Monetary policy, credit constraints and international trade

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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 tightening events in exporting countries based on the "impossible trinity" theorem and apply them to an empirical gravity model. In a large sector bilateral trade dataset for the years 1970-2000, we find strong and robust evidence that the export-reducing effect of tight monetary policy is significantly amplified by various measures of sector financial constraints. We also show that, by reducing financial market frictions at the country level, financial development significantly alleviate the adverse effect of credit constraints. Our empirical results also have important implications for the international transmission of monetary policy.

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

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

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1. Introduction

How does monetary policy affect trade? In addition to the conventional exchange rate channel, is there also a credit channel through which monetary policy can have an impact on a country's exports? Do sector variations in the degrees of credit constraints play a role in determining the responses of exports to an exogenous monetary tightening? Can financial development help alleviate the impact of credit constraints on exports? 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 the real exchange rate, we propose a new credit channel through which monetary policy can also have a significant impact on exports.[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; Gertler and Hubbard, 1988; Gertler and Gilchrist, 1994; Kashyap, Stein and Wilcox, 1993; Kashyap, Lamont and Stein, 1994; Oliner and Rudebusch, 1996; Cetorelli and Goldberg, 2008) and the recently-emerged credit constraints and exports literature in international trade (e.g., Manova, 2008; Muûls, 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 tight-money periods, and the resulting increase 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 the

[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.

credit constraints and exports literature, compared to domestic production, exporting is even 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] One would, therefore, expect that monetary policy to have a significant impact on a country's exports through a credit channel by affecting firms' access to external finance in a credit constrained environment.

We then put this novel hypothesis into a test. Our empirical strategy follows the convention of the credit channel literature and relies on the cross-sectional implications of the theory. While previous studies often search for asymmetric responses of small and large firms to a monetary tightening event, here we explore cross-sector variations in the degrees of technologically 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 we should expect to find a strong export-reducing effect in financially more constrained sectors. Moreover, we also employ cross-country variations in financial development to investigate further whether financial development can help alleviate the effect of financial constraints on exports.

To identify an exogenous component of monetary policy in an exporting country, we make use of the "impossible trinity" (or the "trilemma") theorem in international macroeconomics which states that it is impossible for a country to have an independent monetary policy while maintaining a fixed exchange rate and an open capital account.

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

Based on the uncovered interest rate parity, the "impossible trinity" is not just a theoretical curiosity but supported by recent empirical studies (e.g., Obstfeld and Taylor, 1997; 2003; 2004; Obstfeld, Shambaugh and Taylor, 2004; 2005). We restrict our sample to including only exporters with a fixed exchange rate regime and a sufficiently open capital account. We then identify monetary tightening dates in a corresponding anchor currency country and use them as exogenous monetary tightening events for an exporter in our sample. We also make efforts to isolate the effects of monetary policy through changes in the real exchange rate or foreign demand. This identification strategy also links our study to the international transmission (spillover) of monetary policy literature (e.g., Kim, 2001; Canova 2005; Neumeyer and Perri, 2005; Catorelli and Goldberg, 2008) and particularly to those focusing on role of exchange rate regimes in the transmission mechanism (Frankel, Schmukler and Serven, 2004; Obstfeld, Shambaugh, and Taylor 2005; Di Giovanni and Shambaugh, 2008). Our empirical results would have important implications for the role of exchange rate regime in international monetary policy transmission.

Employing a gravity model approach of Anderson and van Wincoop (2003) and a large sector bilateral trade dataset for the years 1970-2000, 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. We also show 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 study makes several important contributions to the relevant literatures. First, we identify a new channel though which monetary policy can influence exports. We show that, in addition to the conventional exchange rate channel, by alternating credit supply conditions, monetary policy can also have a significant impact on exports through the credit channel transmission mechanism in a credit constrained environment. Second, by examining the effects on exports, we are able to report results novel to the credit channel literature. While existing studies in this literature focus mainly on firm financing or investment activities or bank lending behavior, we are the first to study exports, which are more dependent on external financing. Third, the findings in this paper complement nicely with existing empirical results in the credit constraints and trade literature (e.g., Manova, 2008; Muûls, 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. They also indicate that financial market development is an effective way to alleviate the negative influence of credit constraints on trade. Finally, while identifying exogenous monetary shocks is a challenging task for studies in monetary policy in general, here we propose a new identification strategy based on theory. Further, this identification strategy also enables us to contribute to the international transmission (spillover effects) of monetary policy literature. Our findings show that monetary policy in anchor countries can have significant impacts on pegging countries' exports, suggesting that exchange rate regimes play an important role in the international transmission of monetary policy.

