Talent Management Under Uncertainty

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Firms often face significant uncertainty about their future conditions. How do persistent differences in this uncertainty shape a firm's workforce and its human capital? A common view is that uncertainty reduces firm hiring and employment. In this paper, I study the idea that firms with skill-intensive operations have incentives to increase their skilled workforce when faced with uncertainty. Using a simple theoretical framework, I illustrate why these incentives can be important when training and learning by new workers take time (i.e., there is a human capital lag). When this is the case, a firm's current skilled workforce (previously hired and trained) determines its ability to expand in response to new opportunities, providing a growth option that becomes more valuable with uncertainty. To empirically analyze this idea, I develop a new approach to isolate the effect of persistent shocks to the volatility of importers' firm-specific exchange rates. In the context of Brazil, I combine this approach with detailed plant- and worker-level data. This allows me to examine how these uncertainty shocks shape firms' employment through different margins at a granular level (e.g., hiring of certain types of workers for jobs in specific plants). Higher uncertainty about operating costs leads the average firm to reduce its total hiring and employment. However, firms with skill-intensive plants significantly increase their skilled workforce by hiring new high skilled workers for jobs in these plants. These positive effects of uncertainty on hiring are consistent with the mechanism proposed in this paper. For example, these effects are not present for low skilled workers in skill-intensive plants or jobs outside of these plants, and they are driven by skill-intensive plants located inside smaller firms. I discuss how this mechanism is also consistent with firm surveys, anecdotal evidence, and previous research. Overall, the analysis suggests how operating in an environment with higher uncertainty can lead firms to increase their demand for talent and expand the human capital of their workforce.

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Firms often face significant uncertainty about their future conditions. An important part of this uncertainty reflects persistent differences across economic environments in their (lack of) predictability.[1] How do persistent increases in uncertainty affect a firm's workforce and its human capital? A common view is that uncertainty reduces firm hiring and employment. For example, when faced with uncertainty, firms can have incentives to delay hiring decisions that are costly to reverse. Uncertainty also increases the risks and financing costs associated with the expansion of a firm's workforce, as hiring new workers can be interpreted as an investment associated with initial search and training costs. Moreover, in the presence of higher uncertainty, firms should also find it more expensive to have higher fixed wage costs and become more exposed to episodes of financial distress where they might lose previously trained and hard-to-find workers.[2] Intuitively, it is plausible to expect these effects to be especially relevant for high skilled workers, leading to a negative effect of uncertainty on a firm's skilled workforce. This negative effect can have important economic implications as skilled workers are commonly associated with innovation, productivity growth, the use of new technologies, and positive spillovers to the economy (e.g., Lucas (1988), Moretti (2004), Gennaioli et al. (2012), and Acemoglu et al. (2018)).

In this paper, I study the idea that firms with skill-intensive operations can have incentives to increase their skilled workforce in an environment with greater uncertainty. The motivation for this idea is the notion that, when firms have skill-intensive operations (e.g., because of the technology they use), on-the-job training and learning by new workers can be important and take significant time. In the presence of such lag, firms cannot quickly expand their workforce's human capital and production in response to new opportunities. Instead, they need to largely rely on their current skilled workers (previously hired and trained) when faced with these opportunities. Therefore, the value of having a larger skilled workforce can increase with uncertainty. On the one hand, a larger pool of skilled workers allows firms to take better advantage of the increased opportunities (upsides) associated with higher uncertainty. On the other hand, the downside of having a larger skilled workforce when future opportunities do not arrive is limited by firms' ability to fire these workers or scale down production (not using its full production capacity). Intuitively, when this human capital lag is important, a skilled workforce provides firms with a growth

[1] For example, see the World Bank's *World Development Report 2014*, which highlights how firms face a range of micro and macro risks. Koren and Tenreyro (2007) and Bloom (2014) discuss how measures of uncertainty are persistently larger in developing countries.

[2] For example, see Bloom (2009) and Schaal (2017) for the analysis of these incentives to delay hiring decisions that are costly to reverse (wait-and-see effects), and Hall (2017) and the references therein for the analysis of firms' hiring decisions as an investment. Arellano, Bai, and Kehoe (2019) examine the idea that uncertainty makes it more expensive for firms faced with financing frictions to have (fixed) wage costs. As discussed in greater detail below, the finance literature on the labor costs of financial distress also suggests reasons why uncertainty should reduce firms' incentives (or ability) to expand their workforce.

option that increases in value with uncertainty.[3] As discussed in Section 1, the potential importance of this idea is consistent with firm surveys, previous research, and anecdotal evidence. Firms frequently highlight talent and skill shortages as important constraints affecting them. The notion that training and learning by new workers can take time is supported by previous research and commonly mentioned in several industries. Moreover, the point that hiring and training workers ahead of time allows firms to reduce the risk of such skill shortages is also often discussed.[4]

As a first step in the analysis, I illustrate this idea using a simple framework that builds on previous research analyzing the implications of investment lags (Bar-Ilan and Strange (1996)). I adapt this analysis to examine how firms manage their skilled workforce when training and learning by new skilled workers take time, i.e., there is a human capital lag. Using this framework, I highlight the following key predictions from the idea above. First, persistent increases to the uncertainty faced by firms can lead them to significantly expand their high skilled workforce. Second, if present, these positive effects of uncertainty on high skilled employment should be concentrated on skill-intensive plants. Moreover, these effects should not be present for the low skilled workforce of skill-intensive plants as these workers do not need to be hired and trained well in advance (the human capital lag is not relevant for them). Indeed, the expansion of high skilled workers in skill-intensive plants can lead to a (partial) substitution of low skilled workers and reduce the low skilled workforce in these plants. As discussed in Section 1, this simple framework also helps illustrate the key conditions required for the previous idea: a lag associated with expansions in the human capital of a firm's workforce and limits on a firm's ability to scale up its production without an expansion of this human capital.

A fundamental challenge to empirically analyze these predictions is isolating the effect of persistent shocks to firm-level uncertainty. For example, shocks to firms' uncertainty about future costs might be associated with shifts in firms' beliefs about the average value of these costs. Another important challenge to examine these ideas is the availability of detailed worker- and plant-level data. This data is needed as these positive effects of uncertainty on firms' skilled workforce should be driven by a subset of workers with jobs at specific plants. To address these challenging issues, I develop a new empirical approach to

[3] The traditional intuition that firms have incentives to delay investments when faced with uncertainty (Bernanke (1983), Dixit and Pindyck, (1994)) can be reversed here because delaying the investment in the presence of a lag is costly. Specifically, if the firm waits and delays the investment today, it might be too late to invest tomorrow, and the firm might miss future opportunities to scale up production.

[4] Worker training and learning should be important when firms need skills that are in limited supply outside the firm. The significance of this skill or talent shortage is supported by firm surveys across different countries such as the U.S., China, Germany, India, and Brazil (see Section 1). While this evidence suggests that talent shortages became more pronounced after the recent pandemic, it also suggests that these shortages have been important for many firms prior to the pandemic (including firms in the empirical setting here analyzed). In surveys, firms typically mention training and on-the-job development as their main strategies to address these shortages.

construct persistent shocks to firm-level uncertainty and combine it with unique worker- and plant-level data to study the effects of these shocks at a granular level.

The empirical approach developed in this paper constructs persistent shocks to the volatility of importers' firm-specific exchange rates that are orthogonal to shocks to the level of these exchange rates.[5] Individual importers are exposed to firm-specific exchange rates as they import from different countries of origin, and these exchange rates directly affect the price of their inputs and operating costs. My approach builds on the implications for different importers of a transition in the exchange rate system from a fixed exchange rate into a floating exchange rate. Suppose that a country's currency is initially pegged to the dollar. In the initial regime, the exchange rate will be fixed (or close to fixed) for firms importing from countries with an exchange rate that has a low volatility with respect to the dollar (labeled as the dollar volatility of the importer). For example, firms importing from the U.S. will have low dollar volatility and initially face a fixed exchange rate. On the other hand, importers with higher dollar volatility will have an initial exchange rate closer to a floating exchange rate. For example, firms importing from Germany will have higher dollar volatility and a floating exchange rate in the initial regime. When there is a transition to a floating regime, all importers move into a floating exchange rate, but this shock is stronger for importers initially closer to a fixed exchange rate (as opposed to those already with a floating exchange rate). Consequently, the increase in exchange rate volatility after this regime shift is stronger for importers with lower initial dollar volatility.

Crucially, firms' initial dollar volatility should not predict differences across importers in the shock to the *level* of their exchange rates around the regime change. Going back to the previous example, consider the differential effect of the regime change on the level of the exchange rate of firms importing from the U.S. (low dollar volatility) versus Germany (higher dollar volatility). Relative changes to the level of their exchange rates are determined by the foreign exchange rate between the U.S. and Germany (the Dollar to Euro exchange rate). If the change in exchange rate regime is determined by domestic events, not associated with changes in these foreign exchange rates, importers with different initial dollar volatilities should experience similar shocks to the level of their exchange rates, i.e., their exchange rates should depreciate or appreciate by similar amounts after these domestic events (see Section 3 for more details).

When analyzing the effect of shocks to firm exchange rate volatility, I build on the fact that firms relying more on imports have operating costs that are more exposed to this volatility. Specifically, I combine initial

[5] Following the literature, I refer to persistent shocks to volatility or uncertainty interchangeably as capturing persistent changes to the variance of a variable shaping firms' operating conditions (here their firm-specific exchange rate). Firm-level volatility represents an economically important source of uncertainty faced by firms (e.g., Schaal (2017)).

differences across importers in both their dollar volatility and their reliance on imports to construct persistent shocks to their exposure to exchange rate volatility (uncertainty shocks). When estimating the effect of these shocks, I contrast decisions across importers before versus after the shocks take place and rely on a triple difference (post × low initial dollar volatility × initial import reliance). In principle, differences across importers in their initial dollar volatility could predict their exposure to other economic shocks around the change in exchange rate regime, i.e., shocks different from shifts in the level of exchange rates. This empirical approach builds on the idea that such potential link between the dollar volatility and other shocks should not be asymmetrically important within firms that rely more on imports (relative to other importers). Importantly, building on the predictions from the growth-options mechanism discussed above, I refine this approach by contrasting the effect of uncertainty shocks across different types of plants and workers. As discussed below, these additional contrasts allow one to further address potential identification concerns with the empirical approach used in this paper.

This empirical approach is implemented in the context of Brazil, using plant- and worker-level data on the universe of importers with at least 50 workers in the manufacturing sector. A first advantage of this setting is the presence of an important change in the exchange rate regime from a fixed to a floating system. This change happened at the start of 1999 and was associated with a significant and persistent increase in the exchange rate volatility experienced by importers (see Figure 1). Since the currency was initially pegged to the dollar (as in the examples above), I use importers' initial dollar volatility and exposure to imports to construct uncertainty shocks. As a first step in this analysis, I confirm that importers with lower initial dollar volatility experience differential increases to their volatility that are not associated with differential changes to the level of their firm-specific exchange rates. These differential shocks to volatility are persistent and economically large: a one-standard-deviation reduction in firms' initial dollar volatility predicts an increased exposure to exchange rate volatility equivalent to 40 percent of the sample mean.

A second advantage of this setting is the availability of detailed worker- and plant-level data. This data allows one to track how firms respond to uncertainty shocks by adjusting their workforce in each plant through different margins (e.g., hiring, firing, quits of different types of workers), including the month of these adjustments around the shocks. To isolate adjustments made by firms, I analyze plants' net hiring (hiring minus firing) of high skilled and low skilled workers, but also examine net changes in plants' high skilled and low skilled workforces. Following previous research, I identify high and low skilled workers using their education and define plants as skill-intensive when they initially have a large share of high skilled workers. I consider different definitions for skill-intensive plants, including approaches to identify such plants using differences in wages across plants.[6] This data also allows me to contrast decisions across plants with different exposure to volatility within a same industry, region, and month.

When analyzing the effects of uncertainty shocks, I start by estimating the average effect of these shocks on the total net hiring (hiring minus firing) and employment of plants across all workers. Higher uncertainty about operating costs is associated with an average reduction in the total net hiring and employment of importers. This supports the idea that, in general, firms operating in an environment with higher uncertainty reduce their hiring and employment. However, consistent with the idea discussed above, when faced with higher uncertainty, firms significantly expand their skilled workforce in skill-intensive plants. These effects translate into significant increases in the skilled workforce of the firms operating these plants, as opposed to a reallocation of jobs across plants, and match the detailed predictions of the growth-options mechanism outlined above. Greater uncertainty is not associated with increases in the high skilled (or low skilled) workforce of plants that are not skill intensive. Moreover, these positive effects of uncertainty are only present for high skilled workers in these skill-intensive plants. When faced with increased uncertainty, firms do not expand their low skilled workforce in skill-intensive plants. These results are robust across a range of specifications and are also economically important. They imply that exposure to exchange rate uncertainty leads the average importer to expand its skilled workforce in skill-intensive plants by 3-5 percent (as a percentage of these plants' total workforces).

To further analyze the predictions from the growth-options mechanism, I separately estimate the effect of uncertainty shocks on the hiring and firing decisions of plants. In principle, these expansions to the skilled workforce of skill-intensive plants could be driven by increases in the hiring or reductions in the firing of these workers. Empirically, hiring and firing decisions tend to be concentrated on plants with higher and lower growth, respectively. This growth-options mechanism is only relevant when plants might want to scale up production in the future but are constrained by the limited availability of human capital. Therefore, it is plausible to expect this mechanism to primarily affect plants with a growing workforce and to matter by increasing the hiring of skilled workers. The results directly support this prediction. Additionally, it is also natural to expect this mechanism to be mostly relevant for skill-intensive plants inside smaller firms. Intuitively, when these plants are part of a larger firm, the reallocation of skilled workers (and other potential resources) inside these firms should mitigate binding constraints in the ability of these plants to quickly expand the human capital of their workforce. Therefore, these plants might have a smaller need to build a larger skilled workforce ahead of time. Consistent with this idea, I find that the positive effects of

[6] As discussed in Section 2, previous research suggests that these measures of plant skill intensity and worker skills should predict the importance of the training and learning required by newly hired workers, i.e., the human capital lag.

uncertainty on the hiring of skilled workers are only present for plants that are both skill intensive and part of a smaller firm. This effect is not present for skill-intensive plants inside larger firms or other types of plants (e.g., plants that are not skill intensive within smaller firms). At the same time, I show that the link between uncertainty effects and a plant's skill intensity is not capturing a connection between uncertainty effects and firm size or firm age. These positive effects of uncertainty do not emerge for the average plant of firms in different size or age groups. These effects are only present in the subsets of skill-intensive plants.

I then consider the persistence of these effects of uncertainty on a firm's skilled workforce. In principle, firms' shorter- and longer-term responses to the previous uncertainty shocks could be different. For example, firms' initial responses to the previous uncertainty shocks could reflect temporary adjustments by them when faced with a new regime. Alternatively, the increase in volatility could expose firms to stronger shocks over time. To address this issue, I extend the analysis to track firms' decisions across their plants during a longer (two-year) period after they transition to an environment with higher uncertainty (the baseline results focus on a one-year period). This analysis shows that the positive initial effects of uncertainty shocks on firms' skilled workforce are not reversed or significantly changed by subsequent adjustments to this workforce. The estimated cumulative effects of these uncertainty shocks on skill-intensive plants remain similar as one considers longer time horizons. These findings suggest that the previous findings capture a persistent change to firms' skilled workforces as firms operate in an environment with higher uncertainty.

As a final step in the analysis, I address important concerns that these estimated effects of uncertainty shocks could be confounded by other effects. The identification strategy used in this paper contrasts the effect of an exchange rate regime change across importers based on two factors: their initial dollar exchange rate volatility and their initial reliance on imports. One potential concern with this strategy is that firms with lower initial dollar volatility could also have a differential exposure to other economic shocks taking place around the regime change (different from changes in the level of exchange rates). If this issue is asymmetrically more important among firms that rely more on imports, relative to other importers, it could influence the estimated effects of uncertainty shocks. In additional results addressing this possibility, I estimate a robustness check which incorporates firms that are both importers and exporters. Intuitively, these firms have a greater ability to hedge their exposure to exchange rate risk from their import transactions through their export transactions. Therefore, we should expect these firms to have a smaller (or limited) exposure to exchange rate volatility from the import side of their operations. For this reason, I focus on firms that are only importers in the main results and contrast these two types of firms in this important robustness check. Consistent with this idea, I find that an increased exposure to exchange rate volatility from imports does not predict significant changes in the decisions of importers that also export. If the empirical approach used in this paper captured firms' exposure to other shocks (unrelated to exchange rates), one should expect to also find significant results among these firms with more limited exposure to exchange rates. Additionally, I show that the results in this paper remain similar across a range of specifications with different controls for firm characteristics associated with their initial dollar volatility and reliance on imports.

To further address these identification concerns, I highlight the important contrasts across the results for different types of plants and workers. As predicted by the growth-options mechanism, the positive effect of uncertainty on hiring and employment is only present for skill-intensive plants and, within these plants, is only present for the subset of high skilled workers. To drive these central findings of the paper, alternative effects also need to create a positive link between uncertainty and hiring that is uniquely relevant for these specific plants and workers and that becomes negative (or disappears) for other plants or workers. After presenting the empirical results, I build on this point to discuss the challenges faced by alternative explanations to rationalize the evidence in this paper.[7]

This paper relates to several strands of the literature and makes two main contributions. First, it analyzes the idea that an environment with higher uncertainty can increase firms' demand for talent and lead to an expansion of their skilled workforces. To the best of my knowledge, this paper is the first to provide evidence on the importance of this idea. This evidence complements previous research examining different channels through which uncertainty can reduce firm hiring and employment. For example, uncertainty can create incentives for firms to delay hiring decisions associated with sunk costs or that are costly to reverse (Bloom (2009), Schaal (2017)). It can also increase the risks associated with hiring and training workers, leading to higher discount rates on these investments (Hall (2017)). Additionally, uncertainty can lead to larger financing costs, making it costlier for firms to expand their scale or have larger wage bills (Christiano, Moto, and Rostagno (2014), Arellano, Bai, and Kehoe (2019)). The findings of this paper also relate to the finance literature on the labor costs of financial distress. Higher firm volatility should increase the risk that firms experience financial distress, what could limit firms' ability to retain or attract talent (Brown and Matsa (2016), Baghai et al. (2021)) or lead workers to demand higher wages (Berk, Stanton, and Zechner (2010), Agrawal and Matsa (2013), Graham, Kim, and Qiu (2023)). These considerations should reduce the

[7] Recall that the uncertainty shocks used in the analysis are orthogonal to shocks to the level of importers' exchange rates. However, in principle, a same shock to the level of the exchange rate across importers could have different effects on firms with higher versus lower initial dollar volatility. This possibility and the concern discussed above capture the two main potential alternative explanations for the results in the paper and are both addressed in this discussion (see Section 5).

incentives or ability of firms facing uncertainty to expand their workforces.[8] The results of this paper suggest that, when firms have skill-intensive operations, the positive effects of uncertainty on firms' demand for talent can be stronger than these negative effects highlighted by the literature. At the same time, the analysis supports the importance of these negative effects of uncertainty in the empirical setting here studied. For example, as mentioned above, I estimate that the average effect of uncertainty across firms on their total employment is negative.

