

Evidence on the credit channel of monetary policy: Solving causality by using the impossible trinity

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Abstract

We combine the credit channel of monetary policy transmission literature and the credit constraints and trade literature to examine how monetary policy affects exports through a credit channel. We identify exogenous monetary policy changes in exporting countries based on the "impossible trinity" theorem and make efforts to isolate the effects of monetary policy through changes in the real exchange rate and foreign demand. In a large sector uni-directional trade dataset for the years 1970-2010 we find strong evidence supporting the credit channel transmission of monetary policy on exports. The export-reducing effect of an exogenous monetary tightening (e.g., a large increase in the interest rate) is significantly amplified by various measures of sector financial constraints. Our results are also quantitatively meaningful and robust to alternative samples, measures of monetary policy stances, and model specifications.

Keywords: monetary policy transmission mechanism; trade; credit channel; credit constraints; the impossible trinity

JEL classification: E52, E44, F14, F33, F42

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1. Introduction

How does monetary policy affect the real economy including exports? How strong is the evidence on a credit channel of monetary policy? Do sector variations in the degrees of intrinsic dependence on external finance play a role? In this study, we aim to provide answers to the above important yet unexplored research questions. While the conventional wisdom holds that monetary policy affects exports through its effects on either the aggregate expenditure or the relative price of home to foreign goods, we investigate a new credit channel through which monetary policy can also have a significant impact on exports through changes in the degree of credit availability.¹

Our study is motivated by the credit channel of monetary policy transmission literature in monetary economics (e.g., Bernanke and Blinder, 1988, 1992; Bernanke and Gertler, 1989, 1990, 1995; Bernanke, Gertler and Gilchrist, 1996; Gertler and Hubbard, 1988; Gertler and Gilchrist, 1994; Kashyap, Stein and Wilcox, 1993; Kashyap, Lamont and Stein, 1994; Oliner and Rudebusch, 1995, 1996a, b; Cetorelli and Goldberg, 2008) and the recently-emerged credit constraints and exports literature in international trade (e.g., Manova, 2008; Mu ùls, 2008; Minetti and Zhu, 2010; Amiti and Weinstein, 2011; Ju and Wei, 2011; Manova, Wei and Zhang, 2011; Chor and Manova, 2012; Manova, forthcoming). The former posits that, credit market frictions often worsen during monetary tightening periods, and the resulting rise in the external finance premium amplifies the effects of tight monetary policy on the real economy. The latter literature, on the other hand, emphasizes the crucial role of access to external credit in facilitating firm export activities. According to studies in this literature, compared to domestic

¹ See, among others, Sekkat and Varoudakis (2000), Bernard and Jensen (2004), Baggs et al. (2009) and Berman et al. (2010) for the effects of exchange rate on trade. Also, see Mishkin (1995) for an excellent summary of the exchange rate channel.

production, exporting is more dependent upon external financing due to additional sunk and fixed costs associated with making market-specific investments, product customization and regulatory compliance as well as higher variable costs associated with international shipping, duties and freight insurance.² Taken together, if the credit channel is important, one would expect monetary policy to have a significant impact on a country's exports by affecting firms' ability to accessing external finance.

A challenge in empirical studies of the credit channel transmission (and monetary policy in general), however, is to sort out the causal effects of monetary policy. Previous studies in the credit channel literature typically identify tight-money episodes based on Romer-Romer dates or large increases in the federal funds rate (e.g., Bernanke and Blinder, 1992; Goodfriend, 1991; Kashyap, Stein and Wilcox, 1993; Gertler and Gilchrist, 1994; Oliner and Rudebusch, 1995, 1996a, b). The Romer-Romer dates address the endogeneity issue, but can only identify a very small number of policy changes which could be special and different from other more “normal” changes in monetary policies. They are also hard to be replicated for countries that do not make public their central banks' policy deliberation minutes. An obvious disadvantage of the approach using changes in the federal funds rate is that the identified monetary policy stances can still be endogenous as monetary authorities may respond to economic activities by adjusting their policy stances. Although some studies have attempted to cut through this identification problem by searching for asymmetric responses of small and large firms (e.g., Gertler and Gilchrist, 1994; Bernanke, Gertler and Gilchrist, 1996; Oliner and

² See, for example, Manova (forthcoming) for detailed discussions on the use of external finance in exporting.

Rudebusch, 1995,1996) to policy changes, there are still some concerns.³ To date, the literature has yet been able to find an effective way to identify an exogenous component of monetary policy *per se*.

We propose a new approach to solve this causality challenge by using the "impossible trinity" theorem in international finance. A well-known result of the Mundell-Fleming model (Fleming, 1962; Mundell 1963) is that it is impossible for a country to have the following three things simultaneously: an independent monetary policy, a fixed exchange rate, and an open capital account. In particular, a country that adopts a fixed change rate also has to passively import the monetary policy of the anchor currency country if capital is sufficiently mobile across national borders. This trilemma idea is not just a theoretical curiosity but strongly supported by recent empirical studies (e.g., Obstfeld and Taylor, 1997; 2003; 2004; Obstfeld, Shambaugh and Taylor, 2004; 2005; Aizenman, Chinn and Ito, 2008; Klein and Shambaugh, 2013). Following this idea, we restrict our sample to a set of exporting countries with a fixed exchange rate regime and a sufficiently open capital account. We then use monetary policy changes in the corresponding anchor currency country as exogenous monetary policy changes for the exporters in our sample.⁴ We also make efforts to isolate the effects of monetary policy through changes in the real exchange rate and foreign demand.

To test for the existence of a credit channel, we rely on the cross-sectional implications of the theory and explore sector variations in the degrees of technologically

³ On the one hand, firm size is a crude proxy for credit-market access and it may reflect other non-financial characteristics, which makes the results hard to interpret. On the other hand, the asymmetries may potentially be driven by the possibility that policy responds more to large firms' activities.

⁴ A related study by di Giovanni, McCrary and von Wachter (2009) use German interest rate as an exogenous policy shifter to study the effects of monetary policy on real output growth in several European countries.

determined financial constraints and examine how the effects of a tight monetary policy on exports vary across sectors. If tight monetary policy in an exporting country affects exports through its impact on credit availability, then one should expect to find a stronger export-reducing effect in financially more constrained sectors. Employing a large uni-directional sector level trade dataset for the years 1970-2010, we find strong evidence supporting the credit channel transmission of monetary policy on exports. In particular, the export-reducing effect of a tight monetary policy is found to be significantly stronger in financially more constrained sectors. Our empirical results are robust to alternative samples, measures of monetary policy, and estimation methods.

Our study makes several contributions to the relevant literatures. First, we propose a novel identification strategy of exogenous monetary policy in a cross-country setting based on the insight of impossible trinity in international finance. Second, we detect a new channel through which monetary policy can influence exports. We show that, by alternating credit supply conditions, monetary policy can also have a significant impact on exports and the effect is stronger in sectors that have greater intrinsic dependence on external finance. Finally, the findings in this paper complement nicely with existing empirical results in the credit constraints and trade literature (e.g., Manova, 2008; Mu ùls, 2008; Minetti and Zhu, 2010; Amiti and Weinstein, 2011; Manova, Wei and Zhang, 2011; Chor and Manova, 2012, Manova, forthcoming) that document a crucial role of credit constraints in trade.

The remainder of this paper is organized as follows. In Section 2, we discuss our empirical models and data. Section 3 tests our main hypothesis, and Section 4 explores further the role of financial development. Concluding remarks are offered in Section 5.