The remainder of this paper is organized as follows. In Section 2, we discuss our empirical models, data and identification strategy. 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 a gravity model estimation strategy in our study. The gravity model can be justified theoretically by alternative trade models (e.g., Anderson, 1979; Anderson and van Wincoop 2003; Deardoff, 1998) and is commonly used in empirical studies on bilateral trade flows (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 a monetary tightening on bilateral exports by sector:

$$\log Exports_{ijkt} = \beta_0 + \beta_1 Tight_{it} + \beta_2 Tight_{it} * Fv_k + \beta_3 \log Ergdp_{it} + \beta_4 \log Irgdp_{jt} + \beta_5 \log Ergdppc_{it} + \beta_6 \log Irgdppc_{jt} + \beta_7 \log RER_{ijt} + Z(i,j)\gamma + \varphi_i + \varphi_j + \varphi_k + \varphi_t + \varepsilon_{ijkt} \quad (1)$$

The above empirical specification is motivated by recent theoretical work of Anderson and van Wincoop (2003), which emphasizes the importance of using unilateral trade as the left-hand-side variable and controlling for separate exporter and importer fixed effects as proxy for "multilateral resistance".[3]

The dependent variable in Equation (1) is log exports from country i to country j in sector k in year t. $Tight_{it}$ is a binary indicator of an exogenous monetary tightening in exporting country i, and Fv_k represents an empirical measure of credit constraints at the sector level. Our main variable of interest is interaction term of the monetary tightening

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

dummy and the sector financial vulnerability measure, $Tight_{it}$* Fv_k. In particular, we expect to find a significantly negative interaction effect on exports. The above model controls for exporters' and importers' log real GDP (log*Ergdp* and log*Irgdp*) and log real GDP per capita (log*Ergdppc* and log*Irgdppc*). To shut down the potential exchange rate channel of monetary policy transmission, we also control for log bilateral real exchange rate (log*RER*) in the regression. *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, colonial-ties, currency union, islands and landlocked in *Z(i,j)*.[4] Finally, φ_i , φ_j , φ_k and φ_t are exporter, importer, sector, and year fixed effects, respectively.

To further examine the impacts of financial development, we expand Equation (1) to include exporters' financial development, Fd_{it}, its interaction term with the tightening dummy, $Tight_{it}$*Fd_{it}, and also the triple interaction term, $Tight_{it}$*Fv_k*Fd_{it}:

$$\begin{aligned}\log Exports_{ijkt} &= \beta_0 + \beta_1 Tight_{it} + \beta_2 Fd_{it} + \beta_3 Tight_{it} * Fv_k + \beta_4 Tight_{it} * Fd_{it} + \beta_5 Tight_{it} * Fv_k * Fd_{it} + \\ &\beta_6 \log Ergdp_{it} + \beta_7 \log Irgdp_{jt} + \beta_8 \log Ergdppc_{it} + \beta_9 \log Irgdppc_{jt} + \beta_{10} \log RER_{ijt} + Z(i,j)\gamma \\ &+ \varphi_i + \varphi_j + \varphi_k + \varphi_t + \varepsilon_{ijkt}\end{aligned} \quad (2)$$

In Equation (2), our main variable of interest is the triple interaction term. The estimated coefficient, β_5, would tell us whether financial development can significantly weaken the interaction effect of a monetary tightening in exporting country and credit constraints on exports by sector.

[4] 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.

In addition to the above benchmark models, we also consider the following alternative specifications to ensure the robustness of our results: (1) using country-pair fixed effects rather than separate exporter and importer fixed effects; (2) using country-pair random effects; (3) using a more ambitious set of time-varying exporter and importer fixed effects to replace country and year fixed effects. Finally, we also 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.

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 1970-2000.[5] We obtain data from a variety of sources. The bilateral sector trade data are from the NBER-United Nations trade dataset, which contains the unilateral export data at the SITC 4-digit level. Since our measures of sector financial vulnerability are constructed at the ISIC 3-digit level, we match the SITC 4-digit product codes to those ISIC 3-digit categories using Jon Haveman's Industry Concordances. Interest rates and exchange rates are obtained from the IMF's International Financial Statistics while the CPIs, real GDP and real GDP per capita data are drawn from World Bank's World Development Indicators. We get 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

[5] 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.

regimes using Reinhar and Rogoff's (2004) de facto classifications and its subsequent update by Ilzetzki, Reinhar, and Rgoff (2011) and obtain the capital account openness index from Chinn and Ito (2006). Detailed variable definitions and data sources are listed in the Data Appendix.