The second contribution of this paper to the literature is to analyze the effect of *persistent* differences in uncertainty and develop a new empirical approach to estimate the effect of such differences. When attempting to isolate the effect of uncertainty on firms' decisions, previous research has typically examined how firms respond to shorter-term fluctuations in uncertainty. For example, some studies consider decisions prior to events where uncertainty is expected to be resolved (e.g., elections) or analyze how fluctuations in measures of uncertainty are associated with shifts in firm decisions.[9] In theory, firms' responses to persistent versus short-term increases in uncertainty are economically different. Indeed, the growth-options mechanism analyzed in this paper should be mostly relevant when firms face persistently higher uncertainty. Intuitively, when faced with temporary uncertainty that is expected to be resolved soon (e.g., prior to an upcoming election), firms will have limited incentives to gradually start building a skilled workforce. These incentives should be mostly important for uncertainty about conditions further in the future. More broadly, short-term fluctuations in uncertainty are unlikely to have the persistent effects on firms' workforces here analyzed. An important advantage of the approach here proposed is that predicted shocks to importers' exchange rate volatility are orthogonal to shocks to the level of their exchange rates, capturing the notion of a mean-preserving spread to firm conditions.

This focus on persistent differences in uncertainty connects this paper to previous work on the link between volatility and growth (e.g., Ramey and Ramey (1995)). Given the role of human capital for economic growth (Lucas (1988), Gennaioli et al. (2012)), an important concern is that firms operating in an environment with greater volatility might build a less skilled workforce. For example, this could limit the knowledge spillovers associated with a skilled workforce (Moretti (2004)) or the innovation produced by such workforce (Acemoglu et al. (2018)). The results in this paper illustrate how, in the context of skill-intensive activities, these concerns could be mitigated. These findings complement previous research

[8] More broadly, uncertainty can expose workers to greater firm risks (e.g., risk of economic failure). If firms cannot fully insure workers against such risks, uncertainty can increase firms' hiring costs.

[9] For example, see Leahy and Whited (1996), Julio and Yook (2012), Gulen and Ion (2015), Baker, Bloom, and Davis (2016), Jens (2017), Hassan et al. (2019), and Di Maggio et al. (2022). While some studies have examined the link between persistent differences in uncertainty and firm decisions (e.g., Guiso and Parigi (1999), Kim and Kung (2016)), empirically isolating the effect of such persistent differences in uncertainty can be challenging.

documenting a positive link between measures of shocks to uncertainty and R&D spending at the firm level.[10] The idea that firms are exposed to potential talent shortages and manage these risks by building a larger skilled workforce also relates previous research studying how firms manage liquidity risks using financial policies such as cash holdings (e.g., Acharya, Almeida, and Campello (2013)). As discussed in Section 6, this hiring behavior of firms under uncertainty could amplify talent shortages and potentially induce coordination failures across firms during such shortages. Finally, this paper also connects to previous research analyzing firms' demand for skilled labor (e.g., Autor, Levy, and Murnane (2003), Acemoglu and Autor (2011), and Hershbein and Kahn (2018)) as well as a literature on firms' intangible assets (e.g., Eisfeldt and Papanikolaou (2013), Peters and Taylor (2017), and Falato et al. (2022)).

1. Theoretical Framework

As a first step in the analysis, I discuss the theoretical framework used to motivate the empirical tests. I focus on presenting the main intuitions and predictions here and show a simple model formalizing them in Appendix A. The starting point for this analysis is the notion that, when firms have skill-intensive operations, on-the-job training and learning by new workers can be important and take significant time. This idea is consistent with firm surveys, previous research, and anecdotal evidence. Intuitively, worker training and learning by new workers should be important when firms need skills that are in limited supply outside the firm or face frictions when searching for workers with these skills.

The significance of this skill or talent shortage is supported by business surveys across different countries such as the U.S., China, Germany, India, and Brazil (Manpower (2011, 2023)). Specifically, many firms state that they have "difficulty finding the skilled talent they need" and describe "lack of experience", "lack of job skills", or "lack of knowledge" as primary factors for this difficulty. While this evidence suggests that talent shortages became more pronounced after the recent pandemic, it also suggests that these shortages have been important for many firms prior to the pandemic (including firms in Brazil, the empirical setting here analyzed).[11] In these surveys, firms also mention "training and development to existing staff" and "appointing people without job skills currently, but with potential to learn/grow" as primary strategies to address these shortages. Armstrong (2021) conducts interviews with U.S. manufacturing firms and finds

[10] For example, see Stein and Stone (2013) and Atanassov, Julio, and Leng (2019). This link is consistent with the idea that firms have stronger incentives to innovate more when faced with greater uncertainty and the broader relevance of the growth-options effects of uncertainty here discussed (innovation is associated with a lag). However, higher uncertainty could also affect innovation through alternative mechanisms. For example, uncertainty can lead to decreases in capital expenditures or increases in firms' skilled workforces, increasing the resources available to or the returns to investing in R&D.

[11] For example, 52 percent and 57 percent of firms in these surveys reported difficulty finding skilled talent during 2011 in the U.S. and Brazil, respectively. *Knowledge at Wharton* (January 3, 2012) discusses the skill shortage faced by Brazilian firms during this period and describes how several companies have addressed this shortage by training their workforce.

that most firms report difficulty finding skilled workers and that "firm executives consistently say that they invest in years of training for new hires" and that they "look for entry-level workers who are trainable and can grow".[12]

This importance of on-the-job training and learning is also consistent with a large body of research analyzing workers' accumulation of human capital on the job, e.g., see Sanders and Taber (2012) for a discussion of this literature. Lagakos et al. (2018) analyze wage growth patterns across the lifecycle in a broad range of countries and provide evidence on the importance of this accumulation of skills on the job in this extended setting, which also includes Brazil (where they find important effects). Previous research has also developed approaches to quantify the returns to the on-the-job experience and the time lag associated with this accumulation of skills (e.g., Yamaguchi (2012), and Lise and Postal-Vinay (2020)). These analyses suggest that it can take years for workers to develop important skills required by firms.

The theoretical framework used in this paper builds on two key assumptions regarding firms with skill-intensive operations. First, there is a lag in the ability of these firms to expand the human capital of their workforce (human capital lag). In other words, when conditions change and firms decide to expand this human capital, there is a significant delay on their ability to do so. This assumption follows from the notion above that on-the-job training and learning are important and take time. Second, these firms are limited in their ability to scale up their production without an expansion of this human capital. Specifically, as firms also rely on variable inputs for their production, there is an important complementarity between these inputs and the current human capital of their workforce. When firms attempt to produce more only using additional variable inputs, they face decreasing returns and have a limited production capacity, which can only be increased by expanding their workforce's human capital.[13] This second assumption is natural for skill-intensive firms and has a key implication that is also consistent with the empirical evidence: talent shortages should be costly for firms. When asked in surveys about the costs imposed by talent shortages, most firms describe these costs as high or medium (Manpower (2011)). Lise and Postal-Vinay (2020) estimate the costs for firms of worker skill shortages and find that they are significant.

Under these conditions, the value of having a larger skilled workforce can increase with uncertainty. In the presence of the human capital lag, firms cannot quickly expand their workforce's human capital in

[12] In another example, Sharpe and Sherlund (2016) argue that the training required by new loan officers can limit the ability of commercial banks to originate new additional loans. In the context of the technology sector, *The Wall Street Journal* (April 7, 2023) discusses how "it can take time… for [new] workers to be fully onboarded and contribute in a meaningful way".

[13] The results here discussed do not depend on a specific functional form for firms' production functions. When formalizing these ideas in Appendix A, I consider different standard functional forms that capture this complementarity between variable inputs and human capital (e.g., a Cobb-Douglas production function).

response to new opportunities. Instead, they need to largely rely on their current skilled workers (previously hired and trained) when faced with these opportunities. Therefore, the current human capital of the firm's workforce can be interpreted as an asset. The key point is that increasing this asset provides firms with growth options that become more valuable with uncertainty. To see this point, suppose the firm faces uncertainty about its future profitability, e.g., input prices are volatile and can be significantly different in the future. By expanding the human capital of its workforce today, the firm relaxes potential constraints to its production capacity in future good states of the world. The increased human capital in the future allows the firm to scale up its production by more if needed. This benefit in good states is matched with a cost in future bad states, where the additional production capacity is not needed. However, this cost is limited by the following considerations. The firm does need to use the additional production capacity in bad states, i.e., the firm has the option to not scale up variable inputs and production, keeping some unused production capacity. Additionally, the firm has the option to fire skilled workers that are not needed in future bad states. These considerations lead expansions of the skilled workforce to have a return that is a convex function of future operating conditions, e.g., future input prices. Consequently, the expected value of expanding the workforce's human capital increases when firms face greater uncertainty about these future conditions. While this effect becomes stronger when firms have the option to fire workers at some cost (an assumption that is valid in the empirical setting here studied), the qualitative predictions here analyzed do not depend on this assumption.

This result and framework build on the analysis of Bar-Ilan and Strange (1996, hereafter BS), who illustrate how investment lags can lead the value of investing to increase with uncertainty because of growth options. I adapt their framework to examine how firms manage their skilled workforce and better capture realistic features of this problem (see Appendix A). These results also connect to the ones analyzed in Hartman (1972), Abel (1983), and Caballero (1991). This literature illustrates how, under certain assumptions such as constant returns to scale and adjustment costs for capital, firms' return for investing on capital can become a convex function of output prices. The results here discussed capture a different and specific mechanism and only depend on the key assumptions described above.[14] Importantly, the growth-options mechanism here proposed has detailed predictions for the effect of uncertainty across different types of plants and workers, which are described below and tested in the empirical analysis. One intuitive way to think about this mechanism is that, in the presence of a human capital lag, firms have incentives to hire

[14] In the BS framework, firms only make a choice to enter or exit a market and operate with a fixed exogenous scale when they enter. In contrast, I model firms' joint decisions over the (continuous) size of their skilled workforce and operating scale, i.e., how much they produce and use of variable inputs. The results here discussed are valid for any degree of decreasing returns to scale and do not rely on adjustments costs for skilled labor other than the human capital lag.

ahead of future potential demand. In other words, there is an important cost associated with waiting under uncertainty: it might be too late to hire tomorrow if needed, and the firm can miss valuable future opportunities. This intuition is also consistent with anecdotal evidence.[15]

This mechanism is also related to the idea that firms engage in labor hoarding when faced with uncertainty, as firing and rehiring workers is costly (e.g., Biddle (2014)). This labor hoarding effect could lead to an expansion of a firm's workforce if the firm is expected to fire workers. However, in contrast with the growth-options mechanism, these adjustment costs should also limit firms' incentives to hire new workers (e.g., Bloom (2009)). Therefore, when hiring is more important than firing for firms (as in the empirical setting here studied), this labor hoarding effect should reduce firms' workforces.

When connecting this framework to the data, I note that there are also important reasons to expect persistent differences in uncertainty to reduce firm hiring and employment (see the discussion above in the introduction). If this positive of uncertainty on firms' demand for talent is strong enough, the net effect of uncertainty can be an increase on firms' skilled workforce. Another important consideration is that firms' demand for skills should be linked to specific tasks (Acemoglu and Autor (2011)) and performed at specific plants, where production takes place in manufacturing. A large body of research has highlighted important differences in the skill intensity of firms and establishments, which have been connected to factors such as technology (e.g., see Burstein and Vogel (2017)). If present, this positive effect of uncertainty on firms' demand for talent should be concentrated on skill-intensive plants and should not be relevant (or should be limited) for all workers outside of these plants. Moreover, within skill-intensive plants, these effects should be only present for high skilled workers. These are the workers performing tasks associated with skills that take time to develop. In contrast, firms do not need to hire and train low skilled workers ahead to time. Indeed, the expansion of high skilled workers in skill-intensive plants could lead to a (partial) substitution of low skilled workers and reduce the low skilled workforce in these plants.

2. Data, Sample, and Summary Statistics

2.1. Data Sources and Sample Construction

The information on plants, workers, and firms used in this paper comes from two main data sources. The first main data source is the labor force record RAIS (*Relação Anual de Informações Sociais*) from the

[15] For example, when discussing hiring decisions in the technology sector in face of talent shortages, *The Wall Street Journal* (April 7, 2023) explain that firms "were hiring ahead of demand", that "it can be prudent [for firms] to make long-term bets on roles that are… hard to hire", and that companies "hire… to have a reserve of talent". In the context of talent shortages in Brazil, *Knowledge at Wharton* (April 6, 2011) explains that "some sectors saw the skills shortage coming and are managing [it] … before it gets out of hand". The Internet Appendix presents additional examples, including advice by consultants for firms.

Brazilian labor ministry. Every employer in Brazil is required by law to annually report detailed information on workers and establishments to RAIS. The primary role of this record is to provide information for a federal wage supplement program. But this record is also used as a main source of information by the labor ministry and other government agencies to track the Brazilian formal labor market. For each year, the unit of observation in this report is a job, which is uniquely identified by worker- and plant-level identifiers combined with start and end dates. The start and end dates are the months in which a job starts and ends, respectively. As a worker transitions across different plants during a year, even if across plants from the same firm, different job observations are reported. This allows one to construct a list of all workers with jobs in an establishment (plant *p*) in each month (month *t*). Moreover, for each job, the data also provides information on the average wage during the job as well as on worker characteristics such as education. Therefore, one can measure monthly values for the employment of different types of workers in these plants.[16] My initial sample covers the universe of manufacturing firms with at least 50 employees (total firm employment), including all their plants for each month between 1997 and 2000. This database has information on all workers for each plant-month. I define firms' industry (equivalent to 3-digit SIC code) and location (state) as the industry and state, respectively, with the greatest share of the firm's employment. These definitions are constructed annually using average values during each year.

An important feature of this data is that it provides detailed information on job flows (creation and destruction of jobs) for each plant and worker. Specifically, in addition to determining the timing (month) and location (plant) of each job creation and destruction, one can observe if workers were fired or left for other reasons (mostly quits) and whether new workers in a plant are new hires or were transferred within the firm.[17] This allows me to track different margins through which firms adjust their employment in each plant as well as link these adjustments to specific types of workers.

The second main data source used in the paper is the administrative record of every legally recorded import and export transaction by Brazilian firms. This customs data (*SECEX*) can be matched to RAIS at the firm-year level and is also available between 1997 and 2000. For each import and export transaction

[16] The ministry of labor estimates that the RAIS records cover well above 90 percent of formal workers in Brazil near the sample period. The analysis in this paper focuses on the manufacturing sector which intensely relies on formal workers and anecdotal evidence suggests that this is particularly true for largest firms. Carvalho (2014) finds evidence that firm level employment constructed using this database for manufacturing firms is strongly related to independent measures of firm employment from surveys of manufacturing firms by the Brazilian statistical agency (IBGE). Previous research has also found that this data exhibits many of the same properties found in employee-employer matched datasets for France and the United States. See Helpman et al. (2017) and the references therein for additional details and checks on this data.

[17] Firing decisions can be separated from other separations because firms must pay fines when they fire workers. These fines are waived if the worker quits the job or is fired because of misconduct (as defined by the law). For each separation, the data reports whether such fine was paid or not.

associated with a firm-year, I can observe the value of this transaction and the country of origin (import transactions) or destination (export transactions). I use this customs data to construct annual measures of the value of import and export transactions for individual firms. I normalize firms' total imports and exports by their total revenues. Information on firm revenue is not available from the previous data sources. While normalizing these variables, I measure firms' total revenues by combining firms' total employment with annual information on the ratio of the total value of shipments to the total employment for their industry. This last information is available from the annual survey of manufacturers (PIA) from the Brazilian statistical office (IBGE). I also use this data on import transactions to construct measures of firm-specific exchange rates. As explained below, firm-level exchange rates combine information on firms' import shares from different countries of origin with data on the exchange rates for these countries. Daily exchange rates for different currencies relative to the U.S. dollar are obtained from Datastream and linked to daily exchange rates for the Brazilian real relative to the U.S. dollar from the Brazilian central bank.

When constructing the final sample used in the analysis, I start with the initial sample of manufacturing plants described above. The unit of observation in this database is a plant-month. The exchange-rate regime change used in my analysis takes place during January 1999. In the main sample, I focus on the two years surrounding this shock (1998 and 1999). After excluding the month of the regime change, I combine two symmetric 11-month periods around the shock (February-December of both 1998 and 1999). In additional analyses, I extend this sample period to also include 2000. Firm initial characteristics are measured at the start of 1998 (January) and only firms present between this date and the start of 1999 are included. The analysis focuses on the response of firms to shocks and this allows one to track them before and after these shocks take place. I include all plants from these firms present right before the shock (end of 1998) and measure plants' initial characteristics at this same point in time.[18]

Since the empirical approach focuses on changes to the firm-specific exchange rates of importers, I focus on firms with some import transaction during 1998. When measuring both the initial importance and the country composition of imports for each firm, I use import values from 1998. In contrast with other firm characteristics, these variables cannot be precisely measured using only information at the start of the year (initial month) as import transactions are spread across the year. As an alternative approach, I also construct these variables using import values from 1997. The initial importance of exports for firms is measured in an analogous way using exports from 1998. In the main sample, I exclude importers with initial exports. In

[18] Given plant entry and exit, this allows one to include most plants present when the shock is initiated. In the Internet Appendix, I show that the main results in the paper remain similar using different approaches. For example, I include only plants present at the start of 1998 and measure plant initial characteristics at that point. Alternatively, I include all plants present at any point in 1998 and measure their initial characteristics using average values during 1998 (before the shock).

robustness checks, I analyze a sample of importers that are also exporters. Intuitively, these firms have a greater ability to hedge their exposure to exchange rate risk from their import transactions through their export transactions. This should limit their exposure to exchange rate volatility from the import side of their operations.[19] After imposing these restrictions and requiring firms and plants to have non-missing values for the main variables used in the analysis, I arrive at the final sample. This sample has 90,882 plant-month observations covering 5,184 unique plants from 2,007 unique manufacturing firms (importers).

2.2. Skill- Intensive Plants and High Skilled Workers

An important part of the empirical analysis is identifying skill-intensive plants and high skilled workers. Building on previous research, I identify high skilled workers using their education and capture skill-intensive plants as plants with a high share of educated workers (e.g., see Acemoglu and Autor (2011), Burstein and Vogel (2017) and the references therein). One way to motivate this approach is to interpret plants relying more on educated workers as plants with greater requirements across skills in general, including skills developed through work experience by training and learning on the job. This motivation builds on traditional analyses of human capital, where it is common to assume that workers have an overall skill, that could be specific to an occupation but combines different factors into a one-dimensional skill, e.g., Keane and Wolpin (1997). Education has been highlighted as a key determinant of worker skill by previous research.

However, skills can be multidimensional, and education might capture a subset of worker skills. Another way to motivate this approach is to note that educated workers are associated with an important subset of skills (cognitive skills) and that work experience should be especially important for the development of these specific skills (as opposed to manual or interpersonal skills). Indeed, a growing body of evidence has suggested that the accumulation of human capital on the job and the human capital lag are mostly important for cognitive skills and educated workers (e.g., Bagger et al. (2014), Yamaguchi (2012), Lagakos et al. (2018), and Lise and Postal-Vinay (2020)). Therefore, skill intensive plants can be interpreted as plants with tasks that require more cognitive skills, which take time to build.[20] In principle, one could try to

[19] In principle, one could also construct a sample of exporters without imports. These firms would be exposed to firm-specific exchange rate volatility associated with the countries of destination for their exports. However, in the data, there is a limited number of exporters without imports and a much larger number of importers without exports.