2. Econometric specifications and data

2.1. Empirical specifications and estimation issues

To empirically examine the above hypotheses, we employ an augmented gravity model estimation strategy that features uni-directional exports and separate time-varying importer and exporter fixed effects. The gravity model can be justified theoretically by alternative trade models (e.g., Anderson, 1979; Anderson and van Wincoop 2003; Deardoff, 1998) and has been successfully used in empirical studies on a variety of research questions (e.g., Frankel and Wei, 1993; Subramanian and Wei, 2007; Manova, Wei and Zhang, 2011; Manova, forthcoming). Specifically, we consider the following benchmark empirical specification to examine the effects of monetary policy on exports by sector:

$$\log Exports_{ijkt} = \beta_0 + \beta_1 \Delta anchormp_{it} * Fv_k + \beta_2 \Delta \log RER_{ijt} + Z(i, j)\gamma + \varphi_{it} + \varphi_{jt} + \varphi_k + \varepsilon_{ijkt} \quad (1)$$

The above empirical specification is motivated by recent theoretical work of Anderson and van Wincoop (2003), which emphasizes the importance of using uni-directional trade as the left-hand-side variable and controlling for separate time-varying exporter and importer fixed effects as proxy for "multilateral resistance".⁵

The dependent variable in Equation (1) is log exports from country i to (non-anchor) country j in sector k in year t . $\Delta anchormp_{it}$ is an exogenous change in the money market rate in the anchor currency country of exporting country i , and Fv_k represents an empirical measure of credit constraints at the sector level. Our main variable of interest is thus the interaction term of the exogenous monetary policy change in anchor currency country and the sector financial vulnerability measure, $\Delta anchormp_{it}*$

⁵ See Anderson and van Wincoop (2003) and Subramanian and Wei (2007) for more detailed discussions.

Fv_k . In particular, we expect to find a significantly negative interaction effect on exports. To account for the potential exchange rate channel of monetary policy transmission, we also control for the change in bilateral real exchange rate ($\Delta \log RER$) in the regression.⁶ $Z(i,j)$ is a set of standard country-pair level control variables commonly used in gravity model estimation. We include log distance and a group of bilateral binary variables, same-legal-system, common-language, common-border, FTA, and colonial-ties in $Z(i,j)$.⁷ Finally, φ_{it} , φ_{jt} , and φ_k are time-varying exporter, time-varying importer, and sector fixed effects, respectively. In the above specification, any time-varying exporter and importer specific variables such as their real GDP, real GDP per capita, real GDP growth and also the exogenous monetary policy variable, $\Delta anchormp_{it}$, are submerged by the inclusion of time-varying exporter and importer fixed effects.

Existing theoretical and empirical studies in the credit channel of monetary policy transmission literature (e.g., Gertler and Hubbard, 1988; Bernanke and Gertler, 1989; Stiglitz, 1992; Oliner and Rudebusch, 1996b) often show that a firm's balance sheet should affect its ability to borrow mainly after a significant monetary tightening (when net worth is low). To capture the potential nonlinear effects of monetary policy, we employ the following empirical model:

$$\log Exports_{ijkt} = \beta_0 + \beta_1 \Delta anchormp_{it} * Fv_k + \beta_2 \Delta anchormp_{it} * tight_{it} * Fv_k + \beta_3 \Delta \log RER_{ij} + Z(i, j)\gamma + \varphi_{it} + \varphi_{jt} + \varphi_k + \varepsilon_{ijkt} \quad (2)$$

⁶ A positive change means a real depreciation.

⁷ See the Data Appendix for detailed variable definitions. We do not include a binary variable for common currency in our gravity model. The reason is that this variable would be omitted in the estimation because we exclude importers that share the same anchor country with an exporter in our sample.

where $tight_{it}$ is a binary indicator of a significant monetary tightening event in the anchor currency country of exporting country i .⁸ The estimated coefficient on the triple interaction term, β_2 , would reveal whether the credit channel effects are indeed significantly stronger during tight-money periods as suggested by theory.

Finally, to further explore the impacts of financial development, we expand Equation (2) to include two additional interaction terms with exporting country's financial development:

$$\log Exports_{ijkt} = \beta_0 + \beta_1 \Delta anchormp_{it} * Fv_k + \beta_2 \Delta anchormp_{it} * tight_{it} * Fv_k + \beta_3 \Delta anchormp_{it} * Fv_k * Fd_{it} + \beta_4 \Delta anchormp_{it} * tight_{it} * Fv_k * Fd_{it} + \beta_5 \Delta \log RER_{ijt} + Z(i, j)\gamma + \varphi_{it} + \varphi_{jt} + \varphi_k + \varepsilon_{ijkt} \quad (3)$$

where Fd_{it} is an empirical measure of financial development in exporting country i . In Equation (3), our main variables of interest are the two interaction terms with financial developing, $\Delta anchormp_{it} * Fv_k * Fd_{it}$ and $\Delta anchormp_{it} * tight_{it} * Fv_k * Fd_{it}$. The estimated coefficients, β_3 and β_4 , would tell us whether financial development can significantly alleviate the adverse effects of credit constraints on exports by sector and whether financial development plays a more important role during tight-money periods.

In addition to the above empirical models, we also consider the following alternative specifications to ensure the robustness of our results: (1) add country-pair fixed effects; (2) add country-pair random effects; (3) adopt an instrumental variable regression approach by using anchor country' interest rate change as instrument for an exporting country's own interest rate change; (4) employ Helpman, Melitz, and Rubinstein's (2008) two-stage method to correct the biases associated with selection and the omission of the extensive margin due to ignoring zero trade flows.

⁸ See section 2.3 for details on indentifying exogenous monetary tightening dates in anchor currency countries.

2.2. Sample coverage and data sources

Our sample consists of 137 countries with comprehensive trade and economic data coverage. Country names are listed in Table 1. The full sample period covers the years 1970-2010.⁹ We obtain data from a variety of sources. The uni-directional sector trade data are mainly from the NBER-United Nations trade dataset, which is available till 2000. We then update the data to year 2010 using the Comtrade database. The NBER-United Nations sector trade data is at the SITC 4-digit level while the Comtrade data is at the HS 4-digit level. Since our measures of sector financial vulnerability are constructed at the ISIC 3-digit level, we match the SITC 4-digit and HS 4-digit product codes to those ISIC 3-digit categories. Interest rates and exchange rates are obtained from the IMF's International Financial Statistics while the CPI, real GDP growth and GDP deflator are drawn from World Bank's World Development Indicators. We obtain log distance and bilateral binary variables from Helpman, Melitz and Rubinstein (2008). Our empirical measures of credit constraints at the sector level are from Krosner, Laeven, and Klingebiel (2007), and financial development data are drawn from Beck and Demirgüç-Kunt (2009). Finally, we classify exchange rate regimes using Reinhart and Rogoff's (2004) de facto classifications and its subsequent update by Ilzetzki, Reinhart, and Rogoff (2011) and obtain measures of capital account openness from Chinn and Ito (2006) and Lane and Milesi-Ferretti (2007). Detailed variable definitions and data sources are listed in the Data Appendix.

2.3. Identifying exogenous monetary policy changes and significant tightening dates

⁹ The NBER-United Nations trade data is available for the years 1962-2000. Our sample starts from 1970 because the Chinn and Ito capital account openness index is only available for post-1970 period.

Our identification consists of the following three steps. First, we restrict exporters in our sample to countries that have a fixed exchange rate and a sufficiently open capital account. Second, we exclude exporting countries that adopted the Euro for the whole sample period. Due to the high levels of economic and monetary integrations among those countries, the anchor country's (Germany) monetary policy can be affected by weaker currency countries' political pressure and thus be endogenous even before the formal adoption of the common currency.¹⁰ The remaining exporters, according to the "impossible trinity" are those whose monetary policy is exogenously determined in anchor currency countries. For each exporter in the remaining sample, we then use changes in its anchor country's money market rate as an indicator of exogenous monetary policy changes. Similarly, we also identify significant monetary tightening dates in a corresponding anchor currency country and use them as exogenous monetary tightening events for an exporter. As a final step, for each exporter, we exclude further its exports to its anchor country as well as exports to countries that peg their currencies to the same anchor country as monetary policy in the anchor country can potentially have an impact on those countries' demand for imported goods.