2.3. Identifying exogenous monetary tightening dates

Testing the above hypotheses requires us to find appropriate empirical measures of exogenous monetary tightening events in exporting countries. Previous studies in the credit channel of monetary policy transmission literature often identify monetary tightening events based on large increases in the short-tem nominal interest rate, such as the federal funds rate (e.g., Bernanke and Blinder, 1992; Goodfriend, 1991; Oliner and Rudebusch, 1996). A concern about the above approach, however, is that the identified monetary policy stance can be endogenous as monetary authorities may respond to economic activities by adjusting their policy stances. To obtain an exogenous component of an exporter's monetary policy stance, here we employ an identification strategy based on the "impossible trinity" theorem in international macroeconomics, which states that it is impossible for a country to have an independent monetary policy while maintaining a fixed exchange rate and capital account openness. This theorem is based on the uncovered interest rate parity and is supported by recent empirical studies (e.g., Obstfeld and Taylor, 1997; 2003; 2004; Obstfeld, Shambaugh and Taylor, 2004; 2005).

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, for the years 1999 and 2000, we exclude further exporters that adopted the Euro from our sample. The reason is that the European Central Bank's policy

decisions can be endogenous for each one of those countries even though they have a fixed exchange rate and high levels of capital account openness. The remaining exporters, according to the "impossible trinity" are those whose monetary policy is exogenously determined in anchor currency countries. We thus identify monetary tightening dates in a corresponding anchor currency country and use them as exogenous monetary tightening events for an exporter in the remaining sample. As a final step, for each exporter, we also exclude its bilateral 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 Reinhar and Rogoff's (2004) and Ilzetzki, 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 75th percentile of the sample distribution of this index as the threshold value in our benchmark regressions, but we also consider the 90th percentile and the median sample values as alternatives to ensure the robustness of our results.

Using Ilzetzki, Reinhart and Rogoff's (2011) country chronologies of exchange rate arrangements, we are able identify a total of six anchor currency countries, Australia, France, Germany, the U.K., the U.S., and the Euro area (for the years 1999 and 2000). In our benchmark regressions, we define exogenous monetary tightening dates (*Tight*)for each exporter as years in which its corresponding anchor country's money market rate

rose at least 2.5 percentage points.[6] In addition to the benchmark monetary policy measure, we also employ other definitions of monetary policy, 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 Romer dates, to ensure the robustness of our results. Table 2 shows the identified tightening events based on different criteria.

2.4. Empirical measures of credit constraints and financial development

The empirical measures of credits 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. Following Krosner, Laeven, and Klingebiel (2007) and Manova, Wei and Zhang (2011), here we consider four commonly-used measures of sector financial vulnerability, namely, external finance dependence, asset tangibility, R&D intensity, and inventories to sales ratio.[7] Firms are financially more vulnerable in sectors with higher levels of external finance dependence, R&D intensity, inventories to sales ratios or lower levels of asset tangibility. We, therefore, expect to find a significantly negative interaction effect of a monetary

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

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

tightening and external finance dependence, R&D intensity, or inventories to sales ratio but a positive interaction effect of a monetary tightening and asset tangibility.

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 3 shows our benchmark regression results from Equation (1). As a preliminary exercise, the first column of Table 3 estimates the level effect of a monetary tightening on exports without the interaction of monetary policy and sector of financial vulnerability measures. In the next four columns, we interact the monetary tightening dummy with the four sector financial vulnerability measures to examine further the role of credit constraints in determining the effect of a monetary tightening. The overall fit of the regressions is quite reasonable as the estimated R-squared is around 0.60 in each column. The estimated coefficient on the tightening dummy is negative and statistically significant at the 1% level in the first column, indicating that a monetary tightening in the anchor country has a significantly negative effect on a country's exports in our sample. The estimated level effect is also quantitatively sizable. A monetary tightening in anchor country would lead to a 12.3% reduction in a country's exports on average.