[20] For example, Lise and Postal-Vinay (2020) summarize their main findings in the following way: "*Manual skills are accumulated quickly on the job and have low returns. In contrast, cognitive skills are accumulated more slowly (takes time to build them) and have much higher returns. Interpersonal skills do not adjust much over time and are essentially fixed over workers' lifetime*." Manual and interpersonal skills are often described as noncognitive skills. As highlighted by Lazear (2009) and this literature, skills can be general in nature but specific to certain firms as individual firms rely on unique combinations of different types of general skills.

measure the importance of this on-the-job human capital accumulation for individual plants. However, one cannot observe this accumulation directly and inferring it for individual plants can be challenging. This literature analyzes empirical patterns (e.g., job transitions and wage trajectories) across a range of jobs and infers the importance of this accumulation for broad groups of workers and skills.

In the context of Brazil, Lagakos et al. (2018) show that the experience-wage link is much stronger (more positive) for educated workers, a pattern also that is also present across countries. Their evidence suggests that the accumulation of human capital on the job in Brazil is significant and mostly important for workers with high school or college education (see Figure 8 in their paper). In the data here analyzed, plants significantly rely on workers with high school education but the share of plant workers with college education is typically small (the average share is 10 percent in the final sample). Motivated by these facts, I define skill-intensive plants using their initial share of workers with high school education (*IPLaborSkill*). The analysis uses subsamples of skill-intensive plants and other plants to separately estimate the main empirical specification in each of these subgroups. *Skill-Intensive Plant* is an indicator that equals one if *IPLaborSkill* is above the sample median. In robustness checks, I also define skill-intensive plants using several alternative cutoffs as well as consider continuous differences in plant skill intensity (see Section 4.2). Additionally, I also consider measures of skill-intensive plants based on their initial average wage across workers. Finally, I identify high skilled workers as workers with high school education. In the theoretical framework presented in Section 1, I interpret high skilled workers as the workers performing skill-intensive tasks in the plants where these tasks are located (skill-intensive plants). These are the workers inside skill-intensive plants that might need significant on-the-job learning and training. Low skilled workers are defined as workers without high school education (all other workers).

2.3. Measuring Adjustments to Plants' Workforces

Using the detailed information on job flows (creation and destruction of jobs) for each plant and month, I track how firms adjust their workforce through different margins over time. To isolate adjustments made by firms, I analyze net hiring (hiring minus firing) decisions at each plant, but also examine net changes in plants' workforces. I construct these adjustments for three groups of workers in each plant: all workers, high skilled workers, and low skilled workers.

When measuring these adjustments, I follow Davis and Haltiwanger (1999) and compute them as the ratio of flows between two periods to the average employment across these periods. Specifically, I define *Avg Emp* as the average employment of a plant between months t-1 and t. *Total Net Hiring* is the ratio of the plant's net hiring (hiring minus firing) across all workers during month t to *Avg Emp*, where this net hiring is the difference between all workers hired and fired at the plant during month *t*. *Total Emp Growth* is the ratio of the plant's total employment change to *Avg Emp*, where this employment change is the difference between the plant's total employment during months *t* and *t-1*.[21] The adjustments for high skilled workers are constructed in the following way. *High Skilled Net Hiring* is the ratio of the plant's net hiring of high skilled workers during month *t* to *Avg Emp*, where this net hiring is the difference between the numbers of high skilled workers hired and fired at the plant during month *t*. *High Skilled Emp Growth* is the ratio of the plant's high skilled employment change to *Avg Emp*, where this high skilled employment change is the difference between the plant's high skilled employment during months *t* and *t-1.* These variables are also constructed for low skilled workers following the same steps used for high skilled workers. I annualize all these variables capturing monthly flows by multiplying them by twelve.

Note that these variables for high and low skilled workers are scaled by the total employment of the plant as opposed to the number of workers in these worker subgroups. This allows one to track adjustments to these types of workers for any active plant, including the years where plants are opened and closed. For example, suppose a plant is active (has workers) in years *t* and *t*-1 but chooses to have no skilled worker during both these years. This measure allows one to track this decision not to expand the plant's skilled workforce and incorporate it into the analysis. Moreover, as different adjustments are scaled by plants' total workforce, one can directly compare the magnitude of results across these different margins. In robustness checks (see Section 4.2), I show results where adjustments for high (low) skilled workers are scaled by plants' high (low) skilled employment. In additional variables, I separately analyze plant hiring, firing, and other adjustments (mostly quits) for these same types of workers (see Section 4.3).

2.4. Firm Exchange Rate Volatility

The analysis examines differences across importers in firm-specific exchange rates. Intuitively, as firms import from different countries of origin, they are exposed to exchange rates with different foreign currencies. Shocks to these exchange rates should have significant effects on importers' input prices and operating costs. Indeed, in the Internet Appendix, I provide direct support for this idea by analyzing firms' responses to such exchange rate shocks. Specifically, changes in importers' exchange rates are defined as the weighted average of the log changes in the exchange rates for their countries of origin. The weight for each country of origin is given by the share of the firm's total imports coming from that country. Firm

[21] As discussed by Davis and Haltiwanger (1999), there are multiple advantages of scaling these flows by *Avg Emp*, e.g., this allows one to measure these flows even when the plant is being opened or closed (incorporating extensive margin effects) and places bounds on the value of these ratios (limiting outliers). Workers hired (fired) in month *t* are included in (excluded from) the plant's employment during month *t*, what ensures the consistency between the net hiring and employment growth variables.

exchange rate volatility captures the volatility of these shocks to firm-specific exchange rates. When this volatility is higher, the variance of these shocks to future operating costs is larger. Following the literature, I refer to persistent shocks to volatility or uncertainty interchangeably as capturing persistent changes to the variance of these shocks. The analysis considers changes in this volatility across two periods: before and after an exchange rate regime change (periods described in Section 2.1). I calculate firm exchange rate volatility for each firm-period in the following way. First, I determine import country shares using the total value of the firm's imports from each country of origin during the period. This provides weights that are fixed for the firm-period. Using these weights, I track daily changes to the importer's exchange rate during the period and calculate the annualized standard deviation of these daily changes in each month. To annualize the standard deviations of daily changes in the exchange rate, I multiply them by $\sqrt{250}$. Firm exchange rate volatility (*Firm ERVol*) is the average value of this standard deviation across all months during the period.

The empirical approach used in this paper examines differences across firms in the initial volatility of their dollar exchange rate. For each country of origin for imports, this dollar exchange rate is the exchange rate between the country's currency and the U.S. dollar. Firm-specific dollar exchange rates are constructed in the same way as before using the dollar exchange rates for each country of origin. In my main analysis, I measure the initial volatility of firms' dollar exchange rates (*IFDollarERVol*) using values for 1998, the year before the regime change. I follow the same approach outlined above with fixed weights based on firms' import shares during this year. In robustness checks (see Section 4.2), I construct an alternative measure of firms' initial dollar volatility using import shares from 1997.

2.5. Summary Statistics and Additional Variables

Table 1 presents the summary statistics for the main variables used in the paper. Panel A shows summary statistics for the main sample described in Section 2.1. I construct measures of firms' and plants' initial characteristics. *IFImpRatio* is the firm's initial ratio of imports to sales. *IFEmployment* is the initial number of workers in the firm. *IFWage* is the initial average wage of these workers (monthly wage in Brazilian reais). *IFLaborSkill* is the initial share of workers with high school education in the firm. *IFYoung* is an indicator for young firms (based on their initial age). The variables *IPEmployment*, *IPWage*, *IPEmployment*, and *IPYoung* are defined in an analogous way for plants. In the Internet Appendix, I compare this sample of importers to the broader initial sample of manufacturing firms described in Section 2.1.[22]

[22] The initial periods used to measure firm and plant initial characteristics are described in Section 2.1. I define firms and plants as young if they were created (first appear) after the start of 1995 (when the information on the timing of this entry becomes

3. Empirical Approach

3.1. Basic Idea: Shocks to Firm-Level Exchange Rate Volatility

The basic idea of the empirical methodology proposed in this paper is to construct persistent shocks to the volatility of firm-specific exchange rates that are orthogonal to changes in the level of these exchange rates. To do so, I consider a change in the exchange rate regime system from a fixed exchange rate (dollar peg) into a floating exchange. In this initial regime, the exchange rate will be fixed (or close to fixed) for firms importing from countries with exchange rates that have a low volatility with respect to the dollar, i.e., low dollar volatility firms. For example, firms importing from the U.S. have low dollar volatility and initially face a fixed exchange rate. In contrast, importers with higher dollar volatility will have an initial exchange rate closer to a floating exchange rate. For example, firms importing from Germany will have a higher dollar volatility and a floating exchange rate in the initial regime. When there is a transition to a floating regime, all importers move into a floating exchange rate, but this shock is stronger for importers initially closer to a fixed exchange rate (as opposed to those already with a floating exchange rate). Consequently, the increase in exchange rate volatility after this regime shift is stronger for importers with a lower initial dollar volatility.

A key point is that firms' initial dollar volatility should not predict differences across importers in the shock to the *level* of their exchange rates around the change in regime. Going back to the previous example, consider the differential effect of the regime change on the level of the exchange rate of firms importing from the U.S. (low dollar volatility) versus Germany (higher dollar volatility). Relative changes to the level of their exchange rates are determined by the foreign exchange rate between the U.S. and Germany (the Dollar to Euro exchange rate). If the change in exchange rate regime is determined by domestic events, not associated with changes in these foreign exchange rates, importers with different initial dollar volatilities should experience similar shocks to the level of their exchange rates, i.e., their exchange rates should depreciate or appreciate by similar amounts after these domestic events.

In Appendix B, I formalize these ideas and illustrate how they can be interpreted in the following way. Domestic shocks capture one source of exchange rate volatility faced by importers (domestic currency risk) that significantly increases after the regime change and affects all importers symmetrically. However, the dollar peg creates an asymmetry in the exposure of importers to shocks to the dollar (dollar risk). When the dollar appreciates (or depreciates), firms importing from countries with high dollar volatility (currencies

available). Importers and their plants tend to be more skill intensive and larger (on average) than other manufacturing firms. However, this sample of importers covers firms and plants across a broad range of skill intensities.

not tied to the dollar) are significantly exposed. On the other hand, these dollar shocks are limited for importers facing foreign currencies that are linked to the dollar (low dollar volatility). Intuitively, these differences in dollar volatility across foreign currencies can reflect alternative exchange rate regimes or capture other factors (see Appendix B). When the regime switches, this translates into asymmetric changes in dollar risk across firms. Firms with low dollar volatility become significantly exposed to dollar risk as the domestic currency now adjusts (appreciates or depreciates) relative to the dollar. In contrast, this increase in dollar risk is muted for firms with higher dollar volatility. As the dollar appreciates (depreciates) with respect to the domestic currency, it also appreciates (depreciates) relative to the foreign currency (country of origin for imports) for these firms. This limits the effect of dollar shocks on the exchange rate between the domestic country and the country of origin, i.e., these firms are hedged against the increased dollar risk. Therefore, the increase in dollar risk is concentrated among firms with lower dollar volatility.

3.2. Exchange Rate Regime Change

I describe the exchange rate regime change analyzed and document changes in the volatility and level of firm-specific exchange rates around this event. The analysis focuses on the exchange rate regime change that takes place in Brazil in January of 1999. At the time, Brazil had experienced a long period with the domestic currency largely pegged to the dollar (since 1994). This dollar peg was part of a macroeconomic stabilization plan that successfully reduced inflation in a persistent way (Real Plan). As the plan progressed over time, many believed that the Brazilian currency was overvalued and both political and economic pressures for a transition into a floating regime increased over time. These pressures were managed by the Brazilian government for a long period and the timing of this regime change was not anticipated by market participants (Franco (2000)). This timing was shaped by political events as the regime change was announced and implemented right after the reelection of the president associated with the plan (Cardoso).[23] As discussed below, the identification strategy here developed addresses the point that this regime switch should be associated with and lead to other important economic changes affecting importers.

Figure 1 documents changes in the level and volatility of firm-specific exchange rates around this event. Panel A shows these patterns for the average value of firm exchange rate volatility (*Firm ERVol*)), which is here calculated monthly for each firm. Panel B shows these patterns separately for firms in the three terciles of initial dollar volatility (*IFDollarERVol*). The figure confirms that firms with lower initial dollar

[23] See Franco (2000) for a detailed discussion of this plan and events. For example, the central bank governor at the time explained that he did not anticipate this regime change. President Cardoso was the finance minister at the time of the implementation of the plan (1994) and his first term as president took place between 1995-1998. His second term started in January 1999 and was associated with this important policy change. This is the only exchange rate regime change in the period with available data.

volatility experience a significantly larger increase in volatility after the regime change. Consistent with the ideas explained in Section 3.1, there is a differential increase in the level of volatility (not only in percentage terms) that is persistent over time. The differential increase in *FirmERVol* between the bottom and top tercile groups represents approximately 75 percent of its sample mean. This large magnitude is also consistent with the ideas discussed in Section 3.1 (see Appendix B). Panel C then confirms that these patterns are not matched with differential changes in the *level* of firm-specific exchange rates. Firms in the three terciles experience similar depreciations to the level of their exchange rates. Table 2 (Panel A) shows these patterns using regression results. These results predict changes in the volatility and level of importers' exchange rates around the regime change using *Low_IFDVol* = -*IFDollarERVol*, where *IFDollarERVol* is the firm's initial dollar volatility. These results confirm that firms with lower initial dollar volatility experience a large differential increase in their exchange rate volatility. A one-standard-deviation drop in dollar volatility predicts an increase in *FirmERVol* equivalent to 62-63 percent of its sample mean (columns (1) and (2)). At the same time, firms with lower initial dollar volatility do not experience changes to the *level* of their exchange rates that are economically or statistically different (columns (3) and (4)).

3.3. Identification Strategy

When developing the identification strategy used in the analysis, I combine the previous changes in firm exchange rate volatility with the following important point. Firms relying more on imports have operating costs that are more exposed to exchange rate volatility. I use initial differences across importers in both their dollar volatility and their reliance on imports to construct persistent shocks to their exposure to exchange rate volatility (uncertainty shocks). Specifically, when estimating the effect of these uncertainty shocks, I rely on a triple interaction. This approach contrasts importers' decisions before versus after the change in regime. This contrast over time is interacted with the two initial conditions described above (dollar volatility and import reliance) to capture the importance of uncertainty shocks.

As documented and discussed above, the uncertainty shocks used in the analysis are orthogonal to shocks to the level of importers' exchange rates. However, in principle, differences across importers in their initial dollar volatility could predict their exposure to other economic shocks around the change in exchange rate regime. This empirical approach builds on the idea that such potential link between the dollar volatility and other shocks should not be asymmetrically important among firms that rely more on imports (relative to other importers). Another potential issue with this empirical approach is that a same shock to the level of the exchange rate across importers could have different effects on firms with higher versus lower initial dollar volatility. This issue could asymmetrically affect firms that rely more on imports. I address this issue by controlling for important firm and plant characteristics that could be associated with dollar volatility and examining the sensitivity of the results to these controls. Importantly, building on the predictions from the growth-options mechanism (Section 1), I refine the empirical approach by contrasting the effect of uncertainty shocks across different types of plants and workers. These additional contrasts allow one to further address potential identification concerns with the empirical approach used in this paper.

3.4. Empirical Specification and First-Stage Results

The empirical analysis is based on the estimation of the following specification:

$$Y_{ipt} = \alpha_{j(i)s(i)t} + \beta \times FERVolExp_{it} + \delta' X_{ipt} + \varepsilon_{ipt}, \quad (1)$$

where Y_{ipt} is an outcome variable for plant p from firm i in month t, $FERVolExp_{ipt} = IFImpRatio_i \times FERVol_{it}$ measures the importer's exposure to exchange rate volatility in the period (before or after the regime change), $FERVol_{it}$ is the firm's exchange rate volatility in the period, $IFImpRatio_i$ is the firm's initial import ratio, $\alpha_{j(i)s(i)t}$ denotes industry × state × month fixed effects, and X_{ipt} is a vector of plant and firm controls. Importers' exposure to exchange rate volatility captures the combination of this firm-specific volatility and their reliance on imports (Section 3.3). The unit of observation is a plant-month, and the sample covers two symmetric periods before and after the regime change (Section 2.1). The coefficient of interest is β and captures the link between a firm's exposure to volatility in a period and the plant's outcome. I implement the identification strategy discussed in Section 3.3 and estimate this coefficient using an instrumental-variables (IV) approach, which constructs shocks to $FERVolExp_{ipt}$ (uncertainty shocks). The fixed effects ensure that only differences in these shocks across firms in a same state-industry-month are used to estimate the results.

When implementing this analysis, I use the following first-stage specification:

$$FERVolExp_{ipt} = \alpha_{j(i)s(i)t} + \gamma_1 \times IFImpRatio_i \times Post_t + \gamma_2 \times LowIFDVol_i \times Post_t \quad (2)$$
$$+ \theta \times IFImpRatio_i \times LowIFDVol_i \times Post_t + \delta' X_{ipt} + \varepsilon_{ipt},$$

where $LowIFDVol_i = -IFDollarERVol_i$, $IFDollarERVol_i$ is the firm's initial dollar volatility, $Post_t$ is an indicator that equals one in the period the regime change, and all other variables are defined as in Equation (1). This specification formalizes the triple interaction described in Section 3.3 to construct uncertainty shocks. Intuitively, I use the estimated shock $\hat{\theta} \times IFImpRatio_i \times LowIFDVol_i \times Post_t$ as the uncertainty shock. Specifically, I estimate Equation (1) using $IFImpRatio_i \times LowIFDVol_i \times Post_t$ as an instrument for $FERVolExp_{it}$, while including all the other variables in Equation (2) as controls. The control variables (X_{ipt}) include $IFImpRatio_i \times LowIFDVol_i$ as well as firm and plant initial characteristics (size, age, average wage, labor skill intensity) interacted with $Post_t$. These controls also include firm initial characteristics in a symmetric way to $LowIFDVol_i$ (i.e., interacted with $IFImpRatio_i$, $Post_t$ and $IFImpRatio_i \times Post_t$).

To examine the predictions outlined in Section 1, I separately estimate this effect for skill-intensive versus other plants. In other words, I interact all independent variables (including all controls and fixed effects) with *Skill-Intensive Plant* and *Other Plant* (indicator for other plants). This analysis examines firm-level differences in exposure to volatility. To capture firm-level responses, I weight all regressions using 1/*IFNPlants*, where *IFNPlants* measures the firm's initial number of plants.[24] Panel B of Table 2 shows the first-stage results for the overall sample. Consistent with the previous evidence (Panel A), these results confirm that these uncertainty shocks are economically important.

When implementing this approach, one potential issue is that one could be underestimating the initial value of $FERVolExp_{ipt}$ for firms with low dollar volatility. Firms could face uncertainty about potential future regime changes, and this will not be captured by their initial fixed exchange rate. I address this issue in two main ways. First, I note that this would lead one to underestimate the magnitude of both positive and negative effects of interest. Note that the IV results can be interpreted as the ratio of the reduced-form results for the outcome variable and $FERVolExp_{ipt}$, and this issue leads one to overestimate the magnitude of the uncertainty shock (denominator in this ratio). Second, I also show the main results using a reduced-form specification, which is not subject to this measurement issue (Section 5). This reduced-form specification relies on the assumption that $IFImpRatio_i \times LowIFDVol_i \times Post_t$ predicts an increase in uncertainty but does not requires measuring this increase accurately (issue above).

