# Labor reallocation during booms:
# The role of duration uncertainty[*]

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## Abstract

Booms are recurrent and affect sectors as varied as commodities, construction and tech. I study how uncertainty about duration of the boom shapes workers decision to enter the booming sector. I build a model with sector-specific on-the-job human capital accumulation and show conditions under which increasing uncertainty about duration can induce more entry. The option value is crucial: if duration ends up being short workers will switch out and cut losses, while payoffs are high if duration is long because of increasing returns to sector-specific tenure. To study the effects of duration uncertainty empirically I exploit the boom in world prices of mineral products of 2011-2019. Using novel administrative data from Australia, an exporter of those products, I build and estimate a general equilibrium model accounting for duration uncertainty in the estimation stage. I use the estimated model to simulate a perfect foresight economy in which the duration of the boom is set to be the expected duration from the economy with uncertainty. I find that the booming sector would have higher employment and output in the perfect foresight economy.

*Key words: human capital, labor reallocation, terms of trade shocks, uncertainty.*

# 1  Introduction

From the gold rush in nineteenth century California to the oil boom in North Dakota or agricultural booms in developing countries every couple of decades; from construction booms to the dot-com bubble in the tech industry, booms and busts have been recurrent and affected all kinds of sectors and workers, low-skilled and high-skilled. The specific causes and features differ between settings, but there is something that they all have in common for agents making decisions during the boom: the saliency of the boom's eventual and uncertainty about when that end will come. In this paper I focus on one of these decision makers: I study how uncertainty about duration shapes workers decision to enter into the booming sector.

In the first part of the paper I build a model that isolates the key economic mechanism I will focus on throughout. In this model the economy has two sectors: wages in one sector are exposed to a boom and will fall on impact the moment the boom ends, while wages in the other sector are always the same at some level in between the boom and bust wages for the booming sector. Workers accumulate sector-specific human capital on-the-job in their sector of employment, and this is what makes their problem of where to sort dynamic. In a world where the hazard rate for the end of the boom is constant, these elements are enough to make the problem of the worker who sorts into the booming sector look like a call option (Dixit and Pindyck, 1994). If duration ends up being short, workers will switch out to the outside sector and cut losses, while payoffs are high if duration is long because of increasing returns in human capital as a function of tenure. This leads to risk-loving attitudes towards the duration of the boom around a certain range of durations the boom could have, but not all.

The key conclusion from the model is that moving from an economy in which the duration of the boom is unknown to a comparable perfect foresight economy in which duration is known can either increase or decrease labor supply into the booming sector.[1] The answer will depend in a complicated way on the rates of on-the-job human capital accumulation, wages in both sectors, and the hazard rate of the end of the boom. To understand the effects of duration uncertainty, even qualitatively, requires focusing on a context, estimating the relevant parameters, and using the estimated model to study a counterfactual without duration uncertainty. This is what I do next.

I focus on the commodity boom of hat kicked off in the first years of this century and its impact on Australian labor market. Commodity booms are important both for their cyclical recurrence and their impact on many economies around the world.[2] As shown in Figure 1a, starting in the early years of the century commodity prices started to boom for exporters across the world and peaked around 2010. The boom in Australia was relatively strong and long-lasting. It is understood that the drivers of the latest commodity boom were growth and urbanization in China. As shown in Figure 1b, the participation of China in global commodity imports increased dramatically during the

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[1]By comparable I mean that in the perfect foresight economy duration is set to be exactly equal to the expected duration from the economy with uncertainty.

[2]In 2018, commodities represented more than 60% of exports in more than 100 countries (UNCTAD, 2021).

period, specially for ores and metals. Australia was a key supplier of the latter, used intensively in construction as China urbanized and converged to a higher housing steady state. Crucially, it was understood that demand from China would eventually stabilize and the boom in metal prices would come to an end.[3] In Section **??** I provide more details on the context and how labor markets in Australia evolved broadly during the period. For the goal of this paper this setting is an example of a strong boom, driven by temporary forces and whose duration was unknown.