More interestingly, we find that the estimated coefficients on the interaction terms are all highly significant with correct signs. Specifically, the results suggest that a monetary tightening reduces exports significantly more in sectors with higher levels of external finance dependence, R&D intensity, inventories ratio or lower levels of asset tangibility. The effect of credit constraints is also of economic importance. For example, the professional and scientific equipment sector has the highest external finance dependence (0.72), while external finance dependence in the tobacco sector is the lowest (-1.14). The estimated coefficients on the tightening dummy and the interaction term in the second column of Table 3 indicate that a monetary tightening lowers exports by 20.8% in the former sector but only 0.3% in the latter sector. Similarly, Column 4 suggests that a monetary tightening would reduce exports in the sector at the third quartile of the distribution (textile) by R&D intensity by 12.8% but reduce exports in the sector at the first quartile (plastic products) by only 2.0%. The evidence from the benchmark regressions thus supports strongly our hypothesis that a monetary tightening has a significantly larger negative effect on exports in financially more constrained sectors due to the existence of a credit channel.

As for the control variables, we find that exporters' economic size and importers' real GDP per capita have positive and significant effects on exports while an exporter's income level is negatively associated with its exports. The estimated coefficient on importers' economic size is positive but insignificant. As expected, a real depreciation of an exporter's currency has a significantly positive effect on its exports. In terms of the estimated elasticity, a 1% real deprecation of the exporter's currency relative to that of the importer will lead to a 0.16% increase in bilateral exports. We also find that most

country-pair variables are significant with expected signs. For example, distance is negatively associated with export volumes but having the same legal system or language or colonial ties significantly promotes bilateral trade.

3.2. Robustness checks

The above benchmark regression results are strongly in favor of our hypothesis. In this subsection, we conduct a series of sensitivity analyses to check whether our main results are robust to alternative measures of monetary policy, samples, model specifications and estimation methods. For the sake of saving space, we shall only reported the estimated coefficients and standard errors or the variables of interest from now on.

We first examine whether our results are robust to alternative measures of monetary policy and report the results in Table 4. In Panel A, we redefine a monetary tightening event (*Tight2*) 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.[8] Nevertheless, using the new monetary tightening definition does not alter our findings at all. The level effect is again found to be negative and significant although, as expected, the magnitude now is smaller than that of the benchmark case. More importantly, we continue to find consistent and highly significant interaction effects of monetary tightening and credit constraints.

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

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

monetary policy stances based on large increases in the term spread between the short-term nominal interest and the long-term government bond rate to (e.g., Laurent, 1988; Goodfriend, 1991; Oliner and Rudebusch, 1996). In panel B of Table 4, we follow this alternative approach and consider a year in which an anchor country's term spread rose at least 2 percentage points to be the date of a monetary tightening (*Tighttsp*).[9] The results are consistent with previous ones as both the level and interaction effects remain the same sings and are 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 dates to conduct 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 dates as exogenous tightening dates for those exporters.[10] Since the Romer dates do not have cross-section variation, the level effect now submerges with the inclusion of the year fixed effects. The estimated interaction effects, however, are all highly significant with expected signs, indicating that a monetary tightening in the U.S. reduces a dollar pegging country's exports significant more in sectors with higher levels of credit constraints.

In the last panel of Table 4, we address the concern that monetary policy may impact exports with a lag. We do so by extending the benchmark tightening dates

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

[10] 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.

(*Tightlag*) to including years that immediately follow the benchmark tightening year. The new results are quite similar to the benchmark results as we find both significant level effects and significant interaction effects of monetary policy and credit constraints.

In the second set of robustness checks, we test if our results hold in a variety of subsamples. Since one may argue that the economic and monetary integration of the Euro area economy has already reached a very high level even before the adoption of a common currency. To address this concern, in Panel A of Table 5, we now totally exclude Euro area exporters from our sample (rather than for the years 1999 and 2000 only in the benchmark case). In Panel B, we restrict our sample to years 1970-1989 as most of the identified tightening events occur in the pre-1990 era. Panel C drops the years 1970-1975 to isolate the potential effects associated with the collapse of the Bretton Woods system. We find that our main results are not sensitive to the choices of countries or sample periods. While the level effect of a monetary tightening is negative and significant only in the last panel, the estimated coefficients on the interaction terms are all statistically significant with correct signs, suggesting that a monetary tightening reduces exports more in financially more vulnerable sectors.

Next, we test whether our results are sensitive to alternative threshold values of the Chinn and Ito's index of capital account openness. Here we consider two alternative threshold values, one is set to be equal to the 90th percentile of the sample distribution and the other is chosen to be the median value of the index. The corresponding regression results from the above new samples are shown in Panels A and B of Table 6, respectively. The evidence suggests that our main results are not driven by the choice of a particular threshold value of the Chinn and Ito's capital account openness index. We still find strong

support that monetary tightening has significantly stronger trade-reducing effects in sectors with higher levels of credit constraints. The level effect is negative in both Panels but is significant only in Panel A.