Specifically, we define a fixed exchange rate as a hard peg according to Reinhart and Rogoff's (2004) and Ilzetzi, Reinhart and Rogoff's (2011) de facto exchange rate classifications and consider a country having a sufficiently open capital account if the corresponding Chinn and Ito's capital account openness index is above a certain threshold value. We choose the 90th percentile of the sample distribution of this index as the threshold value in our benchmark regressions. As illustrated in the first column of Table2,

¹⁰ In Section 3.3, we also included Euro exporters to the sample for the pre-1999 period as a robustness check.

among the 137 countries, 26 non-Euro exporters had episodes of both a hard peg and a sufficiently open capital account (a capital account openness index value above the 90th percentile of the sample distribution) and are thus included in our benchmark sample. To ensure robustness of our results, we use an alternative threshold value (75th percentile) of the Chinn and Ito index and employ a de facto measure of capital account openness based on the work of Lane and Milesi-Ferretti (2007). Columns (2)-(4) of Table 2 show that the numbers of non-Euro exporters included in those alternative samples range from 20-41. Finally, we add to our benchmark sample Euro area exporters with sufficiently open capital accounts for the pre-1999 period as an additional robustness check. According to the last column of Table 2, there are a total of 36 exporting countries included in that sample.

Using Ilizetki, Reinhart and Rogoff's (2011) country chronologies of exchange rate arrangements, we identify a total of six anchor currency countries, Australia, France (in pre-euro years), Germany (in pre-euro years), the U.K., the U.S., and the Euro area (for the years 1999 and 2000). In our benchmark regressions, we define exogenous significant tightening events (*Tight*) for each exporter as years in which its corresponding anchor country's money market rate rose by at least 2.5 percentage points.¹¹ In addition to the benchmark significant tightening measure, we also employ other definitions, such as using an alternative threshold value or changes in an anchor country's term spreads between money market rates and long-term government bond rates to redefine tightening dates or using the Romer-Romer dates to ensure the robustness of our results. Table 3 shows the identified significant tightening events based on different criteria.

¹¹ This threshold value is close to the 90th percentile of sample distribution of the annual change in anchor currency countries' money market rates.

2.4. Empirical measures of credit constraints and financial development

The empirical measures of credit constraints and financial development are fairly standard in the literature. It is a common practice in both the credit constraints and growth literature (e.g., Rajan and Zingales, 1998; Claessens and Laeven, 2003; Krosner, Laeven, and Klingebiel, 2007) and the credit constraints and trade literature (e.g., Manova, Wei and Zhang, 2011; Chor and Manova, 2012; Manova, forthcoming) to use US firm level data to construct sector level measures of financial constraints. These measures typically reflect technologically determined sector characteristics that are inherent to the nature of the manufacturing process and beyond the control of individual firms. Following Krosner, Laeven, and Klingebiel (2007) and Manova, Wei and Zhang (2011), here we consider three commonly-used measures of sector financial vulnerability.

The first measure captures firms' dependence on external finance for long-term investment and is constructed as the share of capital expenditures not financed with cash flows from operations. The second measure reflects asset intangibility and is defined as the one minus the share of net plant, property and equipment in total book-value assets. Finally, we also use the ratio of inventories to sales to proxy firms' dependence on external financial for short-term working capital.^{12,13} Firms are financially more vulnerable in sectors with higher levels of dependence on external finance for long-term investment, asset intangibility, and inventories to sales ratios. We, therefore, expect an exogenous change in exporting country's monetary policy to have a more pronounced effects on exports in financially more vulnerable sectors.

¹² See Krosner, Laeven, and Klingebiel (2007) and Manova, Wei, and Zhang (2011) for detailed discussions of these sector financial vulnerability measures.

¹³ We have also tried to use the first principal component of the three measures, the results are similar.

To measure financial development, we also follow the standard practice in the literature and use private credit as a percentage of GDP from Beck and Demirgüç-Kunt (2009) as an indicator of financial development at the country level.

3. Main Empirical results

3.1. Benchmark regression results

This section reports our main results on the role of credit constraints in determining the effect of a monetary tightening on exports by sector. Table 4 shows our benchmark regression results from Equation (1). The three columns correspond to our three sector financial vulnerability measures. The overall fit of the regressions is quite reasonable as the estimated R-squared is around 0.59 in each column. The estimated coefficients on the interaction terms are negative and statistically significant at the 1% level in all regressions, indicating that an exogenous increase in anchor country's interest rate reduces exports significantly more in sectors with higher levels of financial constraints. Quantitatively, the results in Column (1) show that a one-percentage-point increase in anchor currency interest rate would reduce exports in the sector at the 90th percentile of the distribution by external finance dependence by 3.4 percentage points more than its exports in the sector at the 10th percentile. Similarly, Column (2) suggests that a one-percentage-point increase in anchor currency interest rate would reduce exports in the sector at the 75th percentile quartile of the distribution by asset intangibility by 3.5 percentage points more than its exports in the sector at the 25th percentile. The evidence from the benchmark regressions thus supports strongly our hypothesis that an increase in the interest rate has a significantly larger negative causal

effect on exports in financially more constrained sectors due to the existence of a credit channel.

As for the control variables, we find that distance is negatively associated with export volumes but common legal system, common language, and FTA significantly promotes bilateral trade. Other control variables are statistically insignificant.

3.2. The non-linear effect of a monetary tightening

The above results illustrate the average causal effect of an increase in the interest rate on exports by sector. The theory of credit channel of monetary transmission, however, predicts that a firm's balance sheet should affect its ability to borrow mainly during significant monetary tightening periods. To explore this potential non-linear effect, we add a triple interaction term, $\Delta anchor_{it} * tight_{it} * Fv_k$ to the benchmark empirical model, where *tight* is a binary indicator of an exogenous significant tightening event (sufficiently large increase in anchor country's interest rate) that takes the value of unity if anchor country's money market rate increases by at least 2.5 percentage points in a year.

Table 5 demonstrates the results. The estimated coefficients reported in the second row show the effects of monetary policy during a significant tightening event while those reported in the first row illustrate the effects in all other times. We find that, once the triple interaction term is added to the regressions, the estimated coefficients in the first row now have mixed signs and one of them becomes statistically insignificant. The estimated coefficients in the second row, however, are all negative and highly significant at the 1% level. Moreover, we find that the estimated coefficients in the second row are quantitatively much larger than those reported in the first row. For

example, Column (1) suggests that, during a significant tightening period, a one-percentage-point increase in anchor currency interest rate would reduce exports in the sector at the 90th percentile of the distribution by external finance dependence by 11.3 percentage points more than its exports in the sector at the 10th percentile. An exogenous significant tightening event, therefore, would reduce exports in the sector at the 90th percentile of the distribution by external finance dependence by at least 28.3 (11.3*2.5) percentage points more than its exports in the sector at the 10th percentile. As another example, the results in the last column indicate that an exogenous significant tightening would reduce exports in the sector at the 90th percentile of the distribution by dependence on external finance for working capital by at least 47.8 percentage points more than its exports in the sector at the 10th percentile. The evidence thus strongly supports the theoretical prediction that the credit channel of monetary policy works mainly during tight-money periods .

3.3. Robustness checks

The results reported in Tables 4 and 5 are strongly in favor of our hypotheses. In this subsection, we conduct a series of sensitivity analyses to check whether our main results are robust to alternative definitions of monetary tightening, samples, and model specifications. For the sake of saving space, we shall only reported the estimated coefficients on the two interaction terms between monetary policy and sector measure of credit constraints, $\Delta anchormp_{it} * Fv_k$ and $\Delta anchormp_{it} * tight_{it} * Fv_k$.

We first examine whether our results are robust to alternative definitions of significant tightening events and report the results in Table 6. In Panel A, we redefine a significant tightening event as the year in which an anchor currency country's monetary

market rate rose above 1.5 percentage points. Compare to the benchmark definition, this new criterion is less restrictive.¹⁴ Nevertheless, using this new monetary tightening definition does not alter our findings. We continue to find larger trade-reducing effects in financially more constrained sectors. The estimated coefficients on the triple interaction terms are negative, highly significant, and quantitatively large in all three columns.

Since the short-term nominal interest rate may reflect not only monetary policy stance but inflation as well, previous studies in the literature have also identified monetary policy stances based on large increases in the term spread between the short-term nominal interest and the long-term government bond rate (e.g., Laurent, 1988; Goodfriend, 1991; Bernanke and Blinder, 1992; Kashyap, Stein and Wilcox, 1993; Oliner and Rudebusch, 1996b). In panel B of Table 6, we follow this alternative approach and consider a year in which an anchor country's term spread rose by at least 2 percentage points a significant tightening event.¹⁵ The results are consistent with previous ones as the estimated coefficients reported in the second row of Panel B still remain negative and statistically significant.

