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Sovereign default and capital accumulation☆

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ABSTRACT

This paper introduces endogenous capital accumulation into an otherwise standard quantitative sovereign default model *à* la Eaton and Gersovitz (1981). We find that conditional on a level of debt, default incentives are U-shaped in the capital stock: the economy with too small or too large amounts of capital is likely to default. Even without using an ad-hoc output cost of default, the calibrated model generally well matches business cycle facts of emerging economies and generates defaults in "good" and "bad" times, with a frequency of 25.5% and 74.5%, respectively, consistent with Tomz and Wright (2007)'s empirical findings. Simulation results show that the economy defaults in good times when it has "overinvested" in capital during booms before default.

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1. Introduction

Do countries default *only* in "bad times"? No. In December of 2008, Ecuador defaulted when the country failed to make a $30.6 million interest payment on its external debt. What is interesting about Ecuador's default in 2008 is that at the time of default, Ecuador had around $6 billion in foreign reserves and its external debt amounted to $10.2 billion, which only accounted for around 25% of its GDP. Moreover, the annual growth rate of GDP in 2008 (year over year) was 6.5%. This suggests that Ecuador defaulted in "good times,"[1] not to mention it had more than sufficient resources with which to honor its debt. Ecuador's default in 2008 is sharply contrasted with Argentina's default in 2002 in that Argentina defaulted after a long economic downturn.

Fig. 1 shows time-series plots of GDP, consumption, and investment for Ecuador, all detrended through the HP filter with a smoothing parameter of 1600 for the period 1991Q1 through 2012Q4. The Ecuador government defaulted twice over the last two decades: August 1999 and December 2008. Around the default in 1999, we see typical economic dynamics associated with sovereign defaults in "bad" times: at the time of default, output, consumption, and investment were 5.6%, 8.7%, and 27.8 % *below* trend, respectively. Up until the two quarters after default, all relevant variables have stayed much below trend, and since then, these variables start to revert back to the trend. This is the well-known "V" shaped macroeconomic dynamics of sovereign debt crises for emerging market economies as documented by Mendoza and Yue (2012). By contrast, at the time of 2008's default, Ecuador displayed *inverted* V shape dynamics: at the time of default,[2] output, consumption, and investment were 0.7%, 5.0%, and 8.1% *above* trend, respectively, and subsequently they have decreased, but to a much lesser degree than in 1999's default.[3]

Sovereign default in "good times" is, however, neither new nor unique to Ecuador. Tomz and Wright (2007) study the relationship

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[1] Hereafter, default in "good" times refers to a default episode that occurs when output is above trend, whereas default in "bad" times refers to a default episode that occurs when output is below trend as in Tomz and Wright (2007).

[2] Because Ecuador defaulted on Dec. 13, 2008, taking the first quarter of 2009 as the starting quarter for Ecuador's default is appropriate.

[3] Tomz and Wright (2007) find that Chile defaulted twice in 1826 and 1880 when output was above trend, and that the Chilean economy also showed *inverted* V- shaped dynamics of GDP around both default episodes (Fig. 1 in Tomz and Wright (2007)). In Section 3.6, we show that several countries that defaulted in "good" times display similar inverted V shaped economic dynamics around default episodes.

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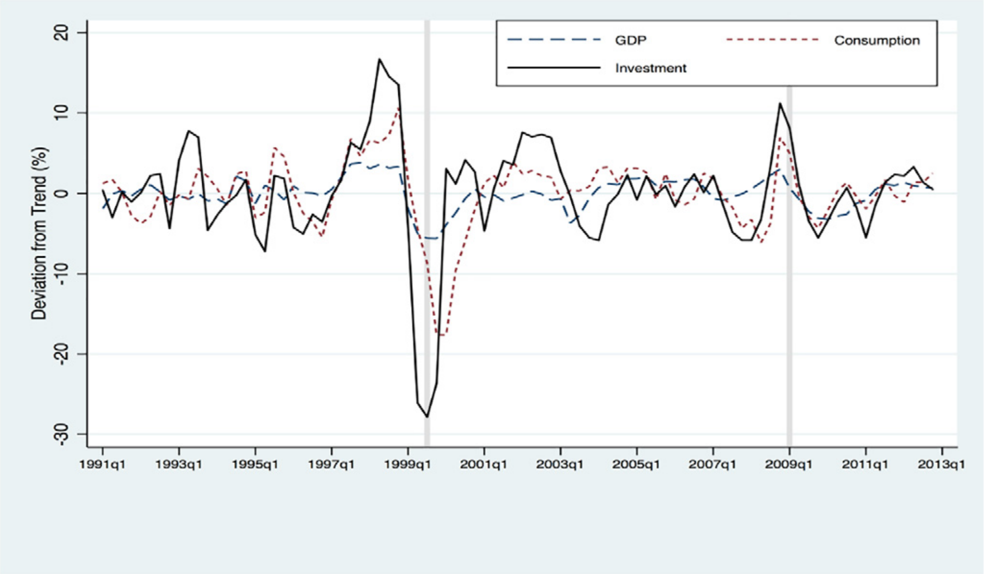