Table 7 checks further the sensitivity of our results to additional controls in the gravity model. In Panels A, we add to the gravity model importers' real GDP growth and its interaction with monetary policy as additional controls. The purpose is to completely shut down any potential effects of an anchor country's tightening event on trade through its impact on foreign demand rather than exporters' credit conditions. Controlling for importer growth does not affect our findings. The results also show that neither importers' growth nor its interaction with monetary policy has any significant effects on trade. Regressions in Panel B include interactions of monetary policy with sector measures of physical and human capital intensities to make sure that our interaction effects 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 make a difference either.

Finally, Table 8 examines if our results are sensitive to alternative estimation methods. In Panels A and B, instead of controlling for separate exporter and importer fixed effects, we now control for country-pair fixed effects and country-pair random effects along with exporter and importer fixed effects, respectively. In Panel C, we try a more aggressive specification by employing time-varying exporter and importer fixed effects. A 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 method to our data and report the results in Panel D. Following their study, we also use the common religion variable as the excluded variable. 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 a monetary tightening has significantly larger adverse effect on exports in financially more constrained sectors. The level effect is found to be generally insignificant though.

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 examine further whether, by reducing financial market frictions at the country level, financial development can help alleviate the adverse impact of credit constraints on exports. We estimate Equation (2) for each sector financial vulnerability measure and report the results in Table 9. To save space, we only report the estimated coefficients of our variable of interest, the triple interaction term, $Tight_{it}*Fv_k*Fd_{it}$.

The first row of Table 9 demonstrates the benchmark regression results. The evidence strongly supports our hypothesis. The estimated coefficients on the triple interaction terms are highly significant with correct signs in all four cases. Specifically, we find that the triple interaction effect is negative for asset tangibility and positive for the rest three measures of sector financial vulnerability. The results thus suggest that financial development in exporting countries can indeed help alleviate the influence of credit constraints in determining the effect of a monetary tightening on trade. That is, the higher the level of financial development, the smaller the effects of credit constraints. While not reported, the estimated coefficients on the interaction terms between a monetary tightening and sector financial vulnerability have the same signs as those reported in previous tables and are highly significant.

The rest rows of Table 9 repeat the same set of robustness checks conducted in Section 3.2. Rows (2)-(5) establish the robustness of our results using alternative measures of monetary policy. Rows (6)-(8) report the subsamples estimation results by excluding particular countries or years from the benchmark sample. Rows (9) and (10) employ two alternative threshold values of the Chinn and Ito's capital account openness index. In Rows (11) and (12), we control for importer real GDP growth and physical and human capital intensities, respectively. The last four rows check the robustness to alternative estimation methods, namely, country-pair fixed effects, country-pair random effects and exporter and importer fixed effects, time-varying exporter-importer fixed effects, and the HMR estimation method. Our results hold strongly in all above robustness checks. In all cases, the estimated coefficients are negative on the triple

interaction term associated with asset tangibility but positive on other triple interaction terms, and most triple interaction terms are statistically significant.

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. We identify exogenous monetary tightening events for an exporter based on the "impossible trinity" theorem and make efforts to isolate the effects of monetary policy on exports through changes in the real exchange rate or foreign demand. Employing a gravity model approach and a large sector bilateral trade dataset for the years 1970-2000, 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 study contributes 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. Finally, our finding also imply that exchange rate regimes play a crucial role in the international transmission of monetary policy.

Data Appendix

Trade data: The bilateral sector trade data comes from the NBER-United Nations trade dataset downloaded from Robert Feenstra's website. It contains the unilateral export data at the SITC 4-digit level. Since our measures of sector financial vulnerability are constructed at the ISIC 3-digit level, we match the SITC 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. CPI 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 CPIs, real GDP, real GDP per capita, and real GDP growth rate are drawn from World Bank's World Development Indicators. Exchange rate regime and arrangement information is obtained from Reinhar and Rogoff's (2004) and Ilzetzki, Reinhart and Rogoff's (2011). Capital account openness index is from Chinn and Ito (2006). Financial development is measured as private credit as a percentage of GDP and is obtained from Beck and Demirgüç-Kunt (2009). Romer dates are from Romer and Romer (1989, 1994).

Country-pair-level data: Bilateral real exchange rates are calculated 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

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.

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

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.

Haveman, Jon. Industry Concordances. http://www.macalester.edu/research/economics /PAGE/HAVEMAN/Trade.Resources/tradeconcordances.html.