Based on the reading of the narrative history of the Federal Reserve, the Romer dates identified by Romer and Romer (1989, 1994) are also commonly used in previous studies that focus on the U.S. experience. Here we employ the Romer-Romer dates to conduct an additional sensitivity analysis. In Panel C, we restrict our sample further to including only exporters that peg their currencies to the U.S. dollar and have sufficiently open capital accounts and use the Romer-Romer dates as exogenous

¹⁴ The alternative threshold value is close to the 75th percentile of sample distribution of the annual change in anchor currency countries' money market rates.

¹⁵ This threshold value is close to the 90th percentile of sample distribution of the annual change in anchor currency countries' term spreads.

significant tightening dates for those exporters.¹⁶ The estimated triple interaction effects have correct signs and are significant, indicating that an exogenous monetary tightening (a large increase in the federal funds rate) in the U.S. reduces a dollar pegging country's exports significant more in sectors with higher levels of credit constraints.

In the second set of robustness checks, we test if our results hold in different samples. To account for the possibility that the anchor country's monetary policy was actually not affected by political pressure from weak currency countries before the formal establishment of the Euro in 1999, in Panel A of Table 7, we now add to our benchmark sample Euro area exporters with a fixed exchange rate and sufficiently open capital accounts for the pre-1999 period. In Panel B, we restrict our sample to years 1970-1989 as most of the identified significant tightening events occur in the pre-1990 era. Panel C drops the years 1970-1975 and 2007-2010 to isolate the potential effects associated with the collapse of the Bretton Woods system and the recent global financial crises. We find that our main results are not sensitive to the choices of countries or sample periods. The estimated coefficients on the triple interaction terms all have correct signs and are significant at least at the 5% level, suggesting that a monetary tightening reduces exports more in financially more vulnerable sectors.¹⁷

Next, in Table 8, we test whether our results are sensitive to alternative threshold values of the Chinn and Ito's index of capital account openness and to using the de facto capital account openness measure. Panel A uses the 75th percentile of the sample

¹⁶ According to Romer and Romer (1989, 1994), the Romer dates in our sample period are April 1974, August 1978, October 1979, and December 1988. Since we use annual data, we consider years 1974, 1978, 1979 and 1989 as monetary tightening years in the U.S.. We chose year 1989 because the tightening in December 1988 is more likely to affect a pegging country's exports in year 1989 rather than year 1988. We also tried to use years 1974, 1978, 1980 and 1989 as tightening years, the results are similar.

¹⁷ We also tried other ways to split the sample, such as splitting the full sample into a pre-1985 subsample and post-1985 subsample. The results are similar.

distribution of the Chinn and Ito's index as the threshold value for capital account openness. Under this less restrictive definition of capital account openness, the number of exporters included in sample now increases to 35. In Panels B and C, we employ the Lane and Milesi-Ferretti's (2007) de facto capital account openness measure defined as the ratio of total external assets and liabilities to GDP. The threshold values considered in the two panels are the 90th percentile and the 75th percentile of the sample distribution of the de facto measure, respectively. The corresponding number of exporters included in the samples are 20 in Panel B and 41 in Panel C. The evidence suggests that our results are not driven by the choices of threshold values or indices of capital account openness. We continue to find strong evidence that an exogenous monetary tightening has significantly stronger trade-reducing effects in sectors with higher levels of credit constraints.

Table 9 checks the sensitivity of our results to additional controls in the gravity model. A potential concern of our results is that an anchor country's policy change can affect trade through its impact on foreign demand rather than exporters' credit conditions. We have already addressed this concern by excluding exports to the anchor country and to countries that also peg to the same currency and by including time-varying importer fixed effects to control for importers' demand conditions (such as real GDP growth). Here in Panels A, we add further to the gravity model the interaction of monetary policy with importers' real GDP growth as an additional control to account for any potential interaction effects of monetary policy and demand conditions in an importing country. The results indicate that controlling for the interaction of monetary policy and importer real GDP growth does not change our findings. Regressions in Panel B include

interactions of monetary policy with sector measures of physical and human capital intensities to make sure that our previous results are not driven by the omission of the potential interaction effects of monetary policy and other sector characteristics. Controlling for physical and human capital intensities does not change our results either.

In Table 10, we examine further if our results are sensitive to alternative estimation methods. In addition to the time-varying exporter and importer fixed effects, we also control for country-pair fixed and random effects in Panels A and B, respectively. In Panel C, we take an instrumental variable approach and report the results from two-stage least square (2SLS) regressions. We use anchor country interest rate change*external finance dependence and anchor country interest rate change*significant tightening dummy*external finance dependence as instruments for exporter interest rate change*external finance dependence and exporter interest rate change*exporter significant tightening dummy*external finance dependence.¹⁸ Another potential concern about our previous results is that we have been focusing on a sample that includes positive-trade observations only. In an influential paper, Helpman, Melitz and Rubinstein (2008) demonstrate convincingly that ignoring the zero-trade observations will lead to biased estimates due to both selection and (more importantly) the omission of the extensive margin. The authors also develop a two-stage estimation procedure to correct the biases. Here we apply this method to our data and report the results in Panel D.¹⁹ Our main results hold strongly regardless of the empirical models we choose to adopt. In each panel, we find that the estimated coefficients on the interaction terms have expected signs and are significant in most cases, indicating that an exogenous monetary tightening

¹⁸ An exporter significant tightening event is defined as an at least 2.5 percentage point increase in an exporting country's own interest rate.

¹⁹ Following their study, we also use the common religion variable as the excluded variable.

reduces exports more in financially more constrained sectors. It is also interesting to note that the first-stage HMR results reported in Panel D suggest that an exogenous significant tightening event has larger adverse effect in financially more constrained sectors even on the extensive margins (probability of exporting). The estimated marginal effects of anchor country interest rate change*tightening*external finance dependence are all negative and significant.

Finally, we search for additional evidence in Table 11 by testing if monetary policy (a significant tightening event in particular) can also affect the extensive margins of trade through a credit channel. Panels A-D report the effects of monetary policy on number of (HS 4-digit) exporting products by (3-digit ISIC) sector, number of exporting destinations by sector, number of exporting destination-product pairs by sector, and number of (HS 4-digit) exporting products by sector and destination, respectively. The overall evidence suggests that a monetary tightening has larger negative effects on the extensive margins in financially more constrained sectors as the estimated coefficients on the triple interaction terms are mostly negative and significant. The only exceptions are the interaction effects associated with inventories ratio in Panels B and C. They are positive and significant.

All in all, the above sensitivity analyses deliver a fairly consistent message. That is, credit constraints play a crucial role in determining the effects of a monetary tightening on exports, and financially more constrained sectors are affected significantly more negatively. This consistency allows us claim the existence of a credit channel with greater confidence.

4. The role of financial development

The empirical results in Section 3 suggest that credit constraints can significantly amplify the negative effects of tight monetary policy on exports. In this section, we explore further the role of an exporting country's financial development in determining the effect of an exogenous monetary tightening. We suspect that, by reducing financial market frictions at the country level, financial development may help alleviate the adverse impact of credit constraints on exports.

To test this hypothesis, we estimate Equation (3) for each sector financial vulnerability measure and report the results in Table 12. To save space, we only report the estimated coefficients on our variables of interest, $\Delta anchormp_{it} * Fv_k * Fd_{it}$ and $\Delta anchormp_{it} * tight_{it} * Fv_k * Fd_{it}$. Panel A of Table 12 uses our benchmark definition of a monetary tightening. We also consider three alternative ways of defining significant tightening events in the next three panels. Panel B uses 1.5 as the threshold value, Panel C identifies tightening events using the term spread, and Panel D uses the Romer-Romer dates as significant tightening dates in the U.S.. Overall the estimation results reported in Table 12 are supportive to our hypothesis. In most cases, the estimated coefficients are positive and significant on the quadruple interaction term, $\Delta anchormp_{it} * tight_{it} * Fv_k * Fd_{it}$. Also they are quantitatively much larger than the estimated coefficients on the triple interaction term, $\Delta anchormp_{it} * Fv_k * Fd_{it}$. Taken together, the evidence suggests that financial development helps alleviate the adverse effects of credit constraints on exports during tight-money periods.

