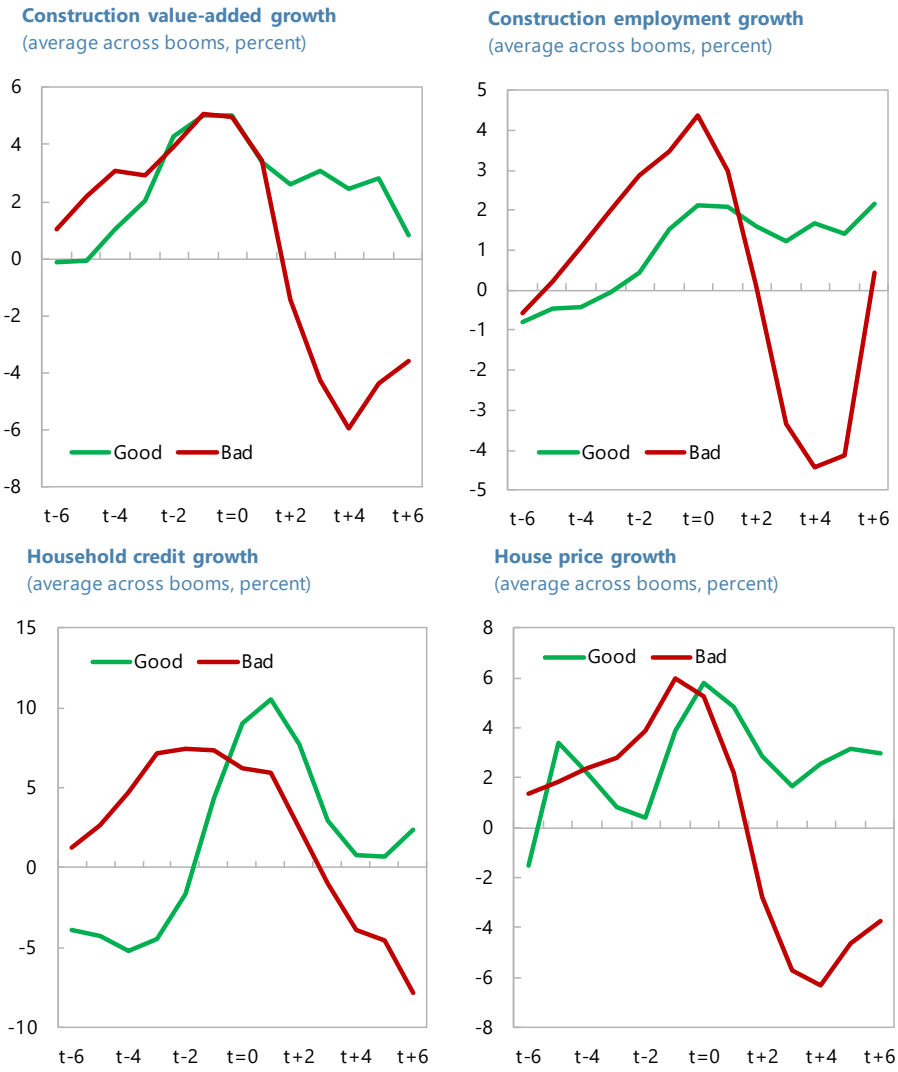
**Appendix Table 5d. Predicting Bad Booms: Robustness to Asset Price Growth**

| | Signaling by Construction Value-Added Growth | | | | Signaling by Construction Employment Growth | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Construction Growth | | **0.098**** | 0.079 | 0.063 | | **0.168**** | **0.166**** | **0.210**** |
| | | (0.050) | (0.053) | (0.063) | | (0.075) | (0.076) | (0.101) |
| Asset Price Growth | 0.027* | | 0.018 | 0.028 | 0.010 | | 0.004 | 0.007 |
| | (0.016) | | (0.018) | (0.021) | (0.017) | | (0.019) | (0.023) |
| Duration | | | | 0.287** | | | | 0.488** |
| | | | | (0.144) | | | | (0.219) |
| Credit/GDP Growth | | | | 0.026 | | | | -0.006 |
| | | | | (0.038) | | | | (0.036) |
| Start Credit/GDP | | | | 0.013* | | | | 0.020* |
| | | | | (0.007) | | | | (0.011) |
| Constant | 0.075 | 0.108 | -0.093 | -2.157** | 0.300 | -0.104 | -0.165 | -2.826** |
| | (0.310) | (0.271) | (0.343) | (1.011) | (0.338) | (0.325) | (0.430) | (1.318) |
| Observations | 49 | 49 | 49 | 49 | 40 | 40 | 40 | 40 |
| Pseudo R-squared | 0.05 | 0.07 | 0.09 | 0.22 | 0.01 | 0.12 | 0.12 | 0.35 |

Source: IMF staff estimates.

Note: This table shows probit results with the dependent variable being equal to 1 when a boom is classified as bad, conditional on being in a boom. *Construction Growth* is the average annual detrended value-added growth rate during a boom episode in columns 1-4 and the average annual detrended employment growth rate during a boom episode in columns 5-8. *Asset Price Growth* is the average annual asset price growth rate during each boom. *Duration* is the length of each boom. *Credit/GDP Growth* is the average annual credit-to-GDP growth during each boom, while *Start Credit/GDP* is the credit-to-GDP ratio at the beginning of each boom. Statistical significance at the 10, 5, and 1 percent level is denoted by *, **, and ***, respectively. Coefficients of interest are shown in **bold**.

## Appendix Figure 6. Evolution of Construction Activity, Household Credit, and House Prices around Good versus Bad Credit Booms




Sources: EU and World KLEMS, IMF *International Financial Statistics*, Bank for International Settlements; IMF staff calculations.

Note: This figure plots the three-year moving average of the median value-added growth and employment growth in construction, as well as household credit growth and house price growth, distinguishing between good and bad credit booms. Construction activity variables are adjusted to purge out country-industry fixed effects, while the household credit and house price growth series are adjusted to purge out the country fixed effects. The median is based on a sample of all (good/bad) booms. t=0 denotes the end of the boom episode.