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## Journal of Monetary Economics

journal homepage: [www.elsevier.com/locate/jme](http://www.elsevier.com/locate/jme)Time to produce and emerging market crises<sup>☆</sup>Felipe Schwartzman<sup>\*</sup>

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## ARTICLE INFO

## Article history:

Received 17 July 2012

Received in revised form

21 July 2014

Accepted 21 July 2014

Available online 31 July 2014

## Keywords:

Working capital

Time to build

Crises

Inventories

Emerging markets

## ABSTRACT

After emerging market crises, value added falls more in manufacturing industries that normally exhibit higher inventory/cost ratios. Moreover, the difference in value added between manufacturing industries with different inventory/cost ratios persists years into the recovery. A shock to aggregate TFP cannot by itself match this pattern. In contrast, a persistent increase in the cost of foreign capital can. In the context of a calibrated multisector small open economy model, a shock to the cost of foreign capital consistent with the cross-industry data leads, 3–5 years after the onset of the crisis, to an average reduction of output relative to a trend of 5.4 percent.

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## 1. Introduction

A key decision for policymakers in developing countries is whether or not to integrate the national economy in international financial markets, thus turning it into an “emerging market” for foreign investors. Critics of financial globalization argue that emerging economies’ access to international financial markets is unstable and that this leads to macroeconomic instability.<sup>1</sup> A major piece of the evidence for that view are recurrent emerging market crises, in which pronounced and persistent output collapses occur in tandem with large scale reversals of foreign capital inflows. Nevertheless, the interpretation of those episodes as being primarily a reflection of interest rate rises has not remained unchallenged. Notably, [Aguiar and Gopinath \(2007\)](#) have argued that the change in the direction of capital flows observed in these episodes is more likely a consequence rather than a cause of the accompanying output collapses, as domestic residents increase their savings in response to a persistent decline in their income.

This paper brings cross-industry data to bear on the question of whether the large and persistent drops in output observed after emerging market crises can be traced to an increase in the cost of capital available to domestic firms. In this case, it is also true that industries that take longer to produce and distribute goods, thus normally exhibiting a higher

<sup>☆</sup> An earlier and much revised version of the paper is available as a Federal Reserve Bank of Richmond Working Paper, 10-15R. For comments and suggestions I thank Urban Jermann, an anonymous referee and seminar participants and commenters at ISIR 2012, the SCIEAM 2011, the Macro Midwest Meetings 2011, the VII LAFN Workshop 2011, at UC Santa Barbara, UC Santa Cruz, the San Francisco Fed, University of Warwick, NCSU, PUC-Rio, EPGE-FGV, UCL, and the Bank of Spain, as well as several colleagues and professors at Princeton and at the Richmond Fed. I also thank Nobu Kiyotaki and Markus Brunnermeier for advising me in this work, Pierre-Daniel Sarte, Alex Wolman, and Sangeeta Pratap for detailed comments, and Jonathan Tompkins for excellent research assistance. The views expressed in this paper are those of the author and do not reflect the position of the Federal Reserve Bank of Richmond or the Federal Reserve System.

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<sup>1</sup> See [Kose et al. \(2009\)](#) for a comprehensive review of the evidence in favor and against financial globalization. [Korinek \(2011\)](#) reviews the theoretical literature making the welfare case for prudential capital controls aimed at stabilizing foreign capital flows.

inventory/cost ratio, should be more intensely affected by the crises. In contrast, there is no a priori reason why an aggregate productivity shock would generate such a cross-industry pattern. The key empirical result of this paper is that, indeed, after emerging market crises, manufacturing industries that normally exhibit larger inventory/cost ratios also take longer to recover. The difference between industries is particularly significant 3–5 years after the episodes. The finding is robust to the inclusion of a large number of controls, and across sub-samples.

What does the cross-industry data imply for the impact of a shock to the cost of capital on aggregate output? A quantitative equilibrium model provides an answer. The model features multiple industries, each equipped with a specific time to produce and distribute goods (time to produce, for short) calibrated to match long term averages of industry-specific inventory/cost ratios. The model indicates that the cross-industry variation observed in the data is consistent with a gradual increase in the cost of foreign capital relative to its pre-crisis level. In the context of the model, this increase generates a reduction in output relative to its trend of 5.4 percent, taking the average over those same 3–5 years. This decline accounts for 48 percent of the overall average deviation of GDP relative to trend.