Figure 1: Commodity boom driven by growth in China

(a) Commodity export prices (Index 2001 = 100)   (b) Imports from China (% World Imports)
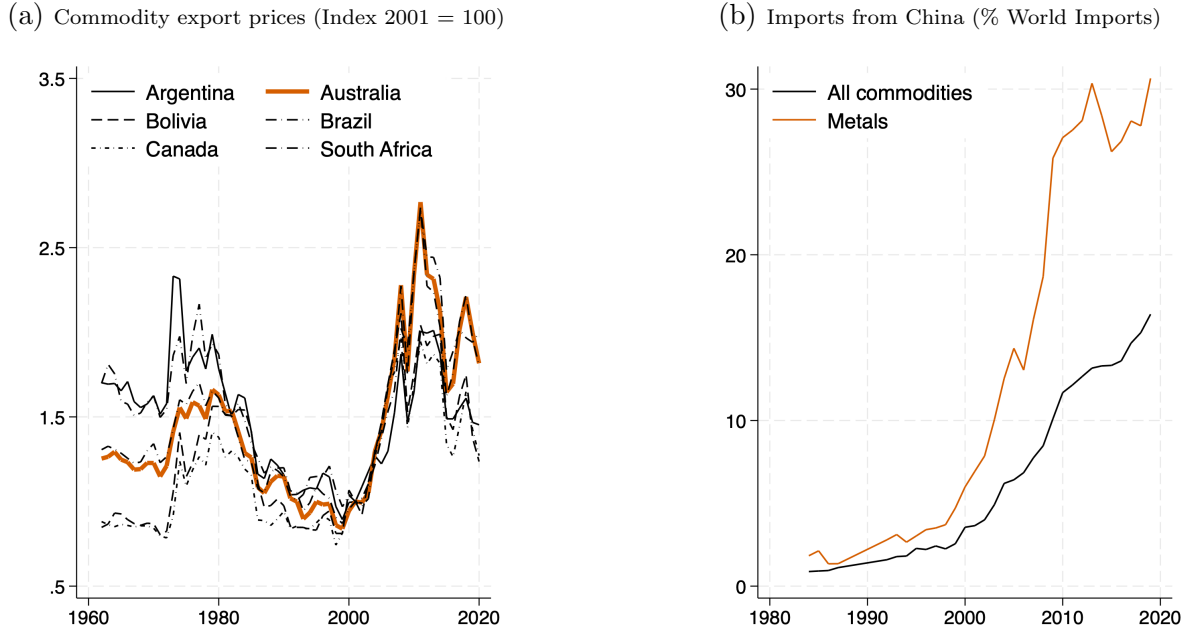


To answer how much of labor reallocation towards mining can be explained by risk-loving attitudes towards duration during this episode, I build a quantitative version of the baseline model that I can take to the data and use for my counterfactual of interest. Several features need to be added. First I incorporate finitely lived agents. Old workers could be less sensitive to an increase an uncertainty as they wouldn't be able to benefit from long durations. I incorporate other determinants of labor income like age, education, and unobserved heterogeneity. I also model costs to switching sectors that are independent of the opportunity cost channel which is the focus of this paper, but have been highlighted in the literature. Finally, as stems from the discussion of the model in the first paragraphs, the nature of outside options in the event of an end of the boom is crucial to understand workers sensitivity to duration uncertainty. To that end I include 5 sectors in the model and specify a structure for labor demand.

To estimate the quantitative version of the model I exploit novel data from administrative sources that covers the universe of Australian workers in the formal sector between 2011 and 2018. To estimate key parameters of the model, like the returns to tenure, a panel in which workers are

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[3]This view can be found in several central bank reports from the period, specially when discussing the evolution of metal prices (Rayner and Bishop, 2013; Kruger et al., 2016).

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followed across years is needed. I can construct such a panel by linking tax returns across years and to the 2016 census, from which I observe education levels. An added advantage of focusing this study on Australia, among all commodity exporters, is that the coverage of such a dataset is relatively high. This is important in light of the initial discussion about getting workers outside options right. I estimate the labor side of the model following the approach in Traiberman (2019), who builds on techniques original to the empirical industrial organization literature (Rust, 1987; Arcidiacono and Miller, 2011; Scott, 2014).

The estimation method in Traiberman (2019) can be applied almost step-by-step in my setting, except for when it comes to estimating the switching costs between sectors. The method relies on matching transition shares between sectors for workers with different characteristics. Intuitively, high switching costs between a pair of sectors are estimated if workers don't migrate between them despite high expected wage differences.[4] In particular, under some extra assumptions on idiosyncratic shocks which are standard in the literature one can write an estimated equation which links migration costs with the gap in expected values between sectors. My key difficulty is that my data covers only boom years, and the expectation error between the observed wages and transition rates and their ex-ante values may be correlated across periods if, for example, the hazard rate is correlated across periods.[5] To deal with this issue I make a different set of assumptions about expectations and write down an estimated equation in which future drops in value in a sector act similarly to migration costs. I show how I disentangle between the two. This last step has important effects on my estimate of switching costs. I estimate the average migration cost for a switcher to be $xx\%$ of labor income in the destination sector, while it would have been $YY\%$ if I had assumed expectation errors to be uncorrelated across periods.

