Stephan analyzes the interaction between job market prospects and scientific productivity in the sciences. She argues that dismal job prospects (will) reduce considerably entry of highly talented young researcher into an academic career. Stephan focusses on the US and she discusses some developments in Italy and Germany.

Being a labor economist, I think this is a very interesting and needed study because it discusses the important relationship between scientific progress and individual job prospects of the researchers. Scientific progress cannot be produced without suitable incentives (career prospects) for the researchers. This is particularly critical for basic research (nobel prize winning research is only the tip of the iceberg) typically not involving immediate commercial returns.

1 Critical Assessment of Analysis for US

Stephan argues that job prospects for PhDs in the sciences have deteriorated tremendously over the recent decade. The implicit contract between PhD and full professors/research universities, involving remuneration of a successful, hard working PhD/assistant professor by eventual tenure in an academic (university) job has not paid off for an increasing share of the PhDs. The increasing supply of completed PhDs in the US has in fact resulted in universities hiring more cheaper postdocs and less more expensive assistant professors on tenure–track positions. These

1 These comments are based on my discussion of Paula Stephan’s paper presented at the conference ‘Scientific Competition: Theory and Policy’ in Saarbrücken, October 2005. I am grateful for helpful comments by Dominique Demougin, Martin Kolmar, and other conference participants. I thank Marie Waller for excellent research assistance. All errors are my sole responsibility.

2 Here, I talk about the sciences when Stephan refers to physical, life, and mathematical sciences including engineering.
changes threaten the viability of the implicit contract and, in response, Stephan predicts a severe decline in the willingness to do a demanding PhD in the future.

Clearly, at face value, this argument relies on irrational behavior of the recent cohorts of PhDs because their expectations regarding the implicit contract have not been realized on average. Stephan argues that such irrational beliefs could have been reinforced by a culture of gift exchange where postdocs could be lured into believing for a while that they will eventually would get a tenure–track position. Only with delay, these postdocs would realize that this expectation will not materialize. As soon as students in the sciences fully realize that these promises are broken, the supply of PhDs will decline considerably.

I am inclined to investigate potential explanations not relying on irrational behavior. For a rational explanation, the difficulty is to explain the strong increase in supply of new PhDs despite the deterioration of the tenure prospects. I will investigate the following two arguments: (1) Increasing supply of foreigners obtaining PhDs in the US. (2) Good job prospects in industry for PhDs.

Both arguments are also discussed by Stephan, though under a different perspective. The first argument is based on the presumption that foreign students still find graduate education in the US very attractive, even if chances for tenure–track positions have deteriorated. Foreign students often prefer staying in the US after completion of their PhD because of better job prospects in the US outside of academia compared to job prospects in their home countries. Postdoc positions are a simple way to extend the stay in the US and to find an attractive job. The huge supply of foreign graduate students is likely to fuel basic research in the US by filling the labs with highly educated and motivated postdocs, unless of course incentives to engage in basic research change themselves as Stephan indicates.

Turning to the second argument, even in the early 1990s almost 90% of biomedical PhDs could not get a tenure–track job (Figure 1 in Stephan’s
paper). Thus, the majority of PhDs must eventually end up in industry jobs which are likely to be quite attractive because these jobs often combine applied academic research with high salaries.\textsuperscript{3} This is confirmed by the discussion in section 4 of Stephan’s paper. It seems plausible that a large number of biomedical PhDs in the US saw only small chances to end up in a tenure–track position. Instead, they view obtaining a PhD and working in a low–paid postdoc position mainly as an investment for their eventual career in industry.

In the face of an increasing supply of PhDs, it is a rational response of universities to change hiring policies such that young researcher obtain more temporary positions with lower salaries. These changes increase uncertainty among young researchers, which Stephan argues to lower research productivity. This trend is associated with a shift away from basic to more applied (commercialized) research.

A major problem arises nevertheless for the US, as Stephan emphasizes, if excellency and creativity (prize winning research) in basic research require independence of the researcher at an age below 40. In addition, increasing competition for tenure–track position might have an ambiguous effect on the research effort of young researchers. On one hand, one might speculate that a more competitive environment might increase incentives to do excellent research in order to get one of the rare tenure–track positions. This way the total research output increases when competition for tenure–track positions increases. On the other hand, the return to research effort declines with the number of competitors, as standard tournament theory suggests, because chances to obtain a tenure–track position (≡ the prize in the tournament) declines at a given level of research effort. In light of the declining returns to the tournament for the tenure–track positions, the share of PhD students engaged in this tournament declines and more of them will focus on applied research.