4. Results

4.1. Firm Uncertainty and Total Employment

I start by estimating the average effect of uncertainty shocks on the total net hiring (hiring minus firing) and employment of plants across all workers. Table 3 reports the results. To better capture their magnitude, the reported coefficients are multiplied by the mean of *IFImpRatio* and the mean of *FERVol* in the sample. Recall that all variables capturing monthly flows are annualized (multiplied by twelve). Panel A shows that uncertainty shocks are associated with an average reduction in the total net hiring and employment of

[24] The use of plant-level data is important in this analysis as I contrast effects across different types of plants (subsamples) and control for important plant characteristics when analyzing their outcomes.

importers. These effects (scaled as described above) represent a drop of approximately 1 percent in a plant's total workforce over one year. This finding supports the idea that, in general, firms reduce their hiring and employment when operating in an environment with higher uncertainty.

Panels B and C decompose these effects into changes in hiring, firing, and other adjustments. *Total Hiring* (*Total Firing*) is the ratio of the plant's hiring (firing) across all workers during month *t* to *Avg Emp.* Note that *Total Net Hiring* = *Total Hiring* - *Total Firing*. The other adjustments to plant employment are captured by *Total Other Emp Adj* ≡ *Total Emp Growth* – *Total Net Hiring*, measure adjustments to plant employment that are not incorporated by hiring and firing decisions and include primarily quits. These results show that the negative estimated effect of uncertainty shocks on plant employment is driven by drops in hiring.

4.2. Firm Uncertainty, Skill-Intensive Plants, and Skilled Workers

I examine how firms adjust their high and low skilled employment after persistent increases in firm-level uncertainty. As explained in Section 3.4, I separately analyze these effects for skill intensive plants and other plants. Table 4 shows these central results of the paper which examine the predictions discussed in Section 1. To better capture their magnitude, the reported coefficients are multiplied by the mean of *IFImpRatio* and the mean of *FERVol* in the sample. Panel A shows the results for high skilled workers. Uncertainty shocks are associated with an economically and statistically significant increase in the net hiring and employment growth of these workers in skill-intensive plants. This increase (scaled as described above) is economically important and represents 4-5 percent of plants' total workforces. At the same time, uncertainty shocks are associated with a drop in the net hiring and employment of skilled workers in other plants (not skill intensive). Moreover, the differential effect of uncertainty on skill-intensive plants is always positive and statistically significant across a range of specifications. Panel B shows these results for low skilled workers and documents that the previous positive effect of uncertainty is not present. In both subsamples of skill-intensive and other plants, uncertainty shocks are not associated with economically or statistically significant increases in the net hiring or employment of low skilled workers.

Overall, these results confirm the detailed predictions discussed in Section 1. When faced with higher uncertainty, firms significantly expand their skilled workforce in their skill-intensive plants. Moreover, these positive effects of uncertainty are only present for the subset of high skilled workers in these skill-intensive plants. When faced with increased uncertainty, firms do not expand their low skilled workforce in skill-intensive plants and do not expand their workforce (high or low skilled) in other plants.

These findings support the idea that uncertainty creates incentives for firms with skill-intensive operations to expand their skilled workforce and are robust across a range of alternative specifications. First, Panel C of Table 4 shows these results with alternative outcome variables. Here, adjustments to high (low) skilled workers are scaled by the plant's high (low) skilled employment as opposed to the plant's total employment (see Section 2.3). The results remain qualitatively and quantitatively similar with these alternative outcomes. Note that high skilled workers represent approximately 75 percent of the workforce from skill-intensive plants (Panel B of Table 1). The average positive effect for skill-intensive plants (0.068) in Panel C implies a change of $0.068 \times 0.75 = 5.1$ percent in the total workforce of these plants, a magnitude comparable to the one for skill-intensive plants in Panel A.

Second, Panel D of Table 4 shows results predicting firms' exposures to shocks with additional lags. Recall that I use firms' imports during 1998 to measure both their initial reliance on imports and their initial dollar volatility, which is measured using import shares across different countries (Section 2.1). As an alternative approach, I construct these variables using import values from 1997. In this analysis, the sample is further restricted to firms present between 1997 and the start of 1999. When calculating firms' initial dollar volatility, I use import shares from 1997 but exchange rate data from 1998. This allows me to use further lags of firm decisions but still rely on recent external conditions imposed on firms (exchange rates) right before the regime change. The results remain economically similar and statistically significant with this alternative approach.[25]

Third, I show the results using several alternative approaches to identify skill-intensive plants. Table 5 reports some of these findings. In Panels A and B, I define skill-intensive plants using two alternative approaches. In one approach (most workers), *Skill-Intensive Plant* is an indicator that equals one if, prior to the shock, most of the plant's workers are high skilled workers, i.e., *IPLaborSkill* > 0.5. In another approach (plant wages), *Skill-Intensive Plant* is an indicator that equals one for plants above the median in terms of their initial average wage (*IPWage*). In this approach using plant wages, I still measure adjustments to high skilled versus low skilled workers inside each plant using workers' education. In principle, one could use workers' past wages in previous jobs to identify such workers. However, this information is not available for many newly hired workers as they transition from informal sector firms, come from other firms outside the sample, or start their first job. Moreover, wages in past jobs might capture skills valuable for previous employers as opposed to skills relevant for the current plant being analyzed. In contrast, worker education

[25] The main advantage of using more recent lags (import values in 1998) is that this allows one to predict firms' exposures to these shocks more precisely. Since imports represent only a portion of firms' input costs, predicting stronger shocks to the volatility of import costs is important to empirically isolate the effects of interest.

can be interpreted as capturing the importance of cognitive skills associated with the accumulation of human capital on the job (see Section 2.2). The results remain qualitatively and quantitatively similar with these two alternative approaches. As in the baseline results (Panels A and B of Table 4), when faced with higher uncertainty, firms only expand the employment of high skilled workers in skill-intensive plants. In the Internet Appendix, I show that these results also remain similar when I define skilled-intensive plants using additional cutoffs for *IPLaborSkill*.

Finally, I also examine the results using continuous differences across plants in their skill intensity. The main advantage of analyzing subsamples of skill-intensive versus other firms is that one can separately estimate Equation (1) in each of these subsamples and check if the effect of interest is positive (as predicted by the framework in Section 1). As an alternative approach, I use *IPLaborSkill* to capture continuous differences in plants' skill intensity. In the Internet Appendix, I check if the effect of uncertainty on the employment of high skilled workers is more positive for skill-intensive plants. The effect of uncertainty on the high-skilled employment from skill-intensive plants is positive with a similar economic magnitude to the one in the main results. As in the previous analyses, the positive effect of uncertainty on the employment of skill-intensive plants is only present for high skilled workers. Taken together, these different analyses confirm the robustness of the main empirical results in the paper.

4.3. Firm Uncertainty and Skill-Intensive Plants: Hiring, Firing, and Other Margins

To further analyze the predictions from the growth-options mechanism, I separately estimate the effect of uncertainty shocks on the hiring and firing decisions of plants. In principle, the previous expansions to the skilled workforce of plants could be driven by increases in the hiring or reductions in the firing of these workers. Empirically, hiring and firing decisions tend to be concentrated on plants with higher and lower growth, respectively. The growth-options mechanism outlined in Section 1 is only relevant when plants might want to scale up production in the future but are constrained by the limited availability of human capital. Therefore, it is plausible to expect this mechanism to be more relevant for plants with a growing workforce and to primarily increase the hiring of new skilled workers.

Motivated by these points, Table 6 decomposes the previous effects into changes in hiring, firing, and other adjustments. *High Skilled Hiring* (*High Skilled Firing*) is the ratio of the plant's hiring (firing) of high skilled workers during month *t* to *Avg Emp.* Note that *High Skilled Net Hiring* = *High Skilled Hiring* – *High Skilled Firing*. Consequently, the previous results analyzing net hiring decisions can be decomposed into effects on these hiring and firing margins. The other adjustments to plant high skilled employment are captured by *High Skilled Other Emp Adj* ≡ *High Skilled Emp Growth* – *High Skilled Net Hiring*. This variable measures adjustments to plant high skilled employment that are not incorporated by hiring and firing decisions and includes primarily quits. I define analogous variables for low skilled workers and estimate the baseline results (Panels A and B of Table 4) using these different adjustments as the outcome variables.

These results confirm that the previous findings are primarily driven by an increase in the hiring of new high skilled workers. At the same time, uncertainty is not associated with increases in the hiring of low skilled workers in skill intensive plants or increases in hiring across workers (high or low skilled) in other plants. There is some link between uncertainty and reductions in the firing of high skilled workers in skill-intensive plants, but these effects are economically smaller and statistically insignificant. These findings support the prediction above from the growth-options mechanism. They also provide additional evidence against the view that a labor hoarding mechanism could rationalize the main effects in this paper: these effects are not driven by firms' reduced incentives to fire their existing workers (see Section 1).

4.4. The Role of Firm Size and Age

To the extent that the results capture the growth-options mechanism, it is also natural to expect them to be mostly relevant for skill-intensive plants inside smaller firms. Intuitively, when these plants are part of a larger firm, the reallocation of skilled workers (and other potential resources) inside these firms should mitigate binding constraints in the ability of these plants to quickly expand the human capital of their workforce. Consequently, these plants can have a smaller need to build a larger skilled workforce ahead of time. In other words, firms might find it easier to expand the skilled workforce of a plant by reallocating workers internally (through internal labor markets) than by hiring new workers in the outside market. As firms have greater access to these internal labor markets, this can lower their exposure to future talent shortages in these high-skilled plants. For example, larger firms can help workers gain experiences in different activities and develop human capital that facilitates these transitions. Indeed, Tate and Yang (2015) provide evidence supporting this role of internal labor markets and find that these effects are especially relevant for high skilled workers.[26]

Motivated by these ideas, I separately estimate the baseline results (Panels A and B of Table 4) in subsamples of large and small firms, which include firms with an initial size (total employment, *IFEmployment*) above and below the sample median, respectively. These subsamples capture significant

[26] In principle, a related possibility is that the effects might be weaker in areas with a greater share of workers in manufacturing or related industries. This local supply of workers could facilitate the hiring of skilled workers when needed. However, these areas should also be associated with a greater competition for skilled workers from other local firms. As other local firms compete more for talent, this can increase the importance of local talent shortages and strengthen the effects analyzed in this paper.

differences in firms' average initial employment (127 versus 1,216 workers) and their average initial number of plants (3.0 versus 23.9 plants). When constructing the indicators *Skill-Intensive Plant* and *Other Plant* in each subsample, I use the median value of plants' initial share of high skilled workers (*IPLaborSkill*) in the subsample. Panel A of Table 7 reports the results and shows that the positive effect of uncertainty on a plant's skilled workforce is only present for skill-intensive plants inside smaller firms. There is no positive effect for high-skilled workers across all other three cases, including skill-intensive plants inside larger firms. Additionally, there is no positive effect of uncertainty on the hiring of low skilled workers in any of the four cases, including skill-intensive plants inside smaller firms. These patterns support the natural implications of the growth-options mechanism discussed above.

I then further analyze the role of firm size and age in the results. In the data, skill-intensive plants tend to be inside younger and larger firms. In principle, the positive effect of uncertainty could be concentrated on plants from these types of firms, as opposed to skill-intensive plants. The previous results already addressed this issue in the case of firm size, but I further examine this possibility by linking the effect of uncertainty to differences in firm size and age. Panel B of Table 7 shows the results. I estimate effects analogous to the ones in the baseline analysis (Panels A and B of Table 4), where I replace the indicators *Skill-Intensive Plant* and *Other Plant* with alternative indicators capturing firm size and firm age. The results show that there is no positive effect of uncertainty on the hiring of high skilled workers for the average firm in each of these groups (large, small, young, or older). These patterns document that the link between uncertainty effects and plants' skill intensity is not capturing a connection between these effects and firm size or age. These positive effects of uncertainty are only present in the subset of skill-intensive plants.

4.5. Firm Uncertainty and Skill-Intensive Firms

The previous analysis suggests that firms with skill-intensive plants expand the skilled workforce of these plants when faced with uncertainty. It is natural to expect these uncertainty effects to increase firms' overall skilled workforces. However, it is possible that firms offset these expansions in skill-intensive plants by hiring less in other plants. Note that the previous results cannot be explained by the internal reallocation of existing workers across plants since the hiring variables isolate the hiring of new workers for firms. But these adjustments to the hiring of new workers across multiple plants could be important. To analyze these possibilities, I examine how firms with different skill intensity (at the firm level) adjust the employment of their plants when faced with uncertainty. Intuitively, these results capture uncertainty effects for the average plant of different types of firms. I follow the same approach as in the baseline results (Table 4) but now construct subsamples using firms' initial shares of skilled workers. Table 8 (columns (1) and (2)) shows the results. Uncertainty shocks are associated with an economically and statistically significant expansion in the hiring of high skilled workers by skill-intensive firms. As in the main results (Table 4), these positive effects are not present for low skilled workers in these same firms or across workers (skilled and unskilled) from other firms. This evidence shows that these positive effects of uncertainty on the hiring of skilled workers can translate into significant increases in firms' skilled workforces. For example, in the sample of skill-intensive firms, the result in column (1) implies an average expansion in the number of skilled workers equivalent to 3.6 percent of plants' total workforces. Recall that this reported coefficient is scaled to better capture its magnitude (as described in Section 4.2).

I then examine these responses of skill-intensive firms across the following margins: hiring of workers for jobs in skilled-intensive plants or hiring for jobs in other plants. This allows one to determine if, within skilled-intensive firms, the previous effects are concentrated on the specific plants that are skill intensive. The framework from Section 1 predicts that these effects should be concentrated on these specific plants, where workers perform skill-intensive tasks, and this motivates the focus of the previous analysis on these plants. However, in principle, uncertainty effects could be spread across the different plants of skill-intensive firms. To examine these possibilities, Table 8 shows the previous results using these different margins of adjustment. In columns (3) and (4), the outcome variables *High Skilled Net Hiring* and *Low Skilled Net Hiring* are constructed in an analogous way but now only include the hiring and firing of workers for skill-intensive plants. In columns (5) and (6), the outcome variables *High Skilled Net Hiring* and *Low Skilled Net Hiring* are constructed in the same way but now focus on the hiring and firing of workers for other plants (not skill-intensive plants). These results confirm that the positive effect of uncertainty on hiring is concentrated on skill-intensive plants. The estimated hiring effect is economically limited and statistically insignificant for jobs in other plans from skill-intensive firms (column (5)).

4.6. Results Using a Longer Time Horizon

Another important issue is the persistence of these uncertainty effects on a firm's skilled workforce. In principle, firms' shorter- and longer-term responses to the previous uncertainty shocks could be different. For example, firms' initial responses to the previous uncertainty shocks could reflect temporary adjustments by them when faced with a new regime. Alternatively, the increase in volatility could expose firms to stronger shocks over time. In other words, shifts in the volatility of realized shocks could have different implications when compared to changes in the incentives of firms when faced with greater uncertainty. Moreover, these realized volatility effects could become more important over longer horizons (e.g., Bloom (2009), Schaal (2017)).

To address this issue, I extend the analysis to track firms' decisions across their plants during a longer, two-year period after they transition to an environment with higher uncertainty. Recall that the baseline results focus on a one-year period (see Section 2.1). Specifically, I use the same sample of firms-plants described in Section 2.1 but extend the coverage of this sample until the end of 2000 (instead of the end of 1999 as in the main sample). All outcome variables and independent variables are defined in the same way as before. Note that firm exchange rate volatility (*Firm ERVol*) is the average value of a monthly exchange rate standard deviation across all months during each period (see Section 2.4). In the previous analysis, there are two periods covering each of the two years (1998 and 1999). Following the same approach, I now create three periods covering each of the three years (1998, 1999, and 2000).

Table 9 shows the results. First, Panel A reports the first-stage analysis with this extended time horizon. This analysis confirms that the predicted shocks to uncertainty remain economically and statistically important at this longer horizon. Moreover, the economic magnitude of these shocks predicted over a two-year horizon remains similar to the one in Table 2 (Panel B) using a shorter time horizon. This is consistent with the discussion in Section 3.1 and the patterns in Figure 1 suggesting that these changes capture persistent differential shocks to firms' volatility. Panels B and C replicate the main results in the paper (Panels A and B of Table 4) using this longer time horizon. As in the previous analysis, in the case of skill-intensive plants, there is an economically and statistically significant positive effect of uncertainty shocks on the net hiring and employment growth of high skilled workers. These effects are scaled in the same way as before (see Section 4.2) and represent persistent increases equivalent to 3-4 percent of plants' total workforces. As in the previous analyses, there are no positive significant uncertainty effects for low skilled workers in these skilled-intensive plants or across all workers (high and low skilled) in other plants.

However, one difference relative to the baseline results (Table 4) is that uncertainty shocks are now associated with a reduction on the low-skilled workforce of skill-intensive plants. This reduction is consistent with the theoretical framework discussed in Section 1 as firms can rely on their incremental skilled workforce as a substitute for some of their low skilled workers. The collective evidence from Tables 4 and 9 suggests that this substitution only takes place at longer horizons, consistent with the view that new high skilled workers are incorporated into firms over time.

Importantly, this analysis shows that the positive initial effects of uncertainty shocks on firms' skilled workforce are not reversed or significantly changed by subsequent adjustments to this workforce. Panel D of Table 9 analyzes the timing of these effects in greater detail and further documents this point. Specifically, this panel presents reduced-form results analyzing how firms respond to uncertainty shocks in both the first and second years after the shock. These results are based on the estimation of an extended version of Equation (2) using the subsample of skill-intensive plants (defined using *Skill-Intensive Plant* from Panels B and C). Equation (2) is extended to include indicators for each of the two separate years after the shock (*Post Year 1* and *Post Year 2*). *Year 1* and *Year 2* denote the first year (1999) and second year (2000) after the shock, respectively. The extended specification includes these two variables symmetrically in an analogous way to *Post* in Equation (2). All independent variables (including controls) are defined in the same way as in Panel B of Table 2. The variables previously interacted with *Post* are now separately interacted with *Post Year 1* and *Post Year 2*. The outcome variables are defined in the same way as in Panels B and C. Column (1) shows that, in the case of skill-intensive plants, the positive effect of uncertainty shocks on high skilled net hiring is concentrated in the first year. This effect is not matched with an economically or statistically significant drop in net hiring in the second year. This confirms that the main effects documented in this paper are not significantly changed by subsequent adjustments to firms' skilled workforces. Overall, this analysis suggests that the previous findings capture a persistent change to firms' skilled workforces as firms operate in an environment with higher uncertainty.

5. Alternative Interpretations

The findings above are interpreted as capturing the effect of uncertainty on firms' incentives to expand their skilled workforce. In this section, I discuss whether alternative explanations can plausibly explain these results. As explained in Section 4.3, there are two main potential issues with the identification strategy used in this paper. A first potential issue is that differences across importers in their initial dollar volatility could predict their exposure to other economic shocks (different from the level of exchange rates) around the regime change. If this issue is asymmetrically more important among firms that rely more on imports, relative to other importers, it could influence the estimated effects of uncertainty shocks. Another potential issue is that a same shock to the level of the exchange rate across importers could have different effects on firms with higher versus lower initial dollar volatility. As this issue asymmetrically affects firms that rely more on imports, it could also shape the estimated effects of uncertainty shocks.