Fig. 1. Ecuador's Economic Activity and Defaults. Note: Data runs from 1991Q1 through 2012Q4. Data source: IFS. All series are logged and HP filtered with a smoothing parameter of 1600. Gray bars denote starting quarters for Ecuador's 1999 and 2008 default.

between sovereign default and output for the period 1820–2004 and across countries, and find that around one third of sovereign defaults occurred in "good times", when output was above trend. Durdu et al. (2013) also document sovereign default episodes in good times with a new data set, supplementing Tomz and Wright (2007). Tomz and Wright (2007) claim that this finding is puzzling, because this is not consistent with the conventional wisdom that sovereign default occurs *only* in bad times, and sovereign default models in the tradition of Eaton and Gersovitz (1981) *only* focus on the role of default as a partial consumption insurance vehicle against sharp declines in output.

This paper introduces endogenous capital accumulation into an otherwise standard quantitative sovereign default model in the tradition of Eaton and Gersovitz (1981) and finds that conditional on a level of debt, default incentives display a U shape in the capital stock: holding all else constant, default incentives are high at a low level of capital stock but decrease as the capital stock increases. Above a certain level of capital stock, however, default incentives are reversed to increase in the capital stock. Finally, when the economy has a sufficiently large capital stock, default incentive is so high that the economy decides to default. That is, by introducing capital accumulation, our model predicts high default incentives in high income states as well as low income states. This prediction of the model is one of novel findings of our paper. Moreover, simulation results show that our model generally well matches business cycle facts of emerging economies, and that in addition to defaults in bad times, the model generates defaults in good times with a significantly high frequency of 25.5%, which is close to the empirical estimate of Tomz and Wright (2007) of 38.5%. Our model thus can account for the puzzling empirical findings by introducing capital accumulation.

The setup of our model is similar to Bai and Zhang (2012) in that it extends Aguiar and Gopinath (2006) and Arellano (2008) by introducing capital accumulation and a production technology. Sovereign debt is not enforceable, and thus at any time, a benevolent sovereign government can decide to default after comparing values of default and repayment. A small open economy produces capital using a CES Armington aggregator that combines domestic and foreign inputs. This assumption is in line with several empirical studies such as Eaton and Kortum (2001) and Burstein et al. (2004), which find that in producing capital goods, emerging market economies rely heavily on foreign investment goods from advanced economies. Default is punished by temporary autarky, during which the economy is banned from saving/borrowing in international financial markets and from importing foreign inputs in world markets. Hence, there are two types of punishment for default: during autarky, (1) the economy loses a savings instrument, and (2) accumulating capital is more costly for the economy (i.e., a high autarky price of investment) because domestic and foreign inputs are *imperfect* substitutes in producing capital.

Like the standard quantitative sovereign default models, our model predicts high default incentives in low income states. In low income states, the economy's debt relative to income is high, so the economy's marginal utility of consumption is high too. With the high marginal utility of consumption, the economy's gain of an increase in currency consumption from default exceeds the cost of default, so that it decides to default.

Our model also predicts high default incentives in high income states: the economy with a sufficiently large amount of capital is likely to default, holding all else constant. The model makes this prediction for three main reasons. First, capital can be used as a consumption insurance vehicle during autarky in a spirit similar to Aiyagari (1994).The economy with a large capital stock can maintain its consumption even during autarky without relying on external borrowing. Hence, with the large capital stock in hand, financial autarky is not costly, and the value of borrowing from foreign lenders is not high, either. Second, costly capital accumulation - another punishment for default due to imperfect substitutability between domestic and foreign inputs-is less costly to the economy with a large capital stock. Finally, our model does *not* use the ad-hoc output cost of default, commonly used by quantitative sovereign default models, which only penalizes default in high income states.

The model is numerically solved and calibrated to match the business cycle statistics of Argentina. Simulation results show that even without using the ad-hoc cost of default, the model generally well accounts for business cycle facts unique to emerging market economies. The event study shows defaults in good times occur (1) after the economy has accumulated a significantly large amount of capital stock during booms before default, and (2) when the economy unexpectedly faces a *modestly* bad shock after having had a sequence of good TFP shocks, both of which indicate that

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