5. Conclusions

Motivated by the credit channel of monetary policy transmission literature and the credit constraints and trade literature, we propose a new credit channel through which monetary policy can potentially have a significant impact on exports. We argue that, by making external finance more costly/difficult to obtain, a tight monetary policy should have significantly affects exports in a credit constrained environment.

We then employ the cross-sector variations in degrees of technologically determined financial constraints and also cross-country variations in financial development to empirically test the above hypothesis. An important innovation of our study is to identify exogenous monetary policy changes for an exporter based on the "impossible trinity" theorem. We also make efforts to isolate the effects of monetary policy on exports through changes in the real exchange rate and foreign demand. Employing a gravity model approach and a large sector bilateral trade dataset for the years 1970-2010, we find strong evidence supporting the credit channel transmission of monetary policy on exports. We show that the export-reducing effect of a tight monetary policy is significantly larger in financially more constrained sectors. We also demonstrate that, by relaxing credit constraints at the country level, financial development can indeed significantly alleviate the impact of credit constraints. Our empirical results are robust to alternative samples, measures of monetary policy, model specifications and estimation methods.

Our result contribute to both the credit channel of monetary policy transmission literature and the credit constraints and trade literature. On the one hand, we show that monetary policy can also have a significant effect on a country's exporting activities through a credit channel. On the other hand, our results are supportive to the argument of

credit constraints and trade literature (e.g., Amiti and Weinstein, 2008; Chor and Manova, 2011; Manova, forthcoming, Manova, Wei, and Zhang, 2011; Minetti and Zhu, 2010) that emphasizes the importance of credit constraints in determining a country's exports.

Data Appendix

Trade data: The sector level trade data comes from the NBER-United Nations trade dataset downloaded from Robert Feenstra's website and also the Comtrade database. The former contains the uni-directional export data at the SITC 4-digit level while the latter is at the HS 4-digit level. Since our measures of sector financial vulnerability are constructed at the ISIC 3-digit level, we match the SITC 4-digit and HS 4-digit product codes to those ISIC 3-digit categories. The export flows are measured in constant 2000 U.S. dollar using the U.S. GDP deflator data obtained from the World Bank's World Development Indicators.

Country-level data: Money market rates, long-term government bond rates, and nominal exchange rates to the U.S. dollar are obtained from the IMF's International Financial Statistics. The CPI, real GDP growth rate, and GDP deflator are drawn from World Bank's World Development Indicators. Exchange rate regime and arrangement information is obtained from Reinhart and Rogoff's (2004) and Ilizetzi, Reinhart and Rogoff's (2011). The de jure and de facto capital account openness indices are from Chinn and Ito (2006) and Land and Milesi-Ferretti (2007), respectively. Financial development is measured as private credit as a percentage of GDP and is obtained from Beck and Demirgüç-Kunt (2009). The Romer-Romer dates are from Romer and Romer (1989, 1994).

Country-pair-level data: Bilateral real exchange rate depreciation is calculated by using each party's nominal exchange rate to the U.S. dollar and are adjusted for CPI changes. Log distance and bilateral binary variables are all from Helpman, Melitz, and Rubinstein (2008).

Sector-level data: Sector financial vulnerability measures are from Krosner, Laeven, and Klingebiel (2007) and Monova, Wei and Zhang (2011).

References

Aizenman, Joshua, Menzie D. Chinn, and Hiro Ito. 2008. "Assessing the emerging global financial structure: Measuring the trilemma's configuration over time." *NBER Working Paper* 14533.

Amiti, Mary and David Weinstein. 2011. "Exports and financial shocks." *Quarterly Journal of Economics* 126, 1841-1877.

Anderson, James E.. 1979. "A theoretical foundation for the gravity equation." *American Economic Review* 69(1), 106–116.

Anderson, James E. and Eric van Wincoop. 2003. "Gravity with gravitas: A solution to the border puzzle," *American Economic Review* 93 (1), 170-192.

Baggs, Jen, Eugene Beaulieu, and Loretta Fung. 2009. "Firm survival, performance, and the exchange rate shocks." *Canadian Journal of Economics* 42, No. 2.

Beck, Thortsen and Asli Demirgüç-Kunt. 2009. "Financial institutions and markets across countries and over time: Data and analysis." World Bank Policy Research Working Paper No. 4943.

Berman, Nicolas, Philippe Martin, and Thierry Mayer. 2010. "How do different exporters react to exchange rate changes? Theory, empirics and aggregate implications." *CEPR Discussion Papers* 7493.

Bernanke, Ben S., and Alan S. Blinder. 1988. "Credit, money, and aggregate demand." *American Economic Review* 78, 435–439.

Bernanke, Ben S., and Alan S. Blinder. 1992. "The federal funds rate and the channels of monetary transmission." *American Economic Review* 82, 901–921.

Bernanke, Ben S., and Mark Gertler. 1989. "Agency cost, net worth, and business fluctuations." *American Economic Review* 79, 14–31.

Bernanke, Ben S., and Mark Gertler. 1990. "Financial fragility and economic performance." *Quarterly Journal of Economics* 105, 87–114.

Bernard Andrew B., and J. Bradford Jensen. 2004. "Why some firms export?" *Review of Economics and Statistics* 86, 561-569.

Chaney, Thomas. 2005. "Liquidity constrained exporters." University of Chicago mimeo.

Chor, Davin, and Kalina Manova. 2012. "Off the cliff and back: Credit conditions and international trade during the global financial crisis." *Journal of International Economics* 87, 117-33.

Claessens, Stijn and Luc Laeven. 2003. "Financial development, property rights, and growth." *Journal of Finance* 58(6), 2401-2437.

Deardorff, Alan V.. 1998. "Determinants of bilateral trade: Does gravity work in a neoclassical world?" in J.A. Frankel, ed. by *The Regionalization of the World Economy*, (Chicago: University of Chicago Press), pp. 7-22.

di Giovanni, Julian, Justin McCrary, and Till von Wachter. 2009. "Following Germany's lead: using international monetary linkages to estimate the effect of monetary policy on the economy." *Review of Economics and Statistics* 91(2), 315-331.

Frankel, Jeffrey A. and Shang-Jin Wei. 1993. "Trade blocs and currency blocks," NBER Working Paper No. 4335.

Fleming, J. Marcus (1962). "Domestic financial policies under fixed and floating exchange rates." *IMF Staff Papers* 9: 369-379.

Gertler, Mark and Simon Gilchrist. 1994. "Monetary policy, business cycles, and the behavior of small manufacturing firms." *Quarterly Journal of Economics* 109, p.309-340.

Gertler, Mark, and R. Glenn Hubbard. 1988. "Financial factors in business fluctuations." *Financial Market Volatility*, 33-71, Federal Reserve Bank of Kansas City.

Goodfriend, Marvin. 1991. "Interest rates and the conduct of monetary policy." *Carnegie-Rochester Conference Series* (Spring), 7-30.

Helpman, Elhanan, Melitz, Marc and Yona Rubinstein. 2008. "Estimating trade flows: Trading partners and trading volumes." *Quarterly Journal of Economics* 123, 441-487.

Ju, Jiandong and Shang-Jin Wei. 2011. "When is quality of financial system a source of comparative advantage?" *Journal of International Economics* 84(2), 178-187.

Kashyap, Anil K., Owen A. Lamont, and Jeremy C. Stein. 1994. "Credit conditions and the cyclical behavior of inventories." *Quarterly Journal of Economics* 109, 565-592.

Kashyap, Anil K., Jeremy C. Stein, and David W. Wilcox. 1993. "Monetary policy and credit conditions: Evidence from the composition of external finance." *American Economic Review* 83, 78-98.

