Market structure and exchange rate pass-through☆

Raphael A. Auer [a], Raphael S. Schoenle [b],*

[a] Swiss National Bank, Borsenstr. 15 P.O. Box Ch-8022, Zurich, Switzerland
[b] Mail Stop 021, Brandeis University, P.O. Box 9110, 415 South Street, Waltham, MA 02454, United States

A R T I C L E   I N F O

A B S T R A C T

We study firm-level pricing behavior through the lens of exchange rate pass-through and provide new evidence on how firm-level market shares and price complementarities affect pass-through decisions. Using U.S. import price micro data, we identify two facts: First, exactly the firms that react the most with their prices to changes in their own costs are also the ones that react the least to changing prices of competing importers. Second, the response of import prices to exchange rate changes is U-shaped in our proxy for market share while it is hump-shaped in response to the prices of competing importers. We show that both facts are consistent with a model based on Dornbusch (1987) that generates variable markups through a nested-CES demand system. Finally, based on the model, we find that direct cost pass-through and price complementarities among importers play approximately equally important roles in determining pass-through but also partly offset each other. This suggests that equilibrium feedback effects in import pricing are large. Omission of either channel in an empirical analysis results in a failure to explain how market structure affects price-setting in industry equilibrium.

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1. Introduction

A large empirical literature has studied exchange rate pass-through (ERPT) into import prices because this important topic in international macroeconomics relates to issues such as the movement of international relative prices, the adjustment of global imbalances, or business cycle co-movements. A common finding in the literature which has yielded many insights into firms' pricing behavior is that pass-through of cost shocks into prices is incomplete, even in the long run.[1]

One leading explanation for such incomplete pass-through is that firms adjust their markups to accommodate the local market environment, a channel first pointed out in Krugman, (1986), Helpman and Krugman (1987) and Dornbusch (1987) and more recently in Melitz and Ottaviano (2008), Atkeson and Burstein (2008), Chen et al.

[1] While some of these studies focus on structural analysis of exchange rate pass-through in single industries (see Knetter (1989) and Knetter (1992) and the analysis of pricing-to-market practices in the automobile sector in Feenstra et al. (1996), Verboven (1996), Goldberg and Verboven (2001), Goldberg and Verboven (2005), Hellerstein (2008) for the beer industry, and Nakamura and Zerom (2010) for the case of the coffee industry), our approach is more closely related to the reduced-form analysis of pass-through rates in datasets spanning many industries (see Gopinath and Rigobon (2008), Gopinath and Itskhoki (2010), Gopinath et al. (2010) and Nakamura and Steinsson (2008)). It is also related to the work of Fitzgerald and Haller (2013), who use plant-level prices of identical goods sold on different markets to study pricing-to-market decisions.

(2009), Berman et al. (2012) and Amiti et al. (2014), Amiti et al. (2015) and Pennings (forthcoming) for the case of heterogeneous firms.[2] Atkeson and Burstein (2008) in particular emphasize that within-sector firm heterogeneity in pricing behavior is essential in order to generate realistic aggregate price dynamics.

We contribute to this literature on exchange rate pass-through and variable markups by providing new empirical evidence on how firm-level market share proxies and price complementarities among importers affect pass-through decisions at the level of the firm, and how heterogeneities in firm-specific responses affect the rate of pass-through in industry equilibrium. We show that in order to explain average price responses, it is not enough to only take into account heterogeneity in the direct response of firms to cost shocks.

In particular, we first show that there is an important type of firm-level heterogeneity in pricing behavior that is undocumented to date and can help discipline our models: exactly the firms that react the most to changes in their own costs are also the ones that react the least to changing prices of competing importers. Second, we also provide new evidence that the rate at which a firm reacts to changing prices of competing importers is hump-shaped in market share. The rate, however, at which a firm reacts to changes in its own cost is U-shaped in market share.

We motivate and rationalize our stylized facts with a model of strategic oligopoly pricing following Dornbusch (1987) and Atkeson and Burstein (2008). Based on the model, we then show that these new heterogeneities are important for our understanding of industry equilibrium pricing. Quantitatively, we find that direct cost pass-through and price complementarities play approximately equally important roles in determining equilibrium pricing behavior, but also partly offset each other. This suggests that equilibrium feedback effects in pricing are large. Indeed, our results show that omission of either channel in an empirical analysis results in a failure to explain how market structure affects price dynamics.

We establish our results in three steps. In a first step, we present a simple theoretical model to guide our intuition about firm heterogeneity and equilibrium pricing. We show how market share affects the firm-level reaction to both own costs and competitor prices. We show this in the framework of strategic oligopoly pricing of Dornbusch (1987) and Atkeson and Burstein (2008). Specifically, we nest preferences following Burstein and Gopinath (2014), who map variation in cost pass-through and price complementarities at the country level into exchange rate pass-through for a wide class of pricing-to-market frameworks. However, we expand upon this framework by allowing for heterogeneity within countries. This leads to our testable expressions: for given own costs, import prices exhibit a hump-shaped reaction to competitor prices in market share while for given prices of competitors, the response to exchange rate changes is U-shaped in market share. The strength of the response to own cost shocks is negatively correlated with the response to competitor prices.