In additional results, I further address the first concern above with a robustness check that incorporates firms that are both importers and exporters. Intuitively, these firms have a greater ability to hedge their exposure to exchange rate risk from their import transactions through their export transactions. This should limit any effect of exchange rate volatility from the import side of their operations (Section 2.1). On the other hand, if the concern above is relevant, we might still detect economically important effects when estimating the main results with these firms. I construct an alternative sample with firms that are both importers and exporters following the same steps outlined for the main sample in Section 2.1. The only difference relative to the main sample is that I require firms to initially be both importers and exporters (as opposed to only importers). This alternative sample has 230,044 plant-month observations covering 12,402 plants from 3,390 firms.

Table 10 shows results incorporating this alternative sample. The analysis examines the reduced-form effect of firms' exposure to import price volatility (due to exchange rate volatility) on hedged importers (that also export) and unhedged importers (with no exports). The analysis is based on the estimation of Equation (2) using subsamples of skill-intensive plants and other plants for each of these types of importers. The outcome variables are the same as in the baseline results (Panels A and B of Table 4). Panels A and B confirm the main findings of the paper using this reduced-form specification. Panels C and D then show that, in the sample of hedged importers, these same shocks to exchange rate volatility are not associated with economically or statistically significant effects. This is the case across a range of specifications covering different types of workers (high and low skilled) and different types of plants (skill intensive and other plants). This analysis shows that the shocks analyzed in this paper are only associated with effects on firms' decisions when they predict significant shifts in firms' exposures to exchange rate volatility.

Another point that helps address these two potential concerns is the fact that the main results in the paper remain stable across a range of specifications with different controls for firm characteristics associated with their initial dollar volatility and reliance on imports. This fact is illustrated across the different specifications in Panels A and B of Table 4. For example, in the case of skill-intensive plants, the positive effects of uncertainty on the net hiring of high skilled workers remains stable across a range of firm and plant controls (columns (1) to (3) of Panel A).

As a main approach to address these concerns, I build on the important contrasts across the results for different types of plants and workers. As predicted by the growth-options mechanism, the positive effect of uncertainty on hiring and employment is only present for skill-intensive plants and, within these plants, is only present for the subset of high skilled workers. Specifically, uncertainty shocks are not estimated to have positive effects on the hiring of low skilled workers in skill-intensive plants and the hiring of all workers (high and low skilled workers) in other plants. To drive these central findings of the paper, the above issues also need to create a positive link between uncertainty and hiring that is uniquely relevant for these specific plants and workers and that becomes negative (or disappears) for other plants or workers. While it is challenging to completely rule out these potential issues with the identification strategy used in the analysis, the collective evidence is most consistent with the idea that the results capture the effect of firm-level uncertainty.

A final important point regarding the interpretation of the findings is whether these uncertainty effects capture the growth-options mechanism. As discussed in Section 1, there are different potential mechanisms that could lead to a positive link between uncertainty and firm employment. However, the empirical analysis in this paper focuses on specific predictions from the growth-options mechanism. As discussed above, this positive link is only present for high skilled workers working in skill-intensive plants. Moreover, also consistent with this mechanism, these effects are driven by the hiring of new workers (as opposed to reductions in firing) and concentrated on skill-intensive plants inside smaller firms (Sections 4.3 and 4.4). Overall, the analysis documents a specific effect of uncertainty on firms' demand for skilled talent and it is challenging to rationalize this effect with other mechanisms previously considered on the implications of uncertainty. For example, a labor hoarding effect could explain an increase in employment driven by reductions in firing but cannot explain these effects which are driven by the hiring margin. While the main goal of this paper is not to distinguish between potential alternative mechanisms for this documented effect of uncertainty, the growth-options mechanism provides a natural explanation for this effect and the evidence supports the additional implications from this mechanism.

6. Conclusion

In this paper, I study the idea that firms with skill-intensive operations have incentives to expand their skilled workforce when faced with uncertainty. Using a simple theoretical framework, I illustrate how these incentives emerge when training and learning by new workers takes time (i.e., it is associated with a lag). To empirically analyze these effects, I develop a new approach to isolate the effect of persistent shocks to uncertainty on firms' decisions. This approach is implemented in the context of Brazilian manufacturing where it is combined with detailed plant- and worker-level data. This allows me to examine how these uncertainty shocks shape firms' employment through different margins at a granular level (e.g., hiring of certain types of workers for jobs in specific plants). Higher uncertainty leads the average firm to reduce its total hiring and employment. However, firms with skill-intensive plants significantly increase their skilled workforce by hiring new high skilled workers for jobs in these plants. Importantly, these positive effects of uncertainty on hiring are consistent with the mechanism proposed in this paper. For example, these effects are not present for low skilled workers in skill-intensive plants or jobs outside of these plants, and they are driven by skill-intensive plants located inside smaller firms.

Overall, the analysis suggests how operating in an environment with higher uncertainty can lead firms to increase their demand for talent and expand the human capital of their workforces. When considering the broader implications of these findings, it is important to note that the incentives here analyzed should not depend on the specific type of uncertainty analyzed in the results. While I focus on shocks to firm exchange rate volatility for identification and measurement reasons, firms are exposed to several sources of uncertainty affecting their operating conditions, including a range of potential economic and policy shocks.

At the broad level, these results have the following main implications. First, they illustrate how, in the context of skill-intensive activities, concerns about the negative effects of uncertainty on the human capital of firms' workforces can be mitigated. These negative effects could have important economic implications as skilled workers are commonly associated with innovation, productivity growth, the use of new technologies, and positive spillovers to the economy.

Second, these effects also suggest how firms' hiring behavior might help amplify the importance of talent shortages. As discussed in Section 1, these shortages are important across a range of settings. Suppose firms in a skill-intensive industry face an initial skill shortage and significant uncertainty about future economic fundamentals. These conditions are often present during industry expansions in skill-intensive industries, which increase the demand for skills in limited supply. For example, consider the hiring booms that took place in the technology sector during the recent pandemic or the finance industry during the early 2000s. The mechanism analyzed in this paper suggests that this initial skill shortage should increase firms' demand for talent. Therefore, firms' hiring behavior should amplify the magnitude of the shortage, making it even harder for all firms to find workers with the skills they need. This increased shortage should then further increase firms' demand for talent, and so on. In other words, this mechanism suggests the potential importance of a feedback loop, where initial talent shortages could be significantly amplified. Moreover, these same effects could amplify the magnitude of layoffs in these industries after initial conditions are reversed and firms start downsizing their skilled workforces. Finally, these effects could also lead to coordination failures across firms during talent shortages. As firms hire more workers in anticipation of future possible demands for talent, they might not internalize the fact that this reduces the availability of talent for other firms experiencing these demands today. When all firms behave in this way, there could be an excessive expansion of firm hiring during the talent shortage. Analyzing in greater detail these broader implications of the effects documented in this paper is an interesting area for future research.

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Appendix A: A Model of Talent Management Under Uncertainty

I provide a simple model of a firm's demand for skilled workers which formalizes the intuitions discussed in the text. The model considers a firm that relies on the human capital of its workers (H, skilled and trained workers) and a variable production factor m for production, which includes other factors of production that are not associated with an investment lag (see below).[27] There are only two periods ($t = 1,2$) and the firm's revenue in each period is given by $R_t = R(H_t, m_t)$. The firm is endowed with initial workers with human capital H_0. At the start of $t = 1$, the firm decides how many skilled workers to fire F_1 (when firing is possible) and hire $Hire_1$, as well as chooses m_1. This determines $H_1 = H_0 - F_1$. Training and learning by new workers take time and new skilled workers hired at $t = 1$ only affect the firm's production at $t = 2$, i.e., the hiring decision at $t = 1$ only increases $H_2 = H_1 + Hire_1$. After making these initial decisions, the firm uses m_1 and H_1 to generate its revenue R_1. These two periods are intended to capture significant delays associated with these human capital investments and the other factors of production can be adjusted within these periods.

When period $t = 2$ arrives, the firm cannot further increase H_2. However, I consider the possibility that the firm can fire F_2 workers, adjusting downwards the human capital of its workforce to $H_2 = H_1 + Hire_1 - F_2$. After the joint choice of (m_2, F_2), the firm relies on m_2 and H_2 to generate its revenue R_2. The firm pays a wage w to existing trained workers and incurs an initial cost h per new hire at $t = 1$ when hiring additional workers in that period. This cost can include training and search costs as well as initial wages paid before the workers become productive. The price of the variable input m_t is given by p_t.

When the firm makes its decisions at $t = 1$, the only source of uncertainty is about the value of the future input price p_2, which is determined at the start of $t = 2$, prior to the choice of F_2 and m_2.[28] Specifically, there is a continuum of states at $t = 2$ and the price can have values $p_2 > 0$. The firm is risk neutral and maximizes the sum of its expected profits over the subsequent periods. For simplicity, I abstract from discounting effects of uncertainty.

I consider both the case where no firing is possible (case with irreversibility) and the case where skilled workers can be fired at some cost (which could be positive or zero). The analysis of these two cases illustrates that the results here presented do not depend on assumptions about firms' ability to fire skilled workers after hiring them. For expositional reasons, I start with the case with irreversibility and then allow for the possibility of firing skilled workers. In this initial case, the firm's human capital decision at $t = 1$ involves only potential additions to the future human capital of its workforce $Hire_1 = (H_2 - H_1) \geq 0$. Moreover, the human capital from the firms' workers at $t = 2$ is completely determined by this initial decision at $t = 1$. The firm's problem at $t = 2$ is the choice of m_2 that maximizes $R(H_2, m_2) - p_2 m_2 - w H_2$, where H_2 is determined by its previous choices and leads to the solution $m_2^*(H_2, p_2)$. The firm's problem at $t = 1$ is then the choice of m_1 and $H_2 \geq H_1$ that maximize the following objective: $R_1(m_1, H_1) - p_1 m_1 - w H_1 - h(H_2 - H_1) + E_1[\pi_2(m_2^*(p_2, H_2), H_2, p_2)]$. H_1 is exogenous and the optimal choice of m_1 maximizes $R_1(H_1, m_1) - p_1 m_1$. The value function $V_2(H_2, p_2) \equiv \pi_2(m_2^*(p_2, H_2), H_2, p_2)$ measures the profit at $t = 2$ and is given by $V_2(H_2, p_2) = R_2(m_2^*(p_2, H_2), H_2) - p_2 m_2^*(p_2, H_2) - w H_2$.

[27] In manufacturing, this variable production factor can be interpreted as capturing materials, an important input in production functions.

[28] One can allow uncertainty about other conditions such as demand conditions shaping the revenues of the firm. The key point is that the uncertainty about input prices analyzed below captures mean-preserving spreads about these prices conditional on the distribution of these other shocks. When analyzing these ideas in the paper, it is therefore important to focus on shifts in input price uncertainty that are orthogonal to other conditions faced by firms.

The central aspect of the analysis is the choice of H_2 at $t = 1$ and its link with the uncertainty about the future price p_2. The FOC associated with this decision is given by $E_1[V_{2H}] = h$, where $V_{2H} \equiv \frac{\partial V_2}{\partial H_2}$. Denote σ a parameter that captures a mean-preserving spread to the price p_2, i.e., an increase in the volatility of this price. Differentiating the previous FOC with respect to σ we can write: $\frac{\partial}{\partial \sigma} E_1[V_{2H}] + E_1[V_{2HH}] \times \frac{\partial H_2}{\partial \sigma} = 0$, where $V_{2H} \quad = \frac{\partial^2 V_2}{\partial H_2^2}$. This leads to the following expression: $\frac{\partial H_2}{\partial \sigma} = \frac{\frac{\partial}{\partial \sigma} E_1[V_{2H}]}{E_1[-V_{2HH}]}$. If $-V_{2HH} > 0$, a condition that is checked in the Internet Appendix, the sign of $\frac{\partial H_2}{\partial \sigma}$ is determined by the sign of $\frac{\partial}{\partial \sigma} E_1[V_{2H}]$.

The key point is to show that V_{2H} is a convex function of p_2 (conditional on a value for H_2). If this is the case, the expected return $E_1[V_{2H}]$ will increase with σ (the volatility of the price p_2).

In this case with irreversibility, the human capital of the workers is fixed in the second period. The intuition for this convexity is analogous to the one for the result that profits are a convex function of prices. The firm has the option to adjust production when responding to changes in prices. This increases the upsides from price increases and limits the downsides from price decreases. Intuitively, firms' production capacity at as $t = 2$ is shaped by H_2. If H_2 and m_2 are important complements, there is only so much the firm can do to expand its production at $t = 2$ without increasing workers' human capital (H_2), i.e., by only increasing m_2. The firm has the option to use this production capacity and expand its production (increase m_2) when faced with lower input prices and favorable economic conditions. At the same time, the firm can keep its production capacity unused and limit losses when input prices are higher (by lowering m_2). This creates the convexity: additional production capacity creates a significant upside matched with a more limited downside. The firm is not required to increase m_2 and produce more if conditions are not favorable. As discussed below, this convexity on the human capital return becomes even stronger when the firm has the option to fire the skilled workers (at some cost). The intuition is that this option to fire workers further limits the downside from having a larger skilled workforce at $t = 2$.

As suggested by the discussion above, this result builds on the following key conditions. First, the firm is limited in its ability to increase its human capital in the short run, i.e., there is a significant lag associated with the investment. Second, there is a strong complementarity between H_2 and m_2. I capture this strong complementarity using alternative revenue functions. I start by considering a Cobb-Douglas production function: $R(m_t, H_t) = A m_t^{\gamma} H_t^{\alpha}$, where $\gamma + \alpha < 1$.[29] I then consider an approach where the revenue function leads to a fixed proportion of m_t and H_t: $R(m_t, H_t) = f(Min\{Am_t, H_t\})$, where $f(x) = x^{\beta}$, and $\beta > 0$. This production function captures the strong complementarity between human capital and variable factors of production by specifying that the firm cannot expand its sales beyond $f(H_t)$ by increasing only the variable factors. In this case, the firm's revenue is given by $f(Am_t)$ when $Am_t < H_t$ and $g(H_t)$ when $Am_t \geq H_t$. I present the details of this last approach in the Internet Appendix but discuss its key results below.[30]

Convexity of Human Capital Return

I assume the revenue function is given by $R(m_t, H_t) = A m_t^{\gamma} H_t^{\alpha} = Af(m_t)g(H_t)$ and first consider the case with irreversibility. Note that $V_{2H} \equiv \frac{\partial V_2}{\partial H_2} = \frac{\partial R_2}{\partial H_2}(m_2^*(p_2, H_2), H_2, p_2) - w = Af(m_2^*(p_2, H_2))g'(H_2) - w$.

[29] The results do not depend on assumptions about the returns to scale, which can be arbitrarily close to one or have any other value below one.

[30] I have also considered an extended version of the Cobb-Douglas case that captures this complementarity, where we have $R(m_t, H_t) = Af(m_t)g(H_t)$. See the Internet Appendix for more details.

The idea above that the firm has the option to adjust m_2 is captured by $m_2^*(p_2, H_2)$ and drives the convexity result.

In the Internet Appendix, I show the following results for this irreversibility case. We have that $\frac{\partial V_{2H}}{\partial p_2} < 0$ and $\frac{\partial^2 V_{2H}}{\partial p_2^2} > 0$. Additionally, we have that V_{2H} goes to $+\infty$ $(-w)$ when p_2 goes to zero $(+\infty)$. Specifically, we can write $V_{2H} = C(H_2, A, \alpha, \gamma) p_2^{-\left(\frac{\gamma}{1-\gamma}\right)} - w$, where $C(H_2, A, \alpha, \gamma)$ is a function of (H_2, A, α, γ). Note that (H_2, A, α, γ) is fixed as we consider the convexity with respect to prices. This illustrates that the marginal return on the human capital is convex (on prices) across all prices. Intuitively, the marginal value of human capital goes to $-w$ (marginal cost of increasing capital) as the benefit from having more capital approaches zero when input prices are very high.

Now consider the case where the firm can reduce H_t at the start of period t with a marginal cost equal to $c \geq 0$, where $c < w$ (otherwise there is no value added by this option). Denote the marginal human capital return V_{2H} in this case as $\widetilde{V_{2H}}$. In the Internet Appendix, I show that $\widetilde{V_{2H}} = V_{2H}$ if $V_{2H} > -c$ and $\widetilde{V_{2H}} = -c$ if $V_{2H} \leq -c$, where V_{2H} is the previous function from the irreversible case. In other words, we have the previous marginal return on human capital truncated at $V_{2H} = -c$. Note that this truncation happens for values of p_2 above some threshold (sufficiently poor conditions). Intuitively, the option to downsize the human capital at the cost c puts a cap on the potential losses associated with the investment. This "increases the convexity" of the previous function V_{2H} with respect to p_2 and captures the intuition above that the option to abandon further limits the downsize from the expansion of human capital. Note that, after this truncation, the expected return on human capital no longer (strictly) increases with price volatility around high prices (where future conditions are poor and $V_{2H} = -c$). This (strict) convexity is now concentrated in good scenarios and capture potential upsides from additional human capital.

More formally, the firm now chooses $(m_2,\ H_2)$ at $t = 2$ to maximize $R(H_2, m_2) - p_2 m_2 - wH_2 - c(H_2^0 - H_2)$, where $H_2^0 \equiv H_1 + Hire_1$ is the initial decision for H_2. This leads to the solutions $m_2^*(H_2^0, p_2)$ and $H_2^*(H_2^0, p_2)$. The firm then chooses $(m_1,\ H_1,\ H_2^0)$ at $t = 1$ to maximize $\pi_1(H_1,\ m_1) - h(H_2^0 - H_1) - c(H_0 - H_1) + E_1[W_2(m_2^*(H_2^0, p_2), H_2^*(H_2^0, p_2), p_2, H_2^0)]$, where $H_2^0 \geq H_1$, $H_1 \leq H_0$, and $\pi_1(H_1, m_1) = R_1(m_1, H_1) - p_1 m_1 - wH_1$ is the firm's profit at $t = 1$. The value function is now determined by $\widetilde{V_2}(p_2, H_2^0) \equiv W_2(m_2^*(H_2^0, p_2), H_2^*(H_2^0, p_2), p_2, H_2^0) = V_2(p_2, H_2^0) - c(H_2^0 - H_2^*(H_2^0, p_2))$, where $V_2(p_2, H_2^0)$ is the value function of the model with irreversibility and captures the firm's profit at $t = 2$ (see above).

As a first point, note from the firm's problem above that the decisions H_1 and H_2^0 are separately determined and that H_1 is not shaped by σ.[31] Note that the choice of H_2^0 maximizes $-hH_2^0 + V_2(p_2, H_2^0) - c(H_2^0 - H_2^*(H_2^0, p_2))$. Suppose initially that the optimal choice for the firm involves no firing at $t = 2$, i.e., that $H_2^*(H_2^0, p_2) = H_2^0$. If this was the case, the decision for $H_2^* = H_2^0$ would be equivalent to the previous one with irreversibility. The human capital return would also be the same as before: $\widetilde{V_{2H}} \equiv \frac{\partial \widetilde{V_2}}{\partial H_2^0} = \frac{\partial V_2}{\partial H_2^0}$. The

[31] The FOC determining H_1 is given by: $\frac{\partial \pi_1}{\partial H_1}(H_1,\ m_1) + c + h = 0$. If $\frac{\partial \pi_1}{\partial H_1}(H_1,\ m_1) + c + h > 0$ and $H_1 = H_0$, the firm will continue to set $H_1 = H_0$ in response to marginal changes in σ. Intuitively, the firm can separately determine its skilled workforce in the two periods. After determining the skilled workforce that it would like to have in the future (H_2^0), the firm can always further scale down is current operations (if needed) by firing and hiring workers.

potential gaps between H_2^* and H_2^0 capture the firm's option to fire workers at $t = 2$ (scale down H_2) and, as discussed above, this option caps the human capital return at $-c$.