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.

Laurent, Robert D. 1988. “An Interest Rate-Based Indicator of Monetary Policy.” *Federal Reserve Bank of Chicago Economic Perspectives*, 3–14.

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

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.

Muûls, M. (2008). "Exporters and Credit Constraints. A Firm Level Approach." *London School of Economics mimeo*.

Oliner, Stephen D, and Glenn D. Rudebusch. 1996. "Is There a broad credit channel for monetary policy?" *Federal Reserve Bank of San Francisco Economic Review* 2, pp. 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.

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-LUX.	GERMANY	MALTA	ST KITTS NEVIS
BELIZE	GHANA	MAURITANIA	SUDAN
BENIN	GREECE	MAURITIUS	SURINAM
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 KINGD
CHAD	INDIA	NIGERIA	UNTD ARAB EM
CHILE	INDONESIA	NORWAY	URUGUAY
CHINA	IRAN	OMAN	USA
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 Identified tightening dates 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 3 Benchmark regressions

	Level	Ext. Fin.	Asset Tang.	R&D Int.	Inv. Ratio
Tight	-0.131	-0.144	-0.995	0.097	0.643
	(0.048)***	(0.048)***	(0.111)***	(0.052)*	(0.104)***
Tight*Fv		-0.124	2.738	-11.719	-4.956
		(0.072)*	(0.296)***	(1.169)***	(0.632)***
Log importer real GDP	0.192	0.190	0.201	0.187	0.198
	(0.223)	(0.223)	(0.223)	(0.223)	(0.223)
Log exporter real GDP	1.012	1.012	0.994	1.009	1.008
	(0.265)***	(0.265)***	(0.264)***	(0.264)***	(0.264)***
Log importer real GDPPC	0.732	0.733	0.724	0.734	0.726
	(0.229)***	(0.228)***	(0.229)***	(0.228)***	(0.229)***
Log exporter real GDPPC	-1.651	-1.651	-1.653	-1.651	-1.660
	(0.203)***	(0.203)***	(0.203)***	(0.203)***	(0.203)***
Log real exchange rate	0.162	0.162	0.161	0.162	0.161
	(0.047)***	(0.047)***	(0.047)***	(0.047)***	(0.047)***
Log distance	-0.872	-0.872	-0.873	-0.872	-0.872
	(0.052)***	(0.052)***	(0.052)***	(0.052)***	(0.052)***
Same legal system	0.101	0.101	0.101	0.101	0.101
	(0.052)*	(0.052)*	(0.052)*	(0.052)*	(0.052)*
Common language	0.182	0.182	0.183	0.183	0.183
	(0.073)**	(0.073)**	(0.073)**	(0.073)**	(0.073)**
Border	0.786	0.786	0.784	0.785	0.785
	(0.185)***	(0.185)***	(0.185)***	(0.185)***	(0.185)***
FTA	0.723	0.723	0.724	0.722	0.724
	(0.164)***	(0.164)***	(0.163)***	(0.163)***	(0.163)***
Colonial ties	0.760	0.760	0.759	0.761	0.760
	(0.100)***	(0.100)***	(0.100)***	(0.100)***	(0.100)***
Island	0.069	0.069	0.069	0.069	0.068
	(0.219)	(0.219)	(0.220)	(0.219)	(0.219)
Landlocked	0.792	0.792	0.792	0.792	0.792
	(0.333)**	(0.333)**	(0.333)**	(0.333)**	(0.333)**
Exporter fixed effects	Y	Y	Y	Y	Y
Importer fixed effects	Y	Y	Y	Y	Y
Sector fixed effects	Y	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y	Y
R^2	0.63	0.63	0.63	0.63	0.63
N	144055	144055	144055	144055	144055

Notes: A constant and year, sector, exporter and importer 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 4 Robustness to alternative measures of monetary tightening dates

Panel A：Tight2	Level	Ext. Fin.	Asset Tang.	R&D Int.	Inv. Ratios
Tight2	-0.076	-0.103	-0.583	0.127	0.495
	(0.031)**	(0.031)***	(0.089)***	(0.038)***	(0.090)***
Tight2*Fv		-0.244	1.662	-10.150	-3.608
		(0.061)***	(0.259)***	(1.012)***	(0.560)***
Panel B：Tighttsp					
Tighttsp	-0.056	-0.076	-0.342	0.089	0.186
	(0.034)*	(0.034)**	(0.078)***	(0.038)**	(0.077)**
Tighttsp*Fv		-0.174	0.937	-7.109	-1.521
		(0.051)***	(0.213)***	(0.924)***	(0.472)***
Panel C：Romer dates (dollar-pegging exporters)					
Romer dates*Fv	---	-0.158	1.918	-7.166	-3.802
		(0.083)*	(0.358)***	(1.313)***	(0.792)***
Panel D：Allow for lags in effects					
Tightlag	-0.163	-0.169	-1.070	0.050	0.642
	(0.047)***	(0.047)***	(0.105)***	(0.050)	(0.096)***
Tightlag*Fv		-0.065	2.837	-10.921	-5.197
		(0.068)	(0.276)***	(1.050)***	(0.572)***