\textsuperscript{3}It is straightforward to develop an economic model of the decision to obtain a PhD where the degree involves two career alternatives: First, PhDs are eligible to apply for a tenure–track position in academia. Second, they might obtain a well paid research job in industry. Ceteris paribus, an increasing number of PhDs can be explained rationally by the second alternative becoming more attractive, even if the first alternative loses in option value.
enhancing their chances for a well paid position in the industry.

Summing up, the increasing supply of PhDs in the sciences in the US by itself might not reflect irrational behavior but rather the immigration of excellent young researchers to the US and the good job prospects of PhDs in industry. It is not clear that these two effects are going to lose importance in the near future. Thus the only concern might be that young US citizens enroll to a lesser extent in PhD programs. However, the effect of the increasing supply of PhDs on total output in basic research (what is the research production function?) is ambiguous. A related open question is whether the top PhDs still strive and obtain the tenure–track positions allowing them to do basic research. Thus, I am not convinced that the amount of basic research will decline dramatically.

2 The situation in Italy and Germany

I think that the situation in Italy and in Germany is very different from the US and therefore, Italy and Germany can not be used as further examples for the arguments put forward for the US. According to Stephan, Italy has turned into a closed shop with basically no (!) hiring of researchers into tenure–track positions in the sciences. Here, the job prospects are clearly so bad that excellent Italian researchers tend to leave the country (e.g. for the US).

The remainder of this section focusses on the situation in Germany. Stephan addresses first the fact that the ratio between Habilitationen and the number of professorships increased considerably between 1992 and 2004 from roughly 3/2 to 5/2 (referring to the numbers in the paper by Schulze and Warning in this volume). However, one should be aware that this might be a cohort effect because a disproportionately large number of older professors are due to retire between 2000 and 2010. Nevertheless, it is likely that prospects to obtain a tenured posi-

4Traditionally, completing a Habilitation was a formal requirement to be considered for a tenured professorship.
tion have deteriorated over the last 15 years. In the early 1990s, many professorships had to be refilled in East Germany. Nowadays, budgets are very tight and a number of professorships are cut or will be cut by the government.

I have run a small exploratory survey about the job prospects among six young researchers in economics and sociology in Germany (for the sake of brevity, I can not report the detailed results here - it goes without saying, that six responses are not sufficient for statistically valid results).

The following answer in the survey:

“What I find worrisome is the current “overproduction” of young researchers due to the promotion of graduate programs and also of post-docs. Combined with a probable decrease in tenured positions and an increased net import of researchers, this may force many of my generation to drop out of academia ...”

confirms at first glance Stephan’s point that job prospects have deteriorated in Germany in a similar way as in the US. There is, however, a major difference between Germany and the US. In Germany, the average age after completion of the Habilitation is above 40. At this age, it is much more difficult to start an alternative career in industry compared to a postdoc a couple of years after completion of the PhD in the US.

In principle, the introduction of the junior professur without the requirement of a Habilitation as the equivalent of the assistant professur should lead to more independence of young researchers. The time limit imposed by the German government should lead to earlier transitions to tenured positions. However, in contrast to the US system, junior professors typically do not have a tenure–track position.

The change of the salary system from the C-system to the W-system involves a considerable decline of the base salary and flexible increases of the salary based on performance. However, upward salary flexibility is severely limited by tight budgets, in fact rendering the new pay system less attractive, especially for those who start their academic career under
the new system.

In the short run, again as a cohort effect, the introduction of the W–system might improve job prospects of young researchers as indicated by the following answer in my survey:

Due to the changes in the salary system, the competition from tenured professors from inside Germany is reduced.

This is because established professors find it less attractive to change jobs under the new W-system.

Overall, as Stephan concludes, an academic career in Germany is likely to become less attractive because of the decline in salaries. The positive incentive effects of the new W-system can only work if universities have sufficient resources to honor performance and if the junior professor becomes a true tenure-track position.

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