Alternative Production Function

As an alternative approach, I assume that $R(m_t, H_t) = f(Min\{Am_t, H_t\})$, where $f(x) = x^{\beta}$, and $\beta > 0$. In this approach, we can interpret the firm as having a revenue function $f(Am_t)$ subject to the capacity constraint $Am_t \leq H_t$, which is shaped by the pre-determined human capital of its workers H_t. Once the firm hits this constraint and $Am_t > H_t$, the revenue function reaches the limit $f(H_t)$. Intuitively, for any value of p_2, there is an optimal choice for m_2 in the absence of this human capital constraint. When this constraint is binding, increases in H_2 add value by increasing firms' production capacity. This happens in good states of the world (low values of p_2). On the other hand, in bad states of the world (high values of p_2), this constraint is not binding and increasing H_2 does not add value (only leads to the marginal cost w or c, depending on the assumption about irreversibility). In the Internet Appendix, I show that this intuition translates into a simple function for V_{2H}: this function is equal to $-w$ if $p_2 \geq \overline{p_2}$ and $V_{2H} = \left\{f'(H_2) - \frac{p_2}{A}\right\} - w$ if $p_2 < \overline{p_2}$, where $f'(H_2) = \overline{p_2}/A$. Therefore, the human capital return in the irreversibility case (V_{2H}) is a convex function of p_2 (conditional on other parameters). Moreover, as in the previous approach, we that $\widetilde{V_{2H}} = V_{2H}$ if $V_{2H} > -c$ and $\widetilde{V_{2H}} = -c$ if $V_{2H} \leq -c$. This ensures that this convexity is also preserved as we allow for the option of firing skilled workers. This approach leads to the same key implications as the Cobb-Douglas approach.

Appendix B: Firm-Level Exchange Rate Volatility and Regime Change

I analyze in greater detail the construction of persistent shocks to the volatility of firm-specific exchange rates discussed in Section 3.1. As motivated in Section 2.4, for any firm i with imports in an initial period, changes to firm-specific exchange rates are defined as $\Delta FEX_{it} \equiv \sum_{c=1}^{N_i} w_{ic0} \times \Delta \log(E_{ct})$, where E_{ct} is the exchange rate between the currency of country c and the domestic currency (measured per unit of the foreign currency), w_{ic0} is the share of imports of the firm from country c during the initial period, and N_i is the number of countries of origin for the importer during this period. Changes to the dollar exchange rate for an importer FEX_{it}^D are defined in the same way using the exchange rates between the currency of country c and the dollar ($\log(E_{ct}^D)$), which are also measured per unit of the currency from country c. I denote $e_{ct} \equiv \log(E_{ct})$, $e_{ct}^D \equiv \log(E_{ct}^D)$, and e_t^D as the value of e_{ct}^D when the country c is the domestic country. I measure these changes in exchange rates using daily values. A firm's exchange rate volatility (σ_i) and dollar exchange rate volatility (σ_i^D) during a period are defined as the standard deviation of these daily changes in FEX_{it} and FEX_{it}^D during this period.[32] I also measure changes to these firm-specific exchange rates over longer periods by adding these daily changes over the period.

The empirical methodology in the paper is motivated by the following idea. Suppose the domestic country has its currency initially pegged to the dollar. Imagine now that domestic events lead to a change in the exchange rate regime into a floating regime. Firms with lower initial σ_i^D (in the initial regime) should experience a significantly larger increase in σ_i. At the same time, these initial differences in σ_i^D should not predict significant changes in the level of these exchange rates across the regimes.

[32] In the empirical analysis, I first measure these volatilities for each month. I then construct these measures over longer periods using averages for these monthly variables (see Section 2.4). The advantage of this approach is that the length of the period being analyzed (e.g., three versus twelve months) does not directly affect the measure of volatility.

For expositional simplicity, I start by considering the case where each importer only imports from a single country of origin, i.e., $w_{ic0} = 1$ for some country of origin c. In this case, we have that $\Delta FEX_{it} = \Delta e_{ct}$ and $\Delta FEX_{it}^{D} = \Delta e_{ct}^{D}$. When considering changes to the level of these exchange rates, it is useful to note that $\Delta e_{ct} = \Delta e_{t}^{D} - \Delta e_{ct}^{D}$. In other words, the exchange rate for a given currency is a combination of the domestic dollar exchange rate and the dollar exchange rate for the foreign currency.[33] This expression implies that $\Delta FEX_{it} = \Delta e_{t}^{D} - \Delta FEX_{it}^{D}$. Since Δe_{t}^{D} captures a common shock across all importers, differences in the shocks to the level of the firm-specific exchange rates must reflect differences in $\Delta FEX_{it}^{D} = \Delta e_{ct}^{D}$ (foreign exchange rates). Specifically, firms' initial values for σ_{i}^{D} will only predict gaps in ΔFEX_{it} if they predict differences in these foreign shocks across importers (Δe_{ct}^{D}). As we analyze responses to a *domestic* event (regime change), it is unclear why we should expect this pattern. Intuitively, the domestic currency should appreciate or depreciate in a similar way across importers with different σ_{i}^{D}. These changes would not be similar for firms with different dollar volatility only if the foreign exchange rates between countries with high versus low dollar volatility are also changing around the reform. The patterns documented in Figure 1 (Panel B) and Table 2 (Panel A) confirm the view that these changes to the level of exchange rates are not predicted by firms' initial values for σ_{i}^{D}.

Consider now the link between firms' exchange rate volatility and their initial values for σ_{i}^{D} across these regimes. Domestic shocks capture one source of exchange rate volatility faced by importers (domestic currency risk). As suggested by the discussion above, this domestic currency risk should be similar across importers and increase in a symmetric way when the regime changes. However, the dollar peg creates an asymmetry in the exposure of importers to foreign risks shaping their exchange rate volatility. Note that the dollar peg (initial regime) implies that $\Delta FEX_{it} = \Delta e_{ct} = -\Delta e_{ct}^{D} = -\Delta FEX_{it}^{D}$ (since Δe_{t}^{D}=0). This means that $\sigma_{i} = \sigma_{i}^{D}$, i.e., differences in dollar volatility translate one-to-one into differences in volatility in this regime. As shown in Table 1 (Panel C), there are significant differences across importers in dollar volatility. What factors explain these differences? One important factor are gaps in the exposure of importers to shocks to the dollar (dollar risk). When the dollar appreciates (or depreciates), firms importing from different countries of origin have different exposures to this shock. For example, differences in exchange rate regimes across foreign countries c can lead to such asymmetric exposure to dollar risk. Countries with a currency tied or pegged to the dollar (including the U.S. and other countries) will have low dollar volatility. Firms importing from such countries will then have low σ_{i} in the initial regime. In contrast, countries with currencies that are not tied to the dollar will have greater exposure to dollar risk and dollar volatility. Firms importing from such countries will then have higher σ_{i} in the initial regime. These differences in exposure to dollar risk across foreign currencies can also be explained by other considerations, such as the link between shocks to the dollar and capital flows.[34]

When the regime shifts and the domestic currency is allowed to float, this translates into asymmetric changes in dollar risk across firms. Firms with low dollar volatility become significantly exposed to dollar risk as the domestic currency now adjusts (appreciates or depreciates) in response to dollar shocks. In contrast, this increase in dollar risk is muted for firms with higher dollar volatility. As the domestic currency appreciates (depreciates) with respect to the dollar, the currency from the country of origin also appreciates (depreciates). This limits the effect of dollar shocks on the exchange rate between the domestic country and the country of origin. In other words, these firms are (partially) hedged and have a more limited exposure

[33] For example, in the case of the Brazilian currency (Real), the Euro-Real exchange rate can be determined using the Euro-Dollar exchange rate and the Dollar-Real exchange rate.

[34] For example, suppose periods where the dollar appreciates are associated with capital flows towards certain countries (including country A) and away from other countries (including country B). This would increase (reduce) the exposure of the currency from country B (A) to these dollar shocks.

to the increase in dollar risk. Therefore, the increase in dollar risk is concentrated among firms with lower dollar volatility.

To illustrate these points more formally, note that $\Delta FEX_{it} = \Delta e_t^D - \Delta FEX_{it}^D$ implies that $(\sigma_i)^2 = (\sigma_d^D)^2 + (\sigma_i^D)^2(1-2\gamma_i)$ in the new regime, where σ_d^D is the volatility of e_t^D (exchange rate between the dollar and the domestic currency), and $\gamma_i \equiv \frac{Cov(\Delta e_t^D, \Delta FEX_{it}^D)}{Var(\Delta FEX_{it}^D)}$ is the coefficient of a linear regression of Δe_t^D on a constant and $\Delta FEX_{it}^D = \Delta e_{ct}^D$ (using these daily values over the same period). This coefficient measures the extent to which a given change in ΔFEX_{it}^D is also matched with changes in Δe_t^D. When changes in $\Delta FEX_{it}^D = \Delta e_{ct}^D$ are associated with changes in Δe_t^D (same sign), they do not translate into changes in $\Delta FEX_{it} = \Delta e_{ct}$. Therefore, when γ_i is larger (more positive), a same value for σ_i^D will have a smaller (less positive) effect on σ_i. Intuitively, we should expect γ_i to be more positive when the dollar risk is important. Shocks to the dollar lead the dollar to appreciate or depreciate relative to both the domestic and foreign currencies, i.e., they have similar effects on Δe_{ct}^D and Δe_t^D. Therefore, in the new regime, the importance of dollar risk weakens any link between σ_i^D and σ_i. This captures the intuition discussed above.

To further illustrate these points, suppose that $\gamma_i = \gamma$, i.e., γ_i is constant across importers or their countries of origin and that $(\sigma_i^D)^2$ is constant across the regimes. As we move into the new regime, we can write the change in volatility for each importer as $(\sigma_i)^2 - (\sigma_i^D)^2 = (\sigma_d^D)^2 - 2\gamma(\sigma_i^D)^2$. As the domestic currency now fluctuates relative to the dollar, there is an increase in volatility across all importers. This increase is captured by the first term $(\sigma_d^D)^2$. However, this increase is matched with a source of decline in volatility: the previous hedging effect (the second term). When firms have low dollar volatility, their exchange rates are tied to the dollar and only the first effect is relevant. As firms have higher dollar volatility, the hedging effect becomes stronger and limits the exposure of firms to shocks to the dollar. This illustrates why the increase in volatility can be significantly larger for firms with lower dollar volatility. For example, when $\gamma = 1/2$, a gap of $-\Delta$ between two firms in their value for $(\sigma_i^D)^2$ translates into a differential increase in $(\sigma_i)^2$ equal to Δ. Given the importance of initial differences in dollar volatility across firms in the data (Panel C of Table 1), these differential shocks can be economically important. When $\gamma = 1/2$, the initial link between σ_i and σ_i^D disappears in the new regime. This shift from a one-to-one link into a zero link between σ_i and σ_i^D matches the empirical patterns across firms for the event here studied.[35]

These points can all be applied to the general case where firms import from an arbitrary number of countries. To see this, note that $\Delta e_{ct} = \Delta e_t^D - \Delta e_{ct}^D$ holds for all countries of origin for firm i. The definitions for ΔFEX_{it} and ΔFEX_{it}^D then imply that $\Delta FEX_{it} = \Delta e_t^D - \Delta FEX_{it}^D$ (same initial expression as before). This means that all the expressions and intuitions discussed above, derived from this initial expression, can be applied to this general case. One way to see these points in the general case is to interpret the weights (w_{ic0}) as determining a unique firm-specific country for each importer, with a currency determined as a linear combination of N_i currencies.

[35] In general, differences in σ_i^D could reflect gaps in dollar risk across countries or could represent gaps in foreign currency risk, i.e., importance of shocks to the foreign currencies of countries of origin, depreciating these currencies relative to all other currencies. One way to interpret γ is as capturing the contribution of dollar risk to these differences in σ_i^D across countries. This example with $\gamma = 1/2$ can be interpreted as a scenario where these two sources of risk (dollar and foreign currency risk) have the same importance. Therefore, as the dollar volatility increases, any increased exposure to foreign currency risk is offset by the hedging effect from the dollar risk.

Table 1
Summary Statistics

This table presents the summary statistics for the main variables used in the paper. Panel A shows summary statistics for the main sample used in the analysis, which includes importers (without exports) present in both 1998 and 1999. The unit of observation is a plant-month during 1998-1999. Panel B describes the subsample of skill-intensive plants, which includes all plants above the median in terms of their initial share of high skilled workers (*IPLaborSkill*). See Section 2.1 for more details on the construction of these samples. Panel C shows the distribution of *IFDollarERVol* in the main sample. This variable measures firms' initial exchange rate dollar volatility during the year prior to the shock (1998, before the change in exchange rate regime), calculated as an average across monthly volatilities during the year (annualized).

Panel A: Summary Statistics - Main Sample				
	Mean	**Median**	**Std. Dev.**	**Nobs**
High Skilled Net Hiring	0.051	0.000	0.820	90,882
High Skilled Emp Growth	-0.003	0.000	1.041	90,860
Low Skilled Net Hiring	0.014	0.000	0.826	90,882
Low Skilled Emp Growth	-0.036	0.000	0.955	90,860
Total Net Hiring	0.065	0.000	1.259	90,882
Total Emp Growth	-0.038	0.000	1.543	90,882
IFEmployment	666.4	253.3	1082.9	90,882
IFYoung	0.180	0.000	0.384	90,882
IFWage	805.1	699.6	425.2	90,882
IFLaborSkill	0.422	0.400	0.221	90,882
IPEmployment	96.404	49.143	165.404	90,882
IPYoung	0.487	0.000	0.500	90,882
IPWage	914.9	753.0	678.2	90,882
IPLaborSkill	0.511	0.481	0.286	90,882
IFImpRatio	0.059	0.014	0.121	90,882
Firm ERVol	0.129	0.089	0.095	90,882
IFDollarERVol	0.055	0.047	0.074	90,882

Panel B: Summary Statistics - Skill-Intensive Plants				
	Mean	**Median**	**Std. Dev.**	**Nobs**
High Skilled Net Hiring	0.069	0.000	1.074	45,428
High Skilled Emp Growth	-0.010	0.000	1.365	45,406
Low Skilled Net Hiring	-0.013	0.000	0.565	45,428
Low Skilled Emp Growth	-0.033	0.000	0.660	45,406
Total Net Hiring	0.056	0.000	1.303	45,428
Total Emp Growth	-0.043	0.000	1.645	45,428
IFEmployment	881.1	346.3	1308.1	45,428
IFYoung	0.219	0.000	0.413	45,428
IFWage	954.9	893.1	471.4	45,428
IFLaborSkill	0.563	0.536	0.193	45,428
IPEmployment	70.941	18.239	142.976	45,428
IPYoung	0.563	1.000	0.496	45,428
IPWage	1154.6	963.2	821.3	45,428
IPLaborSkill	0.754	0.753	0.171	45,428
IFImpRatio	0.074	0.022	0.141	45,428
Firm ERVol	0.129	0.109	0.093	45,428
IFDollarERVol	0.050	0.039	0.064	45,428

Panel C: Distribution of Initial Firm Dollar ER Volatility - Main Sample							
	Initial Firm Dollar ER Volatility (anualized)						
	5th Percentile	10th Percentile	25th Percentile	50th Percentile	75th Percentile	90th Percentile	95th Percentile
	0.000	0.004	0.013	0.047	0.082	0.088	0.117

Table 2
Shocks to Firms' Exposure to Exchange Rate Volatility

This table shows the construction of persistent shocks to firms' exposure to exchange rate volatility. Panel A analyzes how changes in the volatility and level of importers' exchange rates around the regime switch (aggregate shock) are related to firms' initial dollar volatility. The results are based on linear regressions predicting changes in these outcomes using firm-level differences in dollar volatility, firm controls, and fixed effects. The unit of observation is a plant and the sample includes all plants present at the end (last month) of the main sample. Differences in dollar volatility are captured by *Low_IFDVol* = *-IFDollarERVol*, where *IFDollarERVol* is the firm's initial dollar exchange rate volatility (before the shock). In columns (1) and (2), the outcome variable is Δ*FirmERVol*, the difference between the value of *FirmERVol* in the year after the aggregate shock relative to its value in the previous year. *FirmERVol* is average value of the firm's monthly exchange rate volatility (annualized) in each of these two years. In columns (3) and (4), the outcome variable is the cumulative depreciation of the firm's exchange rate (log difference) between one month before the shock and the subsequent twelve months. *Basic Firm Controls* include *IFYoung*, *IFSize*, and *IFWage*. To better capture their magnitude, the reported coefficients are multiplied by the standard deviation of *Low_IFDVol* in the sample. The coefficients in columns (1) and (2) are also divided by the mean of *FirmERVol* during 1998-1999 in the sample. Panel B constructs firm-specific shocks to importers' exposure to exchange rate volatility, which combine initial differences in dollar volatility and the importance of imports with the aggregate shock. The results are based on the estimation of Equation (2) using the main sample (Panel A of Table 1). The unit of observation is a plant-month. The outcome variable is *FirmERVolExp* = *IFImpRatio* × *FirmERVol,* where *IFImpRatio* measures firms' initial ratio of imports to sales (before the shock). *Post* is an indicator that equals one after the aggregate shock. *Firm and Plant Controls* include *IFYoung*, *IFSize*, *IFWage*, *IFLaborSkill, IPYoung, IPSize, IPWage, IPLaborSkill* and their interactions with *Post. Firm Dollar Vol Controls* include *IFYoung*, *IFSize*, *IFWage* in a symmetric way to *Low_IFDVol* (i.e., interacted with *IFImpRatio*, *Post* and *IFImpRatio* × *Post*). To better capture their magnitude, the reported coefficients are multiplied by the standard deviation of *Low_IFDVol* and the mean of *IFImpRatio* in the sample. The reported coefficients are then divided by the mean of *FirmERVolExp* in the sample. Industry (state) denote the firm's main industry (state). To capture firm-level effects, all regressions are weighted using 1/*IFNPlants*, where *IFNPlants* measures the firm's initial number of plants. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Initial Dollar Volatility and Shocks to the Volatility and Level of Firm Exchange Rates

	Main Sample Plants			
Outcome:	ΔFirmERVol		Cumulative Depreciation Firm ER	
	(1)	(2)	(5)	(6)
Low_IFDVol	0.626***	0.625***	-0.002	-0.002
	(0.016)	(0.016)	(0.002)	(0.002)
Observations	3,711	3,711	3,711	3,711
R-Squared	0.906	0.905	0.003	0.003
Industry × State FE	Yes	Yes	Yes	Yes
Basic Firm Controls	Yes		Yes	