In the quantitative model, production is subject to “time to produce” technology, that is, a technology that requires that some of the inputs be used before the final output is produced. This production function is similar to the working capital constraints emphasized in prominent papers in the emerging market business cycle literature such as Neumeyer and Perri (2005), Uribe and Yue (2006), and Mendoza (2010), whereby firms need to acquire variable inputs in advance of production.<sup>2</sup> Relative to existing formulations in the literature, it has the added advantage that, as discussed in detail in Section 2, “time to produce” has clear implications for inventory data.<sup>3</sup>

The results based on cross-industry evidence complement the findings of Garcia-Cicco et al. (2010) and Chang and Fernandez (2013) using time series data, pointing to a prominent role for financial shocks in emerging market business cycles. The result of a persistent rise in the cost of capital after the crisis also echoes findings by Cerra and Saxena (2008) and Reinhart and Rogoff (2009), both of which document persistent drops in output relative to trend after financial crises.

The empirical findings are complementary to independent work by Tong and Wei (2009). Using data from firms in emerging markets, they show that higher inventory-to-sales ratios were associated with larger drop in share prices in the aftermath of the Great Recession. Raddatz (2006) presents another set of related empirical findings: industries with high inventory-to-sales ratios are more volatile in countries with a low level of financial development. Lastly, the paper is also related to work by Alessandria et al. (2010), who study the implications of inventory holdings for price dynamics in the aftermath of emerging market crises.

Section 2 delineates the relationship between inventory/cost ratios and the response to persistent interest rate and productivity shocks in the context of the decision problem of a single firm, providing the key intuitions for the rest of the paper. Section 3 presents the data analysis. Section 4 introduces a multisector equilibrium model to validate the partial equilibrium intuitions in Section 2 and investigate the implications of the findings in Section 3 for aggregate quantities. The last section concludes.

## 2. Time to produce and distribute goods, inventories, and the impact of shocks

The discussion that follows relies on the analysis of optimal firm decisions given a “time to produce and distribute” (time to produce, for short) model of the production technology. This technology induces the holding of inventories, and underpins the analysis of the relationship between the effects of different kinds of shocks and the inventory/cost ratio.

The framework differs from other approaches to modeling inventories. The model provides an intermediate step between the reduced form but highly tractable inventory-in-production-function approach in Ramey (1989) and the tightly microfounded but, for a multi-sector model, prohibitively untractable fixed cost approach in Khan and Thomas (2007). A primary advantage of the approach, for the purposes of the paper, is that it shares with working capital models common in the emerging markets business cycle literature an emphasis on timing restrictions as a key source of borrowing needs. This allows for a more direct comparison with previous work.

Firms are endowed with the following Cobb–Douglas production function:

$$Y_t = \prod_{s=0}^S Z_{t-s}(s)^{\omega(s)}, \quad \sum_{s=0}^S \omega(s) = 1, \quad (1)$$

where  $Y_t$  is sales at  $t$ ,  $Z_{t-s}(s)$ ,  $s = \{0, \dots, S\}$  are dated composite inputs with the time subscripts  $t-s$  referring to when the inputs are included in the production process, the numbers in brackets refer to the time elapsed between the assignment of

<sup>2</sup> Working capital also plays a prominent role in business cycle models designed to study advanced economies, such as Jermann and Quadrini (2012). Such a working capital channel has been the object of empirical investigations, notably by Barth and Ramey (2001).

<sup>3</sup> The narrow focus on inventories as opposed to a broader focus that includes other components of working capital such as trade credit and cash, and marketable securities is justified for three reasons: (a) inventories are clearly associated with the use of variable inputs, (b) the opportunity cost of holding inventories is proportional to the real interest rate, rather than the nominal interest rate or some spread and (c) the ranking of industries with respect to inventory/cost ratios is likely to be linked to technological differences between industries. The supplementary materials available online present the argument in more detail. The lack of clear motivation for the focus on real interest rates has been an important source of criticism for the literature on emerging market business cycles (Chari et al., 2005).

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