Klein, W. Michael, and Jay C. Shambaugh. 2013. "Rounding the corners of the policy trilemma." mimeo, Tufts University.

Kroszner, Randall, Luc Laeven and Daniela Klingebiel. 2007. "Banking crises, financial dependence, and growth." *Journal of Financial Economics* 84(1), 187-228.

- Laurent, Robert D. 1988. "An Interest Rate-Based Indicator of Monetary Policy." *Federal Reserve Bank of Chicago Economic Perspectives*, 3–14.
- Lane, Philip R. and Milesi-Ferretti, Gian Maria. 2007. "The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970-2004." *Journal of International Economics* 73(2), 223-250
- Manova, Kalina. 2008. "**Credit constraints, equity market liberalizations and international trade.**" *Journal of International Economics* 76, 33-47.
- Manova, Kalina. forthcoming. "Credit constraints, heterogeneous firms, and international trade" *Review of Economic Studies*.
- Manova, Kalina, Shang-Jin Wei and Zhiwei Zhang. 2011. "Firm exports and multinational activity under credit constraints." NBER Working Paper No. 16905.
- Minetti, Raoul and Susan Chun Zhu. 2011. "Credit constraints and firm export: Microeconomic evidence from Italy." *Journal of International Economics* 83, 109-125.
- Mishkin, F.S.. 1995. "Symposium on the Monetary Transmission Mechanism." *Journal of Economic Perspectives* 9(4), p. 3-10.
- Mundell, Robert A.. 1963. "Capital mobility and stabilization policy under fixed and flexible exchange rates." *Canadian Journal of Economic and Political Science* 29 (4): 475–485.
- Mu ùls, M.. 2008. "Exporters and credit constraints. A firm level approach." *London School of Economics mimeo*.
- Oliner, Stephen D, and Glenn D. Rudebusch. 1995. "Is there a bank lending channel for monetary policy?" *Federal Reserve Bank of San Francisco Economic Review* 2, 3–20.
- Oliner, Stephen D, and Glenn D. Rudebusch. 1996a. "Monetary policy and credit conditions: Evidence from the composition of external finance: Comment" *American Economic Review* 86, 300-309.
- Oliner, Stephen D, and Glenn D. Rudebusch. 1996b. "Is There a broad credit channel for monetary policy?" *Federal Reserve Bank of San Francisco Economic Review* 2, 3–13.
- Obstfeld, Maurice, Jay Shambaugh, and Alan M. Taylor. 2004. "Monetary sovereignty, exchange rates, and capital controls: The trilemma in the interwar period." *IMF Staff Papers* 51, 75–108.
- Obstfeld, Maurice, Jay Shambaugh, and Alan M. Taylor. 2005. "The trilemma in history: Tradeoffs among exchange rates, monetary policies, and capital mobility" *Review of Economics and Statistics*. Vol. 3 (December) pp. 423-438.

Obstfeld, Maurice, and Alan M. Taylor. 1997. "The Great Depression as a watershed: International capital mobility in the long run." *NBER Working Paper* No. 5960.

Obstfeld, Maurice, and Alan M. Taylor. 2003. "Globalization and capital markets." In *Globalization in Historical Perspective*, edited by Michael Bordo, Alan M. Taylor and Jeffrey G. Williamson. Chicago: University of Chicago Press.

Obstfeld, Maurice, and Alan M. Taylor. 2004. *Global Capital Markets: Integration, Crisis, and Growth*. Cambridge: Cambridge University Press.

Rajan, Raghuram G. and Luigi, Zingales. 1998. "Financial dependence and growth." *American Economic Review* 88(3), 559-586.

Romer, Christina D., and David H. Romer. 1989. "Does monetary policy matter? A new test in the spirit of Friedman and Schwartz." In Olivier Jean Blanchard and Stanley Fischer, eds. *NBER Macroeconomics Annual* , 121–183, MIT Press, Cambridge, MA.

Romer, Christina D., and David H. Romer. 1994. "Monetary policy matters." *Journal of Monetary Economics* 34, pp. 75–88.

Sekkat, K. and A. Varoudakis. 2000. "Exchange rate management and manufactured exports in sub-Saharan Africa." *Journal of Development Economics* 61, p.237-253.

Subramanian, Arvind and Shang-Jin Wei. 2007. "The WTO promotes trade: Strongly but unevenly." *Journal of International Economics* 72, 151-175.

Stiglitz, Joseph. 1992. "Capital Markets and Economic Fluctuations in Capitalist Economies." *European Economic Review* 36, 269–306.

Table 1 Country list

ALBANIA	ECUADOR	KOREA REP	ROMANIA
ALGERIA	EGYPT	KUWAIT	RWANDA
ANGOLA	EL SALVADOR	LAOS P.DEM.R	SAUDI ARABIA
ARGENTINA	EQ. GUINEA	LEBANON	SENEGAL
AUSTRALIA	ETHIOPIA	LIBERIA	SEYCHELLES
AUSTRIA	FIJI	LIBYA	SIERRA LEONE
BAHAMAS	FINLAND	MADAGASCAR	SINGAPORE
BAHRAIN	FRANCE	MALAWI	SOUTH AFRICA
BANGLADESH	GABON	MALAYSIA	SPAIN
BARBADOS	GAMBIA	MALI	SRI LANKA
BELGIUM	GERMANY	MALTA	ST KITTS NEVIS
BELIZE	GHANA	MAURITANIA	SUDAN
BENIN	GREECE	MAURITIUS	SURINAME
BERMUDA	GREENLAND	MEXICO	SWEDEN
BOLIVIA	GUATEMALA	MONGOLIA	SWITZERLAND
BRAZIL	GUINEA	MOROCCO	SYRIA
BULGARIA	GUINEA-BISSAU	MOZAMBIQUE	THAILAND
BURKINA FASO	GUYANA	NEPAL	TOGO
BURUNDI	HAITI	NETHERLANDS	TRINIDAD-TOBAGO
CAMBODIA	HONDURAS	NEW CALEDONIA	TUNISIA
CAMEROON	HONG KONG	NEW ZEALAND	TURKEY
CANADA	HUNGARY	NICARAGUA	UGANDA
CENTRAL AFR.	ICELAND	NIGER	UNITED KINGDOM
CHAD	INDIA	NIGERIA	UNTD ARAB EM
CHILE	INDONESIA	NORWAY	URUGUAY
CHINA	IRAN	OMAN	UNITED STATES
COLOMBIA	IRAQ	PAKISTAN	VENEZUELA
CONGO	IRELAND	PANAMA	VIETNAM
COSTA RICA	ISRAEL	PAPUA N.GUINEA	YEMEN
COTE D'IVOIR	ITALY	PARAGUAY	ZAIRE
CUBA	JAMAICA	PERU	ZAMBIA
CYPRUS	JAPAN	PHILIPPINES	ZIMBABWE
DENMARK	JORDAN	POLAND	
DJIBOUTI	KENYA	PORTUGAL	
DOMINICAN REP	KIRIBATI	QATAR	