Panel B: Predicting Shocks to Firms' Exposure to Exchange Rate Volatility

	Main Sample	
Outcome:	FirmERVolExp (= *IFImpRatio* × *FirmERVol*)	
	(1)	(2)
IFImpRatio × *Low_IFDVol* × *Post*	0.417***	0.421***
	(0.023)	(0.024)
R-Squared	90,882	90,882
Industry × State × Month FE	0.940	0.939
Firm and Plant Controls × Post	Yes	Yes
Firm Dollar Vol Controls	Yes	

Table 3
Firm Uncertainty and Total Employment

This table analyzes how firms adjust their total employment after persistent increases in firm-level uncertainty. The results are based on the estimation of Equation (1) using an instrumental-variable (IV) approach, where the first stage is given by Equation (2) (and shown in Panel B of Table 2). The analysis uses the main sample of importers (Panel A of Table 1), where the unit of observation is a plant-month. This IV approach uses *IFImpRatio* × *Low_IFDVol* × *Post* as an instrument for *FERVolExp* (= *IFImpRatio* × *FERVol*), while controlling for *IFImpRatio* × *Low_IFDVol*, *IFImpRatio* × *Post*, *Low_IFDVol* × *Post*, *IFImpRatio*, and *Low_IFDVol.* Firm-level uncertainty is captured by *FirmERVolExp* = *IFImpRatio* × *FirmERVol,* where *IFImpRatio* is the firm's initial ratio of imports to sales and *FirmERVol* is the importer's average exchange rate volatility in the year (before or after the shock). The outcome variables in Panel A are *Total Net Hiring* = *Total Hiring* - *Total Firing* and *Total Employment Growth. Total Hiring (Firing)* is the total number of workers hired (fired) in the plant during month *t* divided by the average employment of the plant across months *t* and *t*-1. *Total Employment Growth* is the change in total plant employment between month *t*-1 and *t* divided by the average employment of the plant across these two months. In Panel B, the outcome variables are *Total Hiring* and *Total Firing*. The outcome variable in Panel C is *Total Other Employment Adjustment* = *Total Employment Growth* - *Total Net Hiring,* and captures adjustments to total employment not explained by firms' hiring and firing decisions (mostly quits). *Firm and Plant Controls* include *IFYoung*, *IFSize*, *IFWage*, *IFLaborSkill*, *IPYoung*, *IPSize*, *IPWage*, *IPLaborSkill* and their interactions with *Post*. *Firm Dollar Vol Controls* include *IFYoung*, *IFSize*, *IFWage* in a symmetric way to *Low_IFDVol* (i.e., interacted with *IFImpRatio*, *Post*, and *IFImpRatio* × *Post*). To better capture their magnitude, the reported coefficients are multiplied by the mean of *IFImpRatio* and the mean of *FERVol* in the sample. All variables capturing monthly flows are annualized (multiplied by twelve). Industry (state) denote the firm's main industry (state). To capture firm-level effects, all regressions are weighted using 1/*IFNPlants*, where *IFNPlants* measures the firm's initial number of plants. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Effect on Total Net Hiring and Total Employment Growth

	Main Sample, IV Specification			
Outcome:	Total Net Hiring (= Hiring - Firing)		Total Employment Growth	
	(1)	(2)	(3)	(4)
FERVolExp (= *IFImpRatio* × *FERVol*)	-0.011**	-0.010***	-0.011**	-0.010*
	(0.0046)	(0.0035)	(0.0053)	(0.0052)
Observations	90,882	90,882	90,882	90,882
Industry × State × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes		Yes	

Panel B: Effect on Total Hiring and Firing Margins

	Main Sample, IV Specification			
Outcome:	Total Hiring		Total Firing	
	(1)	(2)	(3)	(4)
FERVolExp (= *IFImpRatio* × *FERVol*)	-0.010**	-0.010***	0.001	-0.001
	(0.0053)	(0.0035)	(0.0053)	(0.0041)
Observations	90,882	90,882	90,882	90,882
Industry × State × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes		Yes	

Panel C: Effect on Additional Margins

	Main Sample, IV Specification	
Outcome:	Total Other Emp Adj	
	(1)	(2)
FERVolExp (= *IFImpRatio* × *FERVol*)	-0.001	0.001
	(0.0028)	(0.0033)
Observations	90,882	90,882
Industry × State × Month FE	Yes	Yes
Firm and Plant Controls × Post	Yes	Yes
Firm Dollar Vol Controls	Yes	

Table 4
Firm Uncertainty, Skill-Intensive Plants, and Skilled Workers

This table examines how firms adjust their high and low skilled employment after persistent increases in firm-level uncertainty. The results are based on the estimation of Equation (1) using an instrumental-variable (IV) approach, where the first stage is given by Equation (2) (the first-stage specification and its variables are described in Panel B of Table 2). These results are separately estimated for skill-intensive plants and other plants by including interactions of all independent variables (including all fixed effects and controls) with both *Skill-Intensive Plant* and *Other Plant. Skill-Intensive Plant* is an indicator that equals one for plants above the median in terms of their initial share of high skilled workers (*IPLaborSkill*). *Other Plant* is an indicator that equals one for all other plants. In each of these subsamples, the same IV approach used in Table 3 is being (separately) implemented. The overall sample is the main sample of importers (Panel A of Table 1), where the unit of observation is a plant-month. Firm-level uncertainty is captured by *FirmERVolExp* = *IFImpRatio* × *FirmERVol*, where *IFImpRatio* is the firm's initial ratio of imports to sales and *FirmERVol* is the importer's average exchange rate volatility in the year (before or after the shock). The outcome variables in Panel A are *High Skilled Net Hiring* = *High Skilled Hiring* - *High Skilled Firing* and *High Skilled Employment Growth*. *High Skilled Hiring* (*Firing*) is the number of high skilled workers hired (fired) in the plant during month t divided by the average total employment of the plant across months t and t-1. *High Skilled Employment Growth* is the change in high skilled plant employment between month t-1 and t divided by the average total employment of the plant across these two months. In Panel B, the analysis uses outcome variables for low skilled workers, constructed in an analogous way to the ones for high skilled workers. Panel C shows results with alternative definitions for these outcomes variables, where adjustments or changes to high (low) skilled workers are now divided by the average high (low) skilled employment across months t and t-1 (as opposed to the average total employment in these months). These variables are otherwise defined in the same way as in Panels A and B. Panel D shows results where both *IFImpRatio* and *Low_IFDVol* are measured using additional lags (values in 1997) for firms' imports (see Section 2.1 for additional details). *Firm and Plant Controls* and *Firm Dollar Vol Controls* are defined in the same way as in Table 3. To better capture their magnitude, the reported coefficients are multiplied by the mean of *IFImpRatio* and the mean of *FERVol* in the sample. All variables capturing monthly flows are annualized (multiplied by twelve). Industry (state) denote the firm's main industry (state). To capture firm-level effects, all regressions are weighted using 1/*IFNPlants* , wher *IFNPlants* measures the firm's initial number of plants. *Differential Effect for Skill-Intensive Plants* shows the estimated differences between the coefficients for skill-intensive plants and other plants. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Effects on High Skilled Employment

	Main Sample, IV Specification					
Outcome:	High Skilled Net Hiring (= Hiring - Firing)			High Skilled Employment Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
FERVolExp × *Skill-Intensive Plant*	0.046***	0.047***	0.042***	0.043***	0.048***	0.038***
	(0.0101)	(0.0115)	(0.0105)	(0.0129)	(0.0152)	(0.0137)
FERVolExp × *Other Plant*	-0.011***	-0.010**	-0.009**	-0.008	-0.006	-0.006
	(0.0041)	(0.0043)	(0.0045)	(0.0075)	(0.0054)	(0.0059)
Observations	90,882	90,882	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Plants	0.056***	0.057***	0.051***	0.051***	0.054***	0.044***
	(0.0103)	(0.0119)	(0.0107)	(0.0132)	(0.0146)	(0.0136)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes		Yes	Yes	
Firm Dollar Vol Controls	Yes			Yes		

Panel B: Effects on Low Skilled Employment						
	Main Sample, IV Specification					
Outcome:	Low Skilled Net Hiring (= Hiring - Firing)			Low Skilled Employment Growth		
	(1)	(2)	(3)	(4)	(5)	(6)
FERVolExp × Skill-Intensive Plant	-0.005	0.003	0.003	-0.004	0.006	0.005
	(0.0081)	(0.0072)	(0.0068)	(0.0095)	(0.0133)	(0.0075)
FERVolExp × Other Plant	-0.011	-0.011	-0.010	-0.017**	-0.016***	-0.015***
	(0.0078)	(0.0072)	(0.0063)	(0.0066)	(0.0060)	(0.0055)
Observations	90,882	90,882	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Plants	0.006	0.013	0.012	0.013**	0.022*	0.020*
	(0.0092)	(0.0127)	(0.0119)	(0.0063)	(0.0129)	(0.0115)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes		Yes	Yes	
Firm Dollar Vol Controls	Yes			Yes		

Panel C: Results Using Alternative Outcomes				
	Main Sample, IV Specification			
Outcome:	High Skilled Net Hiring (Alternative)	High Skilled Emp Growth (Alternative)	Low Skilled Net Hiring (Alternative)	Low Skilled Emp Growth (Alternative)
	(1)	(2)	(3)	(4)
FERVolExp × Skill-Intensive Plant	0.069***	0.067***	-0.025	-0.021
	(0.0172)	(0.0217)	(0.0307)	(0.0304)
FERVolExp × Other Plant	-0.029**	-0.022***	0.004	0.004
	(0.0129)	(0.0073)	(0.0259)	(0.0228)
Observations	77,084	77,084	77,084	77,084
Differential Effect for Skill-Intensive Plants	0.099***	0.089***	-0.029	-0.025
	(0.0191)	(0.0257)	(0.0411)	(0.0367)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Panel D: Predicting Exposure to Shocks Using Additional Lags				
	Main Sample, IV Specification, Additional Lags			
Outcome:	High Skilled Net Hiring	High Skilled Emp Growth	Low Skilled Net Hiring	Low Skilled Emp Growth
	(1)	(2)	(3)	(4)
FERVolExp × Skill-Intensive Plant	0.034***	0.046***	-0.003	-0.006
	(0.0089)	(0.0151)	(0.0085)	(0.0065)
FERVolExp × Other Plant	-0.005**	-0.005*	-0.007	-0.011
	(0.023)	(0.0026)	(0.0058)	(0.0083)
Observations	77,082	77,082	77,082	77,082
Differential Effect for Skill-Intensive Plants	0.039***	0.051***	0.004	0.005
	(0.010)	(0.0163)	(0.0084)	(0.0073)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Table 5

Skill-Intensive Plants: Alternative Definitions

This table shows the baseline results from the paper (Table 4) using alternative approaches to capture skill-intensive plants. Panels A and B show the results from Table 4 (Panels A and B) with alternative definitions for *Skill-Intensive Plant*. In the first approach (*Most Workers*), *Skill-Intensive Plant* is an indicator that equals one if, prior to the shock, most of the plant's workers are high skilled workers, i.e., *IPLaborSkill* > 0.5. In the second approach (*Plant Wages*), *Skill-Intensive Plant* is an indicator that equals one for plants above the median in terms of their initial average wage (*IPWage).* All other variables are all defined in the same way as in Table 4. *Differential Effect for Skill-Intensive Plants* shows the estimated differences between the coefficients for skill-intensive plants and other plants. *Firm and Plant Controls* and *Firm Dollar Vol Controls* are defined in the same way as in Table 3. To better capture their magnitude, the reported coefficients are multiplied by the mean of *IFImpRatio* and the mean of *FERVol* in the sample. All variables capturing monthly flows are annualized (multiplied by twelve). Industry (state) denote the firm's main industry (state). To capture firm-level effects, all regressions are weighted using 1/*IFNPlants*, where *IFNPlants* measures the firm's initial number of plants. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Effects on High Skilled Employment

	Main Sample, IV Specification			
Outcome:	High Skilled Net Hiring (= Hiring - Firing)		High Skilled Employment Growth	
Skill-Intensive Plants Definition:	Most Workers	Plant Wages	Most Workers	Plant Wages
	(1)	(2)	(3)	(4)
FERVolExp × *Skill-Intensive Plant*	0.050***	0.016***	0.049***	0.018***
	(0.0139)	(0.0051)	(0.0171)	(0.0058)
FERVolExp × *Other Plant*	-0.011***	-0.006	-0.008	-0.006
	(0.0042)	(0.0067)	(0.0053)	(0.0073)
Observations	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Plants	0.061***	0.023***	0.057***	0.024**
	(0.0136)	(0.0083)	(0.0162)	(0.0102)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Panel B: Effects on Low Skilled Employment

	Main Sample, IV Specification			
Outcome:	Low Skilled Net Hiring (= Hiring - Firing)		Low Skilled Employment Growth	
Skill-Intensive Plants Definition:	Most Workers	Plant Wages	Most Workers	Plant Wages
	(1)	(2)	(3)	(4)
FERVolExp × *Skill-Intensive Plant*	-0.001	-0.001	0.003	-0.011
	(0.0085)	(0.0128)	(0.0098)	(0.0099)
FERVolExp × *Other Plant*	-0.011	-0.024**	-0.017***	-0.022***
	(0.0079)	(0.0118)	(0.0063)	(0.0065)
Observations	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Plants	0.009	0.022	0.019	0.011**
	(0.0132)	(0.0146)	(0.0127)	(0.0051)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Table 6

Firm Uncertainty and Skill-Intensive Plants: Hiring, Firing, and Other Margins

This table analyzes the different margins through which firms adjust their high and low skilled employment when faced with greater firm-level uncertainty. The results estimate the same specifications as in Table 4 (Panels A and B) with different outcome variables. Firm-level uncertainty is captured by *FirmERVolExp* = *IFImpRatio* × *FirmERVol*, where *IFImpRatio* is the firm's initial ratio of imports to sales and *FirmERVol* is the importer's average exchange rate volatility in the year (before or after the shock). *Skill-Intensive Plant* is an indicator that equals one for plants above the median in terms of their initial share of high skilled workers (*IPLaborSkill*). *Other Plant* is an indicator that equals one for all other plants. The outcome variables in Panel A are *High Skilled Hiring* and *High Skilled Firing*. *High Skilled Hiring* (*Firing*) is the number of high skilled workers hired (fired) in the plant during month *t* divided by the average total employment of the plant across months *t* and *t*-1. In Panel B, the analysis uses outcome variables for low skilled workers, constructed in an analogous way to the ones for high skilled workers.The outcome variables in Panel C are given by *High* (*Low*) *Skilled Other Employment Adjustment* = *High* (*Low*) *Skilled Total Employment Growth* - *High* (*Low*) *Total Net Hiring*. These variables capture adjustments to high and low skilled employment not explained by firms' hiring and firing decisions (mostly quits). The total employment and net hiring variables for high/low skilled workers are defined in Table 4. *Firm and Plant Controls* and *Firm Dollar Vol Controls* are also defined in the same way as in Table 4. To better capture their magnitude, the reported coefficients are multiplied by the mean of *IFImpRatio* and the mean of *FERVol* in the sample. All variables capturing monthly flows are annualized (multiplied by twelve). *Differential Effect for Skill-Intensive Plants* shows the estimated differences between the coefficients for skill-intensive plants and other plants. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Hiring Decisions

	Main Sample, IV Specification			
Outcome:	High Skilled Hiring		Low Skilled Hiring	
	(1)	(2)	(3)	(4)
FERVolExp × *Skill-Intensive Plant*	0.032**	0.033**	0.003	0.006
	(0.0139)	(0.0151)	(0.0037)	(0.0052)
FERVolExp × *Other Plant*	-0.010**	-0.010**	-0.010	-0.010
	(0.0046)	(0.0046)	(0.0083)	(0.0078)
Observations	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Plants	0.042***	0.043***	0.013	0.016
	(0.0146)	(0.0161)	(0.0119)	(0.0125)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes		Yes	

Panel B: Firing Decisions

	Main Sample, IV Specification			
Outcome:	High Skilled Firing		Low Skilled Firing	
	(1)	(2)	(3)	(4)
FERVolExp × *Skill-Intensive Plant*	-0.013	-0.014	0.008	0.004
	(0.0127)	(0.0192)	(0.0052)	(0.0032)
FERVolExp × *Other Plant*	0.001	-0.001	0.001	0.001
	(0.0011)	(0.0009)	(0.0033)	(0.0034)
Observations	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Plants	-0.014	-0.014	0.007	0.004
	(0.0125)	(0.0192)	(0.0052)	(0.0068)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes		Yes	

Panel C: Additional Employment Adjustments				
	Main Sample, IV Specification			
Outcome:	High Skilled Other Emp Adj		Low Skilled Other Emp Adj	
	(1)	(2)	(3)	(4)
FERVolExp × Skill-Intensive Plant	-0.003	0.001	0.001	0.004
	(0.0049)	(0.0049)	(0.0036)	(0.0046)
FERVolExp × Other Plant	0.003	0.003	-0.006	-0.005
	(0.0025)	(0.0023)	(0.0053)	(0.0052)
Observations	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Plants	-0.006	-0.002	0.007	0.008
	(0.0053)	(0.0035)	(0.0068)	(0.0059)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes		Yes	

Table 7

The Role of Firm Size and Age

This table analyzes the role of firm size and age in explaining differences across plants in their response to firm-level uncertainty. In Panel A, I replicate the baseline results (Panels A and B from Table 4) in the subsamples *Large Firm* and *Small Firm*. *Large Firm* and *Small Firm* include firms with an initial size (total employment, *IFEmployment*) above and below the sample median, respectively. When constructing the indicators *Skill-Intensive Plant* and *Other Plant* in each subsample, I use the median value of plants' initial share of high skilled workers (*IPLaborSkill*) in the subsample. Firm-level uncertainty is captured by *FirmERVolExp* = *IFImpRatio* × *FirmERVol*, where *IFImpRatio* is the firm's initial ratio of imports to sales and *FirmERVol* is the importer's average exchange rate volatility in the year (before or after the shock). The outcome variables *High* (*Low*) *Skilled Net Hiring* = *High* (*Low*) *Skilled Hiring* - *High* (*Low*) *Skilled Firing* are defined in Table 4. To better capture their magnitude, the reported coefficients are multiplied by the mean of *IFImpRatio* and the mean of *FERVol* in the sample. All variables capturing monthly flows are annualized (multiplied by twelve). *Firm and Plant Controls* and *Firm Dollar Vol Controls* are defined in the same way as in Table 4. *Differential Effect for Skill-Intensive Plants* shows the estimated differences between the coefficients for skill-intensive plants and other plants. Panel B shows results analogous to the ones in Table 4 (Panels A and B), where I replace the indicators *Skill-Intensive Plant* and *Other Plant* with alternative indicators capturing firm size (columns (1) and (2)) and firm age (columns (3) and (4)). *Large Firm* and *Small Firm* are indicators for the subsamples defined in Panel A. *Young Firm* and *Older Firm* are indicators that equal one for firms with an initial age (time since the firm first appeared in the data) smaller or equal to three years and greater than three years, respectively. All other variables and steps in the estimation of these results are the same as in Table 4. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Skill-Intensive Plants from Large and Small Firms

	Main Sample, IV Specification			
Outcome:	High Skilled Net Hiring		Low Skilled Net Hiring	
Subsample:	Large Firms	Small Firms	Large Firms	Small Firms
	(1)	(2)	(3)	(4)
FERVolExp × *Skill-Intensive Plant*	-0.048	0.048***	-0.004	-0.002
	(0.0331)	(0.0086)	(0.0388)	(0.0104)
FERVolExp × *Other Plant*	0.001	-0.016***	-0.041***	-0.003
	(0.0085)	(0.0091)	(0.0053)	(0.0261)
Observations	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Plants	-0.049	0.064***	-0.037	0.001
	(0.0328)	(0.0073)	(0.0359)	(0.0283)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Panel B: Uncertainty Effects by Firm Size and Age