Notes: A constant and year, sector, exporter and importer 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 Robustness to alternative samples

Panel A：Exclude Euro exporters for all years	Level	Ext. Fin.	Asset Tang.	R&D Int.	Inv. Ratios
Tight	0.038	0.010	-0.873	0.262	1.224
	(0.138)	(0.139)	(0.217)***	(0.136)*	(0.241)***
Tight*Fv		-0.241	3.357	-12.248	-7.131
		(0.121)**	(0.612)***	(2.041)***	(1.247)***
Panel B：year<1990					
Tight	-0.075	-0.092	-0.450	0.042	0.177
	(0.054)	(0.055)*	(0.110)***	(0.056)	(0.104)*
Tight*Fv		-0.155	1.185	-6.087	-1.617
		(0.059)***	(0.283)***	(1.003)***	(0.612)***
Panel C：year>1975					
Tight	-0.085	-0.104	-0.800	0.093	0.754
	(0.048)*	(0.049)**	(0.145)***	(0.056)*	(0.142)***
Tight*Fv		-0.186	2.245	-9.049	-5.403
		(0.100)*	(0.413)***	(1.593)***	(0.886)***

Notes: A constant and year, sector, exporter and importer fixed effects and control variables 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 threshold values of financial openness

Panel A：>90th percentile	Level	Ext. Fin.	Asset Tang.	R&D Int.	Inv. Ratios
Tight	-0.111	-0.112	-0.805	0.061	0.518
	(0.030)***	(0.030)***	(0.068)***	(0.033)*	(0.076)***
Tight*Fv		-0.006	2.275	-8.758	-3.977
		(0.054)	(0.200)***	(0.843)***	(0.445)***
Panel B：>median					
Tight	-0.044	-0.075	-0.883	0.187	0.937
	(0.047)	(0.049)	(0.145)***	(0.054)***	(0.139)***
Tight*Fv		-0.301	2.647	-11.859	-6.303
		(0.094)***	(0.415)***	(1.534)***	(0.867)***

Notes: A constant and year, sector, exporter and importer fixed effects and control variables 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 additional controls

Panel A：Control for importer growth	Ext. Fin.	Asset Tang.	R&D Int.	Inv. Ratios
Tight	-0.088	-0.880	0.142	0.786
	(0.057)	(0.125)***	(0.059)**	(0.116)***
Tight*Fv	-0.151	2.543	-11.061	-5.519
	(0.078)*	(0.327)***	(1.259)***	(0.685)***
Importer real GDP growth	4.635	4.804	4.630	4.749
	(4.354)	(4.347)	(4.349)	(4.349)
Tight*Importer real GDP growth	1.026	3.105	2.229	1.884
	(19.405)	(19.535)	(19.313)	(19.658)
Panel B: Control for sector physical and human capital intensities				
Tight	-0.690	-1.103	-0.651	-0.106
	(0.126)***	(0.157)***	(0.127)***	(0.159)
Tight*Fv	-0.250	3.026	-12.060	-2.809
	(0.071)***	(0.416)***	(1.165)***	(0.622)***
Tight*Pkinten	7.663	-1.452	4.610	5.073
	(1.098)***	(1.477)	(1.054)***	(1.159)***
Tight*Hkinten	-0.010	0.151	0.418	0.063
	(0.130)	(0.136)	(0.136)***	(0.134)

Notes: A constant and year, sector, exporter and importer fixed effects and control variables 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 estimation methods