The estimation step described in the last paragraph requires a measure of the hazard rate for the end of the boom. To construct it I collect data on the value of stocks and put options on one of the biggest mining firms in Australia. Financial markets are a natural source to look at when looking to estimate this parameter, given that asset prices are forward looking. Put options in particular gain in value when the expected value of the stock falls, which should make them particularly sensitive to movements in the probability of a bust. The calibrated hazard rate is relatively low and varies across years, with a clear peak in 2015. This can be linked to the crash in the Chinese stock market which, in this context, cast doubts about the continuity of the real estate boom and should impact on future price of mining products.

I use the estimated model to simulate my counterfactual of interest: a perfect foresight economy in which the duration of the boom is fixed to its expected duration. Table 1 below shows how workers sort across sectors into this economy, and how it compares with the data. [TO BE COMPLETED WITH NEW RESULTS!]

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[4]It could also be because of differences in future values. By choosing the right sector pairs and assuming the existence renewal actions, future values can be net out. This is discussed in detail in Section ??. See Scott (2014)

[5]See Figure 1a for why I interpret the 2011-2019 as still being part of the mining boom.

Table 1: Comparison between data and counterfactual without uncertainty
Averages 2011-19

| | % of employment | | Relative wage | |
| --- | --- | --- | --- | --- |
| | Data | Counterfactual | Data | Counterfactual |
| Manufacturing | | | | |
| Mining | 3.3 | 6 | | |
| Agriculture | | | | |
| Construction | | | | |
| Other services | | | | |

**Related literature.** A huge literature has studied labor reallocation after shocks to labor demand that are localized in some sectors or regions. An important strand of this literature has studied labor reallocation following shocks to import competition (Topalova, 2010; Autor et al., 2013; Dix-Carneiro and Kovak, 2017, 2019; Caliendo et al., 2019). Recent papers have argued that sector-specific human capital accumulated on-the-job helps explain why labor reallocation following these shocks can be slow and the heterogeneous responses across workers (Dix-Carneiro, 2014; Traiberman, 2019). An important ingredient in these models is that human capital is not perfectly transferable across sectors, which links them to specific-factor models of trade (Jones, 1971; Mussa, 1974). I build directly on these papers by assuming sector-specific human capital acquired on-the-job. My contribution is to study a very different setting in which boom-bust dynamics are salient and duration uncertainty arises as a potential driver of labor supply decisions.

A key element in this paper is uncertainty about duration. A strand of the literature in trade has studied a similar problem for firms in the US and China during the 1990s, when China's access to low tariffs when exporting to the US had to be renewed yearly by Congress. This uncertainty, which eventually got resolved in 2001 when China entered the WTO, can be seen as uncertainty about how long the low-tariff regime would last. Studies have focused on how uncertainty affected the entry and exporting decisions in China and, indirectly, on US labor markets (Handley and Limão, 2017; Pierce and Schott, 2016). At the conceptual level, a key difference is that in the settings they study uncertainty can only increase the value of waiting. In the context I study, the problem of the worker looks like a call option and this may induce risk-loving attitudes towards duration uncertainty (Dixit and Pindyck, 1994). The results in this paper indicate that the reduced-form results in Pierce and Schott (2016) are potentially a mix of changes in both labor demand and labor supply.

Given my empirical focus on the mining boom in Australia this paper also contributes to the varied literature on commodity cycles. This paper is more closely related to studies focusing on the effects on workers, none of which studies the interaction between human capital accumulation and duration uncertainty (Kline, 2008; Adao, 2016; Benguria et al., 2021). At the macro level, a strand of the literature has concludes that commodity cycles are an important driver of business cycles in emerging economies (Fernández et al., 2017; Drechsel and Tenreyro, 2018). Another strand of the

literature focuses instead on 'Dutch-disease' effects, whereby commodity booms can have a negative effect on long-term income (Corden and Neary, 1982; Allcott and Keniston, 2018). In all of these, a key ingredient is that factors can reallocate between tradable sectors. I focus precisely on that reallocation and highlight duration uncertainty as one of the elements that may be salient in these episodes.

In terms of estimation I follow closely the approach in Traiberman (2019), who builds on a huge literature in industrial organization and labor (Rust, 1987; Lee and Wolpin, 2006; Arcidiacono and Miller, 2011). Lastly, this paper builds on the time series literature on commodity super-cycles, which has documented low-frequency cycles which can be very big in magnitude, making them an interesting setting in which to study boom-busty dynamics with uncertainty about duration (Erten and Ocampo, 2013).

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