What is the intuition behind these exact shapes? The mechanisms of the model that underlie our predictions can easily be understood from the point of view of competition. A very large firm dominates the price index and can fully pass through its own cost shocks. Similarly, a tiny firm has no market share to lose and will also pass through cost shocks

fully. By the same token, the large firm will not care to react to its competitors as will the tiny firm. For intermediate market shares, the responses take a non-zero value. Very intuitively, then, pass-through of own costs and competitor prices must also be negatively correlated.

In a second step, we establish our novel empirical regularities that correspond to these predictions. First, we show that firms' pricing responses are heterogeneous along two important dimensions. To this purpose, we use U.S. firm-level micro data on prices, and construct proxies for firm-specific market share. Using these micro data, we document that while the rate at which a firm reacts to changes in its own cost is U-shaped in market share, the rate at which it reacts to competitor prices is hump-shaped in the proxy for market share. The first of these two results confirms previous findings from the literature that relate a firm's market share directly to exchange rate pass-through.[3] The second relationship is novel: we document that market share also affects the rate at which firms react to changing competitor prices and we show that exactly the firms that react the most to changes in their own cost react the least to changing competitor prices.

In a third step, we show that our intuition from the theoretical framework is important in explaining the cross-section of pass-through responses in the data. Using the micro data, we show that taking into account an industry's market structure and the interplay of heterogeneity in reaction to own cost and to the competition can improve our understanding of the cross-sectional variation in pass-through rates across industries and trade partners. We find that direct cost pass-through and price complementarities play approximately equally important roles in determining pass-through but partly offset each other. Specifically, to gauge the importance of the two channels, we follow the model and construct overall predicted price changes and the two components due to each channel. To do so, we take exchange rate movements to identify cost shocks in our model-implied expression for firms' equilibrium price responses. Then, together with the distribution of firms' market shares and origins, this allows us to construct overall predicted price changes for all firms. At the same time, as implied by the model, we construct one component of these predicted price changes as coming from price complementarities, and another from a firm's direct cost response. When we regress observed price changes on these two components, we find that not only are both statistically significantly related to price changes but also have the same economic importance. Overall, the actual and total predicted price changes are also related to each other. Regressions deliver highly significant coefficients.

We also document that our results have important aggregate implications. First, we find that the heterogeneous firm model of Atkeson and Burstein (2008) is able to deliver high predictive power for ERPT when we go to the aggregate level. To demonstrate this, we estimate sector and trade partner specific pass-through rates, and compare them to our theoretical benchmark as well as its two components. We find that estimated and predicted pass-through rates are significantly related, like for our result on price changes: a regression of estimated on predicted pass-through rates gives us a statistically highly significant coefficient of 0.73 for sector-country pairs, and 0.82 at the country level. Moreover, that both direct cost responses as well as price complementarities are equally important for understanding pass-through. Overall, we find that the calibrated model can explain approximately 29% of the variation in pass-through rates across countries.

Second, our results provide important guidance for researchers looking to model how market characteristics affect pass-through rates. For example, our findings shed light on why Gopinath and Itskhoki

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[2] Firm heterogeneity is only one of many dimensions along which pass-through rates differ. When evaluating prices at the dock (that is, net of distribution costs), other important dimensions include the currency choice of invoicing as in Gopinath et al. (2010), Goldberg and Tille (2009), Bacchetta and van Wincoop (2005), inter- versus intra-firm trade as in Neiman (2010), sectoral import composition as in Campa and Goldberg (2005), Goldberg and Campa (2010), and input-use intensity. When evaluating retail prices, the share of the distribution costs may matter for pass-through as found by Bacchetta and van Wincoop (2003) and Burstein et al. (2003), while the movement of margins seems to play only a minor role as shown in Goldberg and Hellerstein (2013). Generally, also the size and origin of the exchange rate movement matter for pass-through (see Michael et al. (1997) and Burstein et al. (2005, 2007) as does the general equilibrium interaction between exchange rate volatility, invoicing currency choice, and pass-through rates (see Devereux et al. (2004)).

[3] A U-shaped relation between market share and pass-through has originally been documented in Feenstra et al. (1996) for the case of country-specific market shares. For the case of firm-specific market shares, Berman et al. (2012) empirically document a monotonic relationship between firm size and pass through, while Garetto (2012), Devereux et al. (2015) and Yoshida (2013) document a U-shaped relation. Amiti et al. (2014) theoretically highlight the close analogy between the monotonic and U-shaped relations conditional on the in- or exclusion of the right set of fixed effects or on normalizing each firm's price change by the sectoral price index.