Panel A：Country-pair fixed effects	Level	Ext. Fin.	Asset Tang.	R&D Int.	Inv. Ratios
Tight	0.038	0.027	-0.786	0.254	0.771
	(0.048)	(0.048)	(0.111)***	(0.052)***	(0.104)***
Tight*Fv		-0.108	2.604	-11.185	-4.699
		(0.072)	(0.297)***	(1.136)***	(0.620)***
Panel B: Country-pair random effects and exporter and importer fixed effects					
Tight	-0.064	-0.076	-0.895	0.155	0.680
	(0.042)	(0.042)*	(0.109)***	(0.047)***	(0.100)***
Tight*Fv		-0.152	2.630	-11.323	-4.768
		(0.063)**	(0.298)***	(1.127)***	(0.618)***
Panel C: Time-varying exporter and importer fixed effects					
Tight*Fv		-0.116	2.726	-11.547	-4.986
		(0.074)	(0.308)***	(1.195)***	(0.641)***
Panel D: Include zero-trade flows					
Tight	-0.040	-0.037	-0.973	0.143	0.765
	(0.045)	(0.046)	(0.112)***	(0.050)***	(0.104)***
Tight*Fv		-0.010	2.957	-9.107	-5.155
		(0.078)	(0.314)***	(1.513)***	(0.630)**

Notes: A constant and year, sector fixed effects and control variables are included but not reported in each regression. Panels A and B include country-pair fixed effects, panels C and D include country-pair random effects and exporter and importer fixed effects, panels E and F include time-varying export and importer fixed effects and Panels G and H include exporter and importer fixed effects. Robust standard errors are reported in the parentheses. They are clustered at country-pairs in Panels A-D, clustered at exporter-year level in Panels E and F and clustered at ordered exporter-importer pairs in Panels G and H. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.

Table 9 The role of financial development

	Ext. Fin.	Asset Tang.	R&D Int.	Inv. Ratios
(1) Benchmark	0.164	-2.745	15.980	2.239
	(0.138)	(0.463)***	(2.449)***	(1.127)**
(2) Tight2	0.337	-5.894	20.904	9.681
	(0.113)***	(0.579)***	(1.947)***	(1.262)***
(3) Tighttsp	0.403	-5.421	20.687	8.133
	(0.108)***	(0.534)***	(1.848)***	(1.179)***
(4) Romer dates (dollar-pegging exporters only)	-0.747	-6.796	22.497	15.353
	(0.597)	(2.205)***	(8.046)***	(4.889)***
(5) Allow for lags in effects	0.018	-3.140	15.624	3.082
	(0.131)	(0.425)***	(2.248)***	(1.042)***
(6) Exclude Euro countries	0.409	-2.570	17.192	4.374
	(0.184)**	(0.769)***	(3.293)***	(1.623)***
(7) year<1990	0.229	-2.666	17.307	2.117
	(0.130)*	(0.470)***	(2.389)***	(1.129)*
(8) year>1975	0.423	-2.426	15.985	3.486
	(0.176)**	(0.826)***	(3.330)***	(1.769)**
(9) Financial openness value>90th percentile	0.409	-2.570	17.192	4.374
	(0.184)**	(0.769)***	(3.293)***	(1.623)***
(10) Financial openness value>median	0.049	-3.135	15.336	4.850
	(0.130)	(0.432)***	(2.240)***	(1.120)***
(11) Control for importer real GDP growth	0.273	-2.533	15.417	3.353
	(0.138)**	(0.497)***	(2.471)***	(1.142)***
(12) Control for physical and human capital intensities	0.104	-2.964	15.689	2.752
	(0.133)	(0.467)***	(2.425)***	(1.136)**
(13) Country-pair fixed effects	0.124	-2.616	15.301	1.956
	(0.135)	(0.471)***	(2.352)***	(1.089)*
(14) Country-pair random effects and export and importer fixed effects	0.135	-2.527	15.464	1.915
	(0.131)	(0.464)***	(2.338)***	(1.087)*
(15) Time-varying importer-exporter fixed effects	0.148	-2.775	16.320	2.457
	(0.141)	(0.481)***	(2.463)***	(1.242)**
(16) Include zero-trade flows	-1.741	-4.099	11.297	4.385
	(0.146)	(0.735)***	(2.560)***	(1.517)***

Notes: A constant, year, sector fixed effects and controls are included but not reported in each regression. Regressions in Rows (13) and (14) include country-pair fixed effects and country-pair random effects and exporter and importer fixed effects, respectively. Regressions in Rows (15) include time-varying exporter and importer fixed effects. Separate exporter and importer fixed effects are included in all other regressions. Robust standard errors are reported in the parentheses. They are clustered at country-pairs in Rows (13) and (14) and clustered at exporter-year level in Row (15) and clustered at ordered exporter-import pairs in all other regressions. * $p<0.1$; ** $p<0.05$; *** $p<0.01$.