Table 2 Exporters Included in Different Samples

Benchmark	Openness>75th Percentile	De facto Openness>90th Percentile	De facto Openness>75th Percentile	Include Euro Exporters for the Pre-1999 Period
BAHAMAS	ARGENTINA	BAHAMAS	BAHAMAS	AUSTRIA
BAHRAIN	BAHAMAS	BAHRAIN	BAHRAIN	BAHAMAS
BELIZE	BAHRAIN	BARBADOS	BARBADOS	BAHRAIN
BENIN	BELIZE	BURKINA FASO	BELIZE	BELGIUM
BURKINA FASO	BENIN	CONGO	BULGARIA	BELIZE
DENMARK	BULGARIA	DENMARK	BURKINA FASO	BENIN
DJIBOUTI	BURKINA FASO	DJIBOUTI	BURUNDI	BURKINA FASO
EL SALVADOR	COSTA RICA	EQ. GUINEA	CONGO	DENMARK
EQ. GUINEA	DENMARK	HONG KONG	COTE D'IVOIR	DJIBOUTI
GAMBIA	DJIBOUTI	IRAQ	DENMARK	EL SALVADOR
GUATEMALA	ECUADOR	JORDAN	DJIBOUTI	EQ. GUINEA
HAITI	EGYPT	KIRIBATI	EGYPT	FINLAND
HONDURAS	EL SALVADOR	KUWAIT	EQ. GUINEA	FRANCE
HONG KONG	EQ. GUINEA	LEBANON	GAMBIA	GAMBIA
KIRIBATI	GAMBIA	LIBERIA	EQ. GUINEA	GUATEMALA
KUWAIT	GUATEMALA	LIBYA	GUYANA	HAITI
LEBANON	HAITI	PANAMA	HONG KONG	HONDURAS
LIBERIA	HONDURAS	QATAR	IRAQ	HONG KONG
MEXICO	HONG KONG	ST KITTS NEVIS	JAMAICA	IRELAND
NICARAGUA	KIRIBATI	SURINAME	JORDAN	ITALY
PANAMA	KUWAIT		KIRIBATI	KIRIBATI
QATAR	LEBANON		KUWAIT	KUWAIT
SAUDI ARABIA	LIBERIA		LEBANON	LEBANON
ST KITTS NEVIS	MEXICO		LIBERIA	LIBERIA
SWITZERLAND	NICARAGUA		LIBYA	MALTA
UNITED KINGD.	KIRIBATI		MALAWI	MEXICO
	OMAN		MALAYSIA	NICARAGUA
	PANAMA		MOZAMBIQUE	NETHERLANDS
	QATAR		NICARAGUA	PANAMA
	SAUDI ARABIA		PANAMA	PORTUGAL
	ST KITTS NEVIS		QATAR	QATAR
	SWITZERLAND		SAUDI ARABIA	SAUDI ARABIA
	UNTD ARAB EM		ST KITTS NEVIS	SPAIN
	UNITED KINGD.		SURINAME	ST KITTS NEVIS
	VENEZUELA		SWITZERLAND	SWITZERLAND
			TOGO	UNITED KINGD.
			UNTD ARAB EM	
			UNITED KINGD.	
			VENEZUELA	
			ZAMBIA	
			ZIMBABWE	

Table 3 Identified significant tightening events in anchor currency countries

Danchorrate>2.5 (benchmark)	Danchorrate>1.5	Danchortsp>2
AUSTRALIA1981	AUSTRALIA1981	AUSTRALIA1985
AUSTRALIA1985	AUSTRALIA1982	AUSTRALIA1989
AUSTRALIA1989	AUSTRALIA1985	AUSTRALIA1995
FRANCE1973	AUSTRALIA1989	FRANCE1973
FRANCE1974	AUSTRALIA1995	GERMANY1970
FRANCE1980	FRANCE1973	GERMANY1973
FRANCE1981	FRANCE1974	GERMANY1980
GERMANY1970	FRANCE1980	GERMANY1989
GERMANY1973	FRANCE1981	UNITED KINGDOM1972
GERMANY1979	FRANCE1989	UNITED KINGDOM1978
GERMANY1980	GERMANY1970	UNITED KINGDOM1979
GERMANY1989	GERMANY1973	UNITED KINGDOM1980
UNITED KINGDOM1974	GERMANY1979	UNITED STATES1973
UNITED KINGDOM1978	GERMANY1980	UNITED STATES1979
UNITED KINGDOM1979	GERMANY1981	UNITED STATES1989
UNITED KINGDOM1980	GERMANY1989	UNITED STATES1995
UNITED STATES1973	UNITED KINGDOM1972	
UNITED STATES1979	UNITED KINGDOM1974	
UNITED STATES1981	UNITED KINGDOM1978	
	UNITED KINGDOM1979	
	UNITED KINGDOM1980	
	UNITED STATES1973	
	UNITED STATES1974	
	UNITED STATES1978	
	UNITED STATES1979	
	UNITED STATES1980	
	UNITED STATES1981	
	UNITED STATES1989	
	UNITED STATES1995	

Table 4 Benchmark regressions

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Anchor interest rate change* external finance dependence	-0.034 (0.011)***	-0.177 (0.051)***	-0.308 (0.115)***
Real exchange rate depreciation	-0.006 (0.004)	-0.006 (0.004)	-0.006 (0.004)
Log distance	-0.498 (0.062)***	-0.498 (0.062)***	-0.498 (0.062)***
Same legal system	0.393 (0.113)***	0.393 (0.113)***	0.393 (0.113)***
Common language	0.479 (0.133)***	0.479 (0.133)***	0.479 (0.133)***
Border	0.400 (0.272)	0.398 (0.271)	0.399 (0.271)
FTA	1.317 (0.281)***	1.321 (0.280)***	1.321 (0.280)***
Colonial ties	0.194 (0.253)	0.192 (0.253)	0.194 (0.253)
Time-varying Exporter fixed effects	Y	Y	Y
Time-varying Importer fixed effects	Y	Y	Y
Sector fixed effects	Y	Y	Y
R^2	0.59	0.59	0.59
N	47358	47358	47358

Notes: A constant, time-varying exporter and importer fixed effects, and sector fixed effects are included but not reported in each regression. Robust standard errors clustered at ordered export-import pairs are reported in the parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 5 The non-linear effect of monetary tightening

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Anchor interest rate change* external finance dependence	-0.005 (0.013)	0.173 (0.058)***	0.477 (0.130)***
Anchor interest rate change*tightening* external finance dependence	-0.112 (0.038)***	-1.303 (0.194)***	-2.921 (0.398)***
Real exchange rate depreciation	-0.006 (0.004)	-0.006 (0.004)	-0.006 (0.004)
Log distance	-0.498 (0.062)***	-0.499 (0.062)***	-0.499 (0.062)***
Same legal system	0.393 (0.113)***	0.391 (0.113)***	0.389 (0.113)***
Common language	0.480 (0.133)***	0.479 (0.132)***	0.478 (0.133)***
Border	0.399 (0.272)	0.397 (0.270)	0.398 (0.271)
FTA	1.318 (0.282)***	1.323 (0.275)***	1.325 (0.275)***
Colonial ties	0.195 (0.253)	0.200 (0.254)	0.200 (0.254)
Time-varying Exporter fixed effects	Y	Y	Y
Time-varying Importer fixed effects	Y	Y	Y
Sector fixed effects	Y	Y	Y
R^2	0.59	0.59	0.59
N	47358	47358	47358

Notes: A constant, time-varying exporter and importer fixed effects, and sector fixed effects are included but not reported in each regression. Robust standard errors clustered at ordered export-import pairs are reported in the parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 6 Robustness to alternative definitions of tightening

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Panel A: Tightening if anchor interest rate change > 1.5			
Anchor interest rate change* external finance dependence	0.046 (0.020)**	0.713 (0.086)***	1.455 (0.184)***
Anchor interest rate change*tightening* external finance dependence	-0.199 (0.049)***	-2.176 (0.224)***	-4.346 (0.449)***
Panel B: Tightening if anchor term spread change > 2			
Anchor interest rate change* external finance dependence	-0.017 (0.012)	0.009 (0.060)	0.048 (0.133)
Anchor interest rate change*tightening* external finance dependence	-0.070 (0.028)**	-0.717 (0.123)***	-1.420 (0.265)***
Panel C: Romer-Romer dates (dollar-pegging exporters)			
US interest rate change* external finance dependence	-0.011 (0.013)	0.050 (0.052)	0.129 (0.119)
US interest rate change* Romer-Romer dates * external finance dependence	-0.128 (0.041)***	-1.356 (0.207)***	-2.460 (0.432)***

Notes: A constant, control variables, time-varying exporter and importer fixed effects, and sector fixed effects are included but not reported in each regression. Robust standard errors clustered at ordered export-import pairs are reported in the parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 7 Robustness to alternative samples