	Main Sample, IV Specification			
Outcome:	High Skilled Net Hiring		Low Skilled Net Hiring	
	(1)	(2)	(3)	(4)
FERVolExp × *Large Firm*	-0.005		-0.033***	
	(0.0085)		(0.0114)	
FERVolExp × *Small Firm*	0.012		-0.006	
	(0.0107)		(0.0127)	
FERVolExp × *Young Firm*		-0.008		-0.002
		(0.0201)		(0.0281)
FERVolExp × *Older Firm*		0.001		-0.012
		(0.0045)		(0.0039)
Observations	90,882	90,882	90,882	90,882
Differential Effect for Large Firms	-0.017		-0.027*	
	(0.0160)		(0.0167)	
Differential Effect for Young Firms		-0.009		0.010
		(0.0189)		(0.0312)
Industry × State × Firm Type × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × Firm Type × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Table 8

Firm Uncertainty and Skill-Intensive Firms

This table analyzes the role of firms' skill intensity in explaining differences across plants in their response to firm-level uncertainty. Columns (1) and (2) show results analogous to the ones in Table 4 (Panels A and B), where we replace the indicators *Skill-Intensive Plant* and *Other Plant* with alternative indicators capturing firms' skill intensity. *Skill-Intensive Firm* is an indicator that equals one for firms above the median in terms of their initial share of high skilled workers (*IFLaborSkill*). *Other Firm* is an indicator that equals one for all other firms. All other variables and steps in the estimation of these results are the same as in Table 4. Columns (3)-(6) replicate the results in columns (1) and (2) using different outcome variables. In columns (3) and (4), the outcome variables *High Skilled Net Hiring* and *Low Skilled Net Hiring* are constructed in an analogous way to Table 4 but now only include the hiring and firing of workers at skill-intensive plants (as defined in Table 4). As in Table 4, the net hiring (hiring minus firing) of these workers is scaled by the average total employment of the plant across months t-1 and t. In columns (5) and (6), the outcome variables *High Skilled Net Hiring* and *Low Skilled Net Hiring* are constructed in the same way as in columns (3) and (4) but now focus on the hiring and firing of workers at other plants (not skill-intensive plants). Firm-level uncertainty is captured by *FirmERVolExp* = *IFImpRatio* × *FirmERVol*, where *IFImpRatio* is the firm's initial ratio of imports to sales and *FirmERVol* is the importer's average exchange rate volatility in the year (before or after the shock). To better capture their magnitude, the reported coefficients are multiplied by the mean of *IFImpRatio* and the mean of *FERVol* in the sample. All variables capturing monthly flows are annualized (multiplied by twelve). *Differential Effect for Skill-Intensive Firms* shows the estimated differences between the coefficients for skill-intensive firms and other firms. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Main Sample, IV Specification					
Outcome:	High Skilled Net Hiring	Low Skilled Net Hiring	High Skilled Net Hiring	Low Skilled Net Hiring	High Skilled Net Hiring	Low Skilled Net Hiring
	Jobs in All Plants		Jobs in Skilled-Intensive Plants		Jobs in Other Plants	
	(1)	(2)	(3)	(4)	(5)	(6)
FERVolExp × Skill-Intensive Firm	0.036***	-0.005	0.028***	-0.003	0.007	-0.002
	(0.0136)	(0.0111)	(0.0101)	(0.0092)	(0.0058)	(0.0028)
FERVolExp × Other Firm	-0.008**	-0.009	0.003	-0.002	-0.011***	-0.007
	(0.0041)	(0.0093)	(0.0027)	(0.0015)	(0.0034)	(0.0086)
Observations	90,882	90,882	90,882	90,882	90,882	90,882
Differential Effect for Skill-Intensive Firms	0.044***	0.004	0.026**	-0.001	0.018***	0.005
	(0.0163)	(0.0158)	(0.0122)	(0.0062)	(0.0062)	(0.0086)
Industry × State × SI Firm × Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Firm × Post	Yes	Yes	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 9
Results Using a Longer Time Horizon

This table shows the baseline results from the paper (Panels A and B of Table 4) using a longer sample period (1998-2000) to analyze how firms respond to increased uncertainty over a two-year period (1999 and 2000). The analysis uses an extended sample that covers importers (without exports) present in three subsequent years: 1998, 1999, and 2000 (see Section 4.6 for more details). Panel A shows the first-stage results using this longer horizon. The results replicate the ones from Panel B of Table 2 using the extended sample. Firm-level uncertainty is captured by *FirmERVolExp* = *IFImpRatio* × *FirmERVol*, where *IFImpRatio* is the firm's initial ratio of imports to sales and *FirmERVol* is the importer's average exchange rate volatility in the year (the year before the shock or one of the two years after the shock). Panels B and C show the estimated effects of firm-level uncertainty on plant outcomes using the same empirical specification and IV approach as in Table 4 (Panels A and B), but now implemented with the extended sample. All variables (including controls and outcome variables) in Panel A (Panels B and C) are defined in the same way as in Table 2 (Table 4). The reported coefficients in Panel A (Panels B and C) are also scaled in the same way as in Table 2 (Table 4). In Panels B and C, *Differential Effect for Skill-Intensive Plants* shows the estimated differences between the coefficients for skill-intensive plants and other plants. Panel D shows reduced-form results analyzing how firms respond to persistent shocks to uncertainty in both the first and second years after the shock. These results are based on the estimation of an extended version of Equation (2) using the subsample of skill-intensive plants (defined using *Skill-Intensive Plant* from Panels B and C). Equation (2) is extended to include indicators for each of the two separate years after the shock (*Post Year 1* and *Post Year 2*). *Year 1* and *Year 2* denote the first year (1999) and second year (2000) after the shock, respectively. The extended specification includes these two variables symmetrically in an analogous way to *Post* in Equation (2). All independent variables (including controls) are defined in the same way as in Panel B of Table 2. The variables previously interacted with *Post* are now separately interacted with *Post Year 1* and *Post Year 2*. The outcome variables are defined in the same way as in Panels B and C. To better capture their magnitude, the reported coefficients are multiplied by the standard deviation of *Low_IFDVol* and the mean of *IFImpRatio* in the sample. All variables capturing monthly flows are annualized (multiplied by twelve). To capture firm-level effects, all regressions are weighted using 1/*IFNPlants*, where *IFNPlants* measures the firm's initial number of plants. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Predicting Shocks to Firms' Exposure to Exchange Rate Volatility

	Longer Horizon Sample	
Outcome:	FirmERVolExp (= *IFImpRatio* × *FirmERVol*)	
	(1)	(2)
IFImpRatio × *Low_IFDVol* × *Post*	0.406***	0.407***
	(0.043)	(0.050)
Observations	129,915	129,915
R-Squared	0.871	0.864
Industry × State × Month FE	Yes	Yes
Firm and Plant Controls × Post	Yes	Yes
Firm Dollar Vol Controls	Yes	

Panel B: : Effects on High Skilled Employment

	Longer Horizon Sample, IV Specification			
Outcome:	High Skilled Net Hiring		High Skilled Employment Growth	
	(1)	(2)	(3)	(4)
FERVolExp × *Skill-Intensive Plant*	0.029***	0.035***	0.030***	0.040***
	(0.0096)	(0.0099)	(0.0110)	(0.0121)
FERVolExp × *Other Plant*	-0.020***	-0.018***	-0.012**	-0.011**
	(0.0055)	(0.0048)	(0.0058)	(0.0050)
Observations	129,915	129,915	129,915	129,915
Differential Effect for Skill-Intensive Plants	0.049***	0.053***	0.042***	0.051***
	(0.0133)	(0.0116)	(0.0142)	(0.0114)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes		Yes	

Panel C: : Effects on Low Skilled Employment				
	Longer Horizon Sample, IV Specification			
Outcome:	Low Skilled Net Hiring		Low Skilled Employment Growth	
	(1)	(2)	(3)	(4)
FERVolExp × *Skill-Intensive Plant*	-0.053***	-0.041***	-0.049***	-0.034**
	(0.0237)	(0.0124)	(0.0271)	(0.0153)
FERVolExp × *Other Plant*	-0.017	-0.013	-0.027	-0.026
	(0.0154)	(0.0157)	(0.0092)	(0.0096)
Observations	129,915	129,915	129,915	129,915
Differential Effect for Skill-Intensive Plants	-0.037***	-0.028	-0.022	-0.008
	(0.0109)	(0.0189)	(0.0146)	(0.0173)
Industry × State × SI Plant × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × SI Plant × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes		Yes	

Panel D: : Effects by Year - Reduced-Form Specification				
	Longer Horizon Sample, Skill-Intensive Plants			
Outcome:	High Skilled Net Hiring	Low Skilled Net Hiring	High Skilled Employment Growth	Low Skilled Employment Growth
	(1)	(2)	(3)	(4)
IFImpRatio × *Low_IFDVol* × *Post Year 1*	0.031***	-0.002	0.030***	-0.001
	(0.0064)	(0.0023)	(0.0082)	(0.0011)
IFImpRatio × *Low_IFDVol* × *Post Year 2*	-0.004	-0.023***	-0.004	-0.020***
	(0.0072)	(0.0040)	(0.0069)	(0.0065)
Observations	64,973	64,973	64,973	64,973
Industry × State × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × Post Variables	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Table 10
Hedged Firms

This table shows a robustness check on the main empirical approach used in the paper. The analysis examines the reduced-form effect of firms' exposure to import price volatility (due to exchange rate volatility) on hedged importers (that also export) and unhedged importers (with no exports). The analysis is based on the estimation of Equation (2) using subsamples of skill-intensive plants and other plants for each of these types of importers. The results are estimated using the same specification as in Table 2 (Panel B) with different outcome variables. The unit of observation is a plant-month. The outcome variables measure the net hiring (hiring minus firing) of high skilled and low skilled workers at the plant level and are defined in the same way as in Table 4. All independent variables (including all controls) and fixed effects are defined in the same way as in Panel B of Table 2. In Panels A and B, the subsamples of skill-intensive plants and other plants are constructed in the same way as in Table 4 and capture unhedged importers (with no exports). In Panels C and D, these subsamples are constructed using hedged importers. The overall sample is a sample of hedged importers (which also export) present in 1998-1999 (see Section 5). *Skill-Intensive Plants* are plants above the median in terms of their initial share of high skilled workers (*IPLaborSkill*) in this importer-exporter sample. *Other Plants* are all other plants in this sample. To better capture their magnitude, the reported coefficients are multiplied by the standard deviation of *Low_IFDVol* and the mean of *IFImpRatio* in the sample. All variables capturing monthly flows are annualized (multiplied by twelve). To capture firm-level effects, all regressions are weighted using 1/*IFNPlants*, where *IFNPlants* measures the firm's initial number of plants. Standard errors are heteroskedasticity robust and double clustered at the industry and state levels. The standard error for each estimate is reported inside brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: Main Results Using Reduced-Form Specification, Skill-Intensive Plants

	Main Sample - Skill-Intensive Plants			
Outcome:	High Skilled Net Hiring	High Skilled Emp Growth	Low Skilled Net Hiring	Low Skilled Emp Growth
	(1)	(2)	(3)	(4)
IFImpRatio × Low_IFDVol × Post	0.027***	0.025***	-0.003	-0.002
	(0.0050)	(0.0074)	(0.0048)	(0.0056)
Observations	45,454	45,454	45,454	45,454
Industry × State × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Panel B: Main Results Using Reduced-Form Specification, Other Plants

	Main Sample - Other Plants			
Outcome:	High Skilled Net Hiring	High Skilled Emp Growth	Low Skilled Net Hiring	Low Skilled Emp Growth
	(1)	(2)	(3)	(4)
IFImpRatio × Low_IFDVol × Post	-0.007***	-0.005	-0.008	-0.012***
	(0.0027)	(0.0035)	(0.0055)	(0.0044)
Observations	45,428	45,428	45,428	45,428
Industry × State × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

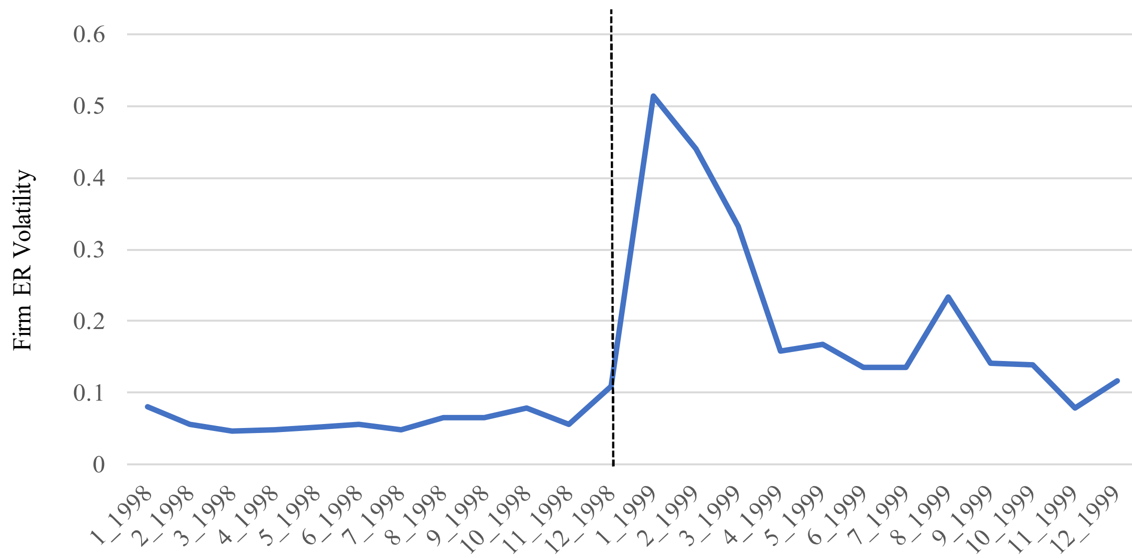
Panel C: Hedged Firms, Reduced-Form Results, Skill-Intensive Plants				
	Importer and Exporter Sample - Skill-Intensive Plants			
Outcome:	High Skilled Net Hiring	High Skilled Emp Growth	Low Skilled Net Hiring	Low Skilled Emp Growth
	(1)	(2)	(3)	(4)
IFImpRatio × *Low_IFDVol* × *Post*	-0.002	0.003	0.003	-0.001
	(0.0064)	(0.0047)	(0.0035)	(0.0041)
Observations	115,023	115,023	115,023	115,023
Industry × State × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

Panel D: Hedged Firms, Reduced-Form Results, Other Plants				
	Importer and Exporter Sample - Other Plants			
Outcome:	High Skilled Net Hiring	High Skilled Emp Growth	Low Skilled Net Hiring	Low Skilled Emp Growth
	(1)	(2)	(3)	(4)
IFImpRatio × *Low_IFDVol* × *Post*	-0.003	-0.003	-0.004	0.001
	(0.0020)	(0.0028)	(0.0059)	(0.0078)
Observations	115,021	115,021	115,021	115,021
Industry × State × Month FE	Yes	Yes	Yes	Yes
Firm and Plant Controls × Post	Yes	Yes	Yes	Yes
Firm Dollar Vol Controls	Yes	Yes	Yes	Yes

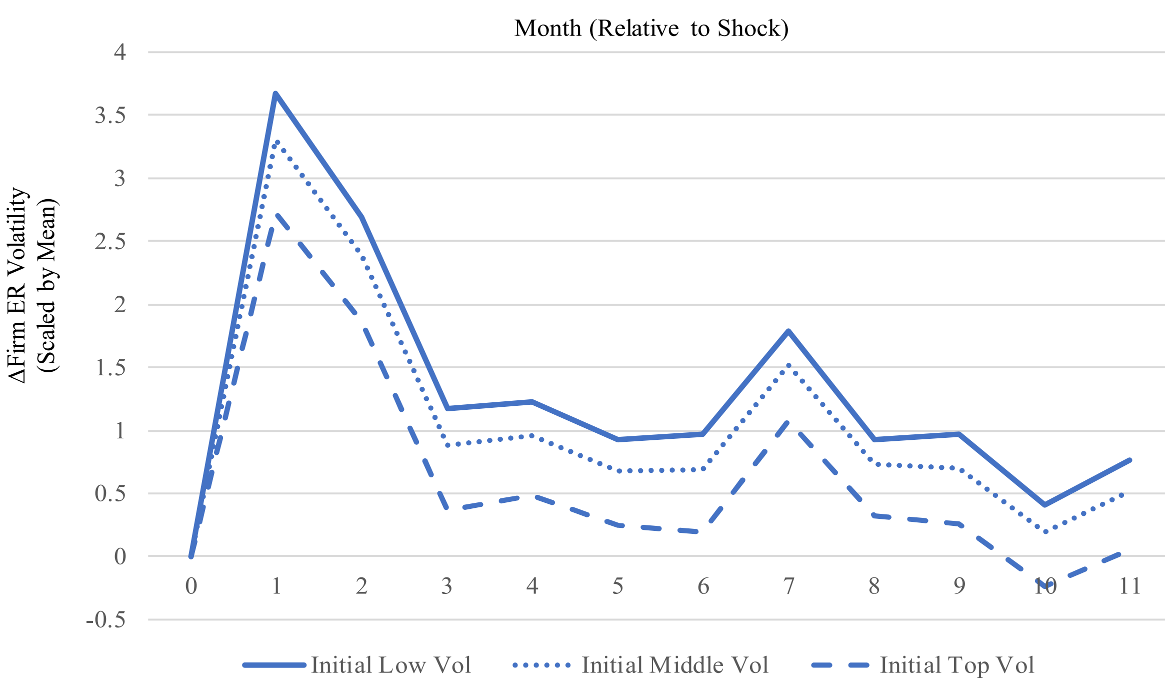
Figure 1
Firm Exchange Rate Volatility Around Shock

This figure shows patterns for the firm-level exchange rate volatility faced by importers in the main sample. Panel A shows aggregate patterns for this volatility around the change in exchange rate regime (shock) analyzed in the paper, which takes place during January 1999. For each month, the average value of *FirmERVol* in the month across all sample firms is reported (this monthly firm exchange rate volatility is annualized). Panel B shows average changes (after the shock) in the value of this volatility across three groups of firms: the three terciles of *IFDollarERVol*, which measures firms' initial exchange rate dollar volatility (prior to the shock). For each month t after the shock, the figure shows the difference between the mean of *FirmERVol* in the tercile during t relative to this mean during the year before the shock (average across the months of this initial year). To better capture its magnitude, this difference is divided by the average value of *FirmERVol* across all sample firms during 1998-1999. Panel C shows the average change in the level of firms' exchange rate (depreciation) between a date right before the shock (first day of January 1999) and the last day of month t. These patterns are shown for the same terciles analyzed in Panel B. The average log change across the exchange rates of all firms in the tercile is reported.

Panel A: Aggregate Patterns Around Change in Exchange Rate Regime



Panel B: Differential Patterns (Volatility) for Firms with Low Initial Dollar Volatility



Panel C: Differential Patterns (Level of Exchange Rate) for Firms with Low Initial Dollar Volatility