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Panel A: Include Euro countries for years 1970-1998			
Anchor interest rate change* external finance dependence	-0.028 (0.010)***	0.251 (0.045)***	0.572 (0.098)***
Anchor interest rate change*tightening* external finance dependence	-0.075 (0.031)**	-1.119 (0.151)***	-2.630 (0.306)***
Panel B: Pre-1990 sample			
Anchor interest rate change* external finance dependence	-0.010 (0.015)	0.128 (0.078)	0.508 (0.166)***
Anchor interest rate change*tightening* external finance dependence	-0.086 (0.035)**	-0.817 (0.192)***	-2.027 (0.400)***
Panel C: 1976-2006 sample			
Anchor interest rate change* external finance dependence	-0.012 (0.016)	-0.009 (0.074)	0.061 (0.166)
Anchor interest rate change*tightening* external finance dependence	-0.111 (0.055)**	-1.269 (0.221)***	-2.549 (0.472)***

Notes: A constant, control variables, time-varying exporter and importer fixed effects, and sector fixed effects are included but not reported in each regression. Robust standard errors clustered at ordered export-import pairs are reported in the parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 8 Robustness to alternative threshold values and measures of capital account openness

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Panel A: Openness>75th percentile			
Anchor interest rate change* external finance dependence	-0.033 (0.011)***	-0.020 (0.044)	-0.170 (0.101)*
Anchor interest rate change*tightening* external finance dependence	-0.098 (0.036)***	-0.757 (0.162)***	-1.779 (0.326)***
Panel B: De facto openness>90th percentile			
Anchor interest rate change* external finance dependence	0.027 (0.014)*	-0.413 (0.066)***	0.784 (0.142)***
Anchor interest rate change*tightening* external finance dependence	-0.296 (0.061)***	-1.792 (0.309)***	-3.625 (0.633)***
Panel C: De facto openness>75th percentile			
Anchor interest rate change* external finance dependence	0.042 (0.012)***	-0.013 (0.049)	-0.138 (0.109)
Anchor interest rate change*tightening* external finance dependence	-0.298 (0.058)***	-0.980 (0.293)***	-2.071 (0.587)***

Notes: A constant, control variables, time-varying exporter and importer fixed effects, and sector fixed effects are included but not reported in each regression. Robust standard errors clustered at ordered export-import pairs are reported in the parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 9 Robustness to additional controls

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Panel A: Control for the interactions of monetary policy with importer real GDP growth			
Anchor interest rate change* external finance dependence	-0.005 (0.014)	0.188 (0.060)***	0.504 (0.135)***
Anchor interest rate change*tightening* external finance dependence	-0.114 (0.041)***	-1.387 (0.207)***	-3.091 (0.426)***
Panel B: Control for the interactions of monetary policy with sector physical and human capital intensity			
Anchor interest rate change* external finance dependence	0.006 (0.013)	0.066 (0.090)	0.316 (0.134)**
Anchor interest rate change*tightening* external finance dependence	-0.173 (0.041)***	-1.238 (0.248)***	-1.942 (0.349)***

Notes: A constant, control variables, time-varying exporter and importer fixed effects, and sector fixed effects are included but not reported in each regression. Robust standard errors clustered at ordered export-import pairs are reported in the parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 10 Robustness to alternative estimation methods

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Panel A: Add country-pair fixed effects			
Anchor interest rate change* external finance dependence	-0.004 (0.012)	0.140 (0.056)**	0.403 (0.129)***
Anchor interest rate change*tightening* external finance dependence	-0.113 (0.039)***	-1.262 (0.195)***	-2.783 (0.391)***
Panel B: Add country-pair random effects			
Anchor interest rate change* external finance dependence	-0.007 (0.013)	0.189 (0.058)***	0.513 (0.130)***
Anchor interest rate change*tightening* external finance dependence	-0.106 (0.039)***	-1.302 (0.195)***	-2.903 (0.399)***
Panel C: IV regression results			
Exporter interest rate change* external finance dependence	-0.021 (0.024)	-0.530 (0.141)***	-1.386 (0.297)***
Exporter interest rate change*exporter tightening* external finance dependence	-0.600 (0.127)***	-1.399 (1.197)	-5.263 (2.402)**
Panel D: Include zero trade flows (HMR method)			
First-stage (marginal effects)			
Anchor interest rate change* external finance dependence	0.0006 (0.0002)*	0.0015 (0.0007)**	0.0068 (0.0019)***
Anchor interest rate change*tightening* external finance dependence	-0.0025 (0.0005)***	-0.0036 (0.0020)*	-0.0163 (0.0048)***
Second-stage			
Anchor interest rate change* external finance dependence	-0.032 (0.013)**	0.079 (0.055)	0.216 (0.129)*
Anchor interest rate change*tightening* external finance dependence	0.006 (0.042)	-1.089 (0.183)***	-2.380 (0.389)***

Notes: A constant, control variables, time-varying exporter and importer fixed effects and sector fixed effects are included but not reported in each regression. Panels A and B also include country-pair fixed and random effects, respectively. Robust standard errors are reported in the parentheses. They are clustered at ordered exporter-importer pairs. Common religion is used as the excluded variable in Panel D. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 11 The effects on the extensive margins

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Panel A: log # HS-4 products by 3-digit ISIC sector			
Anchor interest rate change* external finance dependence	-0.013 (0.006)**	-0.035 (0.005)***	0.565 (0.023)***
Anchor interest rate change*tightening* external finance dependence	-0.033 (0.017)*	-0.060 (0.013)***	-0.355 (0.025)***
Panel B: log # destinations by 3-digit ISIC sector			
Anchor interest rate change* external finance dependence	-0.031 (0.009)***	-0.089 (0.011)***	0.101 (0.030)***
Anchor interest rate change*tightening* external finance dependence	-0.033 (0.017)*	-0.093 (0.024)***	0.159 (0.034)***
Panel C: log # destination-product pairs by 3-digit ISIC sector			
Anchor interest rate change* external finance dependence	-0.009 (0.010)	-0.040 (0.010)***	0.260 (0.036)***
Anchor interest rate change*tightening* external finance dependence	-0.115 (0.020)***	-0.173 (0.024)***	0.236 (0.036)***
Panel D: log # HS-4 products by 3-digit ISIC sector and destination			
Anchor interest rate change* external finance dependence	0.025 (0.001)***	0.069 (0.013)***	0.046 (0.018)**
Anchor interest rate change*tightening* external finance dependence	-0.080 (0.009)***	-0.062 (0.018)***	-0.057 (0.020)***

Notes: A constant, control variables, time-varying exporter fixed effects, and sector fixed effects are included but not reported in each regression. Robust standard errors clustered at ordered export-import pairs are reported in the parentheses. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Table 12 The role of financial development

	Dependence on External Finance for Long-term Investment	Ratio of intangible assets	Dependence on External Finance for Working Capital
Panel A: Benchmark tightening definition			
Anchor interest rate change*external finance dependence* financial development	-0.025 (0.030)	-0.701 (0.149)***	-1.867 (0.322)***
Anchor interest rate change*tightening* external finance dependence*financial development	-0.101 (0.281)	3.034 (0.988)***	4.348 (2.068)**
Panel B: Tightening if anchor interest rate change>1.5			
Anchor interest rate change*external finance dependence* financial development	-0.117 (0.049)**	-2.623 (0.229)***	-5.412 (0.480)***
Anchor interest rate change*tightening* external finance dependence*financial development	0.187 (0.120)	6.311 (0.544)***	11.919 (1.138)***
Panel C: Tightening if anchor term spread change>2			
Anchor interest rate change*external finance dependence* financial development	-0.042 (0.034)	-1.109 (0.176)***	-2.591 (0.365)***
Anchor interest rate change*tightening* external finance dependence*financial development	0.190 (0.088)**	4.468 (0.453)***	8.968 (0.961)***
Panel D: Romer-Romer dates (dollar-pegging exporters)			
US interest rate change*external finance dependence* financial development	-0.056 (0.030)*	-0.725 (0.153)***	-1.687 (0.322)***
US interest rate change*Romer-Romer dates* external finance dependence*financial development	-0.108 (0.281)	3.734 (1.036)***	7.226 (2.109)***

Notes: A constant, time-varying exporter and importer fixed effects, sector fixed effects and controls are included but not reported in each regression. Robust standard errors are in parentheses and are clustered at ordered exporter-import pairs in all